California Energy Efficiency Potential Study

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Submitted to:

Pacific Gas & Electric Company

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Executive Summary

ES.1 Introduction

Overview

This report summarizes the findings of the California Energy Efficiency Potential Study (Itron 2008 study). The primary focus of the study is the gross and net potential estimates for electricity and gas savings in the existing and new residential, commercial, and industrial sectors. The study builds on the 2006 Energy Efficiency Potential Study (Itron 2006 study), updating input assumptions and unifying the approach undertaken for all sectors of analysis. The study was overseen by a Project Advisory Committee (PAC) consisting of representatives from Pacific Gas and Electric (PG&E), Southern California Edison Company (SCE), Southern California Gas Company (SCG), San Diego Gas & Electric Company (SDG&E), the California Public Utilities Commission (CPUC), and the California Energy Commission (CEC).

The study forecasts the short- and mid-term gross and net market potential resulting from the installation of energy efficiency measures funded through publicly funded energy efficiency programs. For this analysis, the short-term potential was defined as market potential achievable through 2016 (10 years) while the mid-term potential was defined as achievable potential through 2026 (20 years). The geographic area covered by the study includes the service areas of the four major investor-owned utilities (IOUs): PG&E, SCE, SCG, and SDG&E. Previous similar studies were completed in 2002 and 2003 by KEMA-Xenergy, Inc (KEMA 2002/2003 study) and in 2006 by Itron, Inc.[1] The potential energy savings estimated in this study include those savings resulting from the installation of high efficiency measures for retrofit, replace-on-burnout, conversions, and new construction situations.[2] Energy savings resulting from changes in behavior, or requiring major redesign of existing systems, were not included in the scope of this work.

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1 KEMA-Xenergy, Inc. *California Statewide Commercial Sector Energy Efficiency Potential Study. Final Report. Volumes 1 and 2*. July 2002.
KEMA-Xenergy, Inc. *California Statewide Residential Sector Energy Efficiency Potential Study. Final Report. Volumes 1 and 2*. April 2003.
KEMA-Xenergy, Inc. *California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study, Final Report. Volumes 1 and 2.* May 2003 (revised July 2003).
Itron, Inc. *Energy Efficiency Potential Study, Volumes 1 and 2*. May 2006.
All prepared for Pacific Gas & Electric Company.

2 The study used the 2006 avoided costs and the 2005 DEER. Recent changes in the avoided costs and the DEER update (2008), could lead to adjustments in the technical, economic, and market estimate presented in this analysis.

Study Objectives and Scope

The primary objective of the work underlying this report was to produce estimates of remaining potential energy savings that might be obtainable in the near (2007-2016) and foreseeable (2017-2026) future through publicly funded energy efficiency programs in the existing and new residential, industrial, and commercial sectors.[3] The findings from this study will be used by the four California IOUs and their program planners to focus utility program offerings by technologies, sectors, and climate zones. The results will help determine where potential savings remain and which technologies offer the most efficient opportunities for energy savings. The results from this study will also help the utilities assess and, to the extent possible, meet the energy saving goals set by the CPUC. The CPUC has established aggressive energy saving goals for electric and natural gas savings for the four state IOUs over the years 2004-2013. The results will also help to inform the CPUC and the CEC. The CPUC's reassessment of the future IOU energy savings goals will be informed by the types and levels of energy savings potential forecast by this analysis. The CEC analysis of energy efficiency, its associated potential greenhouse gas savings, and the costs of these savings will be aided by the estimated potential in this analysis.

Market Potential Scenarios

Given that the primary purpose of this study is to assist the IOUs and their program planners, the study focuses on the remaining market energy efficiency potential for the four California IOUs. Market potential denotes the energy savings that can be expected to result from specific scenarios relating to program designs and market conditions. Market potential was estimated under 10 scenarios relating to incentive levels, market awareness, cost-effectiveness, and the base lighting technology.

The Base program scenario reflects the continuation of the incentives in effect during 2006.[4] The results for this scenario were calibrated to the average of actual program accomplishments for the 2004-2005 program cycle.[5] The Full incremental cost market potential estimates were derived on the assumption that incentives are increased to cover full incremental measure costs. A third set of estimates, the Mid scenario, was developed to reflect a scenario in which incentives are equal to the average between current (2006) incentives and full incremental costs. The Full incremental cost and Mid scenario-level rebates are implemented beginning in 2007. The three market scenarios were also re-

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3 The study did not include the analysis of the savings potential in the agricultural, transportation, communication, or utility sectors.

4 The potential estimates are calibrated to the average of 2004-2005 program accomplishments. Incentives from 2005 were used during the calibration period.

5 Program accomplishments were extracted from the IOUs' 2006 Q1 reports for measures in their 2004 and 2005 programs. For programs with non-specific measure savings, the team attempted to obtain additional information on end use and measure from the IOUs and third party implementers. These savings were allocated to measures and end uses to the best of the team's ability.

estimated (scenarios 4-6) restricting individual measures to those with a TRC ≥ 0.85. A seventh and eighth set of estimates reflect scenarios in which the incentives are increased over a four-year period from the 2006 incentive level to full incremental cost incentives. The ninth scenario models the impact of increased levels of general population awareness and willingness to adopt high efficiency technologies. This scenario adapts the Base TRC Restricted scenario to the possibility that higher levels of IOU marketing and general awareness of greenhouse gases and global warming may lead to a higher level of naturally occurring adoptions of energy efficiency measures. The tenth scenario modifies the potential estimates associated with lighting technologies to simulate the remaining potential if incandescents are eliminated and compact fluorescent lamps (CFLs) become the base lighting technology in both the residential and commercial sectors. This scenario is intended to reflect a simplified estimate of the potential remaining given the recently signed AB 1109, or Huffman Bill.

Market Calibration Framework

The study uses the ASSET forecasting framework to estimate market potential energy savings. For this study, the model was calibrated to the average of the 2004-2005 energy efficiency program adoptions or energy savings accomplishments.[6] Through the calibration process, the average level of program activity in the 2004-2005 program cycle directly influences the estimates of future market potential. During the calibration process, measures with significant program activity in the 2004-2005 program cycle will appear to have fewer barriers and more public acceptance than measures with lower levels of program adoptions.[7] The model calibration internalizes the 2004-2005 calibrated barriers and/or acceptance and uses the econometrically determined calibration constants in its estimates of future program adoptions.

The calibration process ensures that the model estimates reflect current program activity and available information concerning the influence of incentives and market barriers on future customer adoption behavior. Using recent adoption behavior ensures that the model reflects the current understanding of consumer behavior and how this behavior is likely to change when incentives change. Calibration, however, limits the model’s ability to forecast the influence of unanticipated changes that may influence customer adoption choices. For example, the model may underestimate net program potential if the utilities find new and novel approaches to program delivery that reduce market barriers and increase customers’ willingness to adopt high efficiency measures which were under represented in the 2004-

[6] Where possible, the model was calibrated to average adoptions. Adoption quantities are clearly defined whereas savings levels depend on IOU assumptions and the assumptions used by Itron in this study.

[7] The program accomplishments for the 2004-2005 program cycle were significantly weighted towards lighting. The model’s forecasts for future program potential estimates will, through the calibration process, also be weighted toward lighting. If the 2004-2005 program cycle had produced more HVAC or Refrigeration savings, it is likely that the study would have forecast more potential in these end uses.

2005 program accomplishments. Alternatively the model may over estimate net program potential if the public becomes more concerned about global warming and this concern is translated into a willingness to purchase high efficiency measures without utility rebates.

The ASSET model scenarios undertaken for this study were carefully reviewed to ensure that they reflect the best available estimate of future potential given current information. Changes in customer behavior, utility program delivery methods, available measures, or the acceptance of energy efficiency by the public will lead to changes in energy savings potential that are not reflected by the scenarios presented in this study. The estimates presented in this report, reflect our current understanding of likely future outcomes.

Technical and Economic Potential

Estimates of technical and economic potential are also provided in the report. Technical potential refers to the savings potential that would be captured if all energy efficiency measures were installed in all applicable and feasible applications. Economic potential indicates the savings potential that would be achieved if measures were installed in all applicable, feasible cost-effective applications. In this context, cost-effectiveness is assessed using a total resource cost (TRC) test, which takes into account the value of savings evaluated at avoided costs and incremental measure costs. The TRC test used to evaluate economic potential does not incorporate program costs.

Technical and economic potential estimates should be viewed as theoretical constructs. These estimates do not attempt to incorporate the willingness of customers to adopt these technologies or the market barriers associated with these products, and they do not reflect the budget constraints faced by utilities as they implement demand side management programs. In addition, the estimates of technical and economic potential do not provide information on the appropriate time-line associated with market adoption scenarios. For these reasons, technical and economic potential estimates are informative but provide limited value to program planners concerning achievable levels of measure-specific potential. Given the limitations of these constructs, this study focuses on the market potential estimates, restricting discussion of the technical and economic estimates to the description of theoretical upper-limits of potential given existing technologies.

ES.2 Background on California Energy Efficiency Program Impacts and Future Savings Goals

The 2000-2001 energy crisis led to an escalation of energy prices in California and to an increase in the importance of energy efficiency programs. Annual spending on energy efficiency programs by the major California IOUs for planning years 1995-1999 averaged less than $220 million per year (in 2000 dollars).[8] Energy efficiency expenditures by utilities increased significantly in the 2000-2004 period. Annual spending for energy efficiency programs by PG&E, SCE, and SDG&E exceeded $300 million in planning years 2000, 2001, and 2004, with an average of $286 million spent for planning years 2000-2004 (in program year dollars).[9] Table ES-1 lists the IOU-specific recorded program costs for the 2004/2005 program cycle. During the 2004/2005 program cycle, the average annual spending for energy efficiency programs by the four California IOUs exceeded $400 million, exceeding $800 million for the two-year program cycle.

Table ES-1: Recorded Costs for California IOU Energy Efficiency Programs for the 2004/2005 Program Cycle

	Recorded Costs ($1,000,000s) (Spent + Committed)	
	2004/2005 Workbooks	**2004/2005 Filings**
PG&E	$329.36	$369.71
SCE	$347.01	$326.00
SCG	$57.38	$60.47
SDG&E	$111.41	$114.17
Total	$845.17	$870.34

Annual first-year impacts from energy efficiency programs have risen with the increases in funding. Historically, first-year impacts averaged approximately 1,000 GWh, with non-residential programs representing 80% and residential programs claiming the remaining 20% of the savings.[10] Figure ES-1 illustrates the first-year energy claimed by the IOU energy efficiency programs for the years 2004-2006. The IOU-claimed savings were 1,193 GWh in 2004, 2,361 GWh in 2005 (with an additional 1,234 GWh of committed savings), and 1,604 GWh in 2006.

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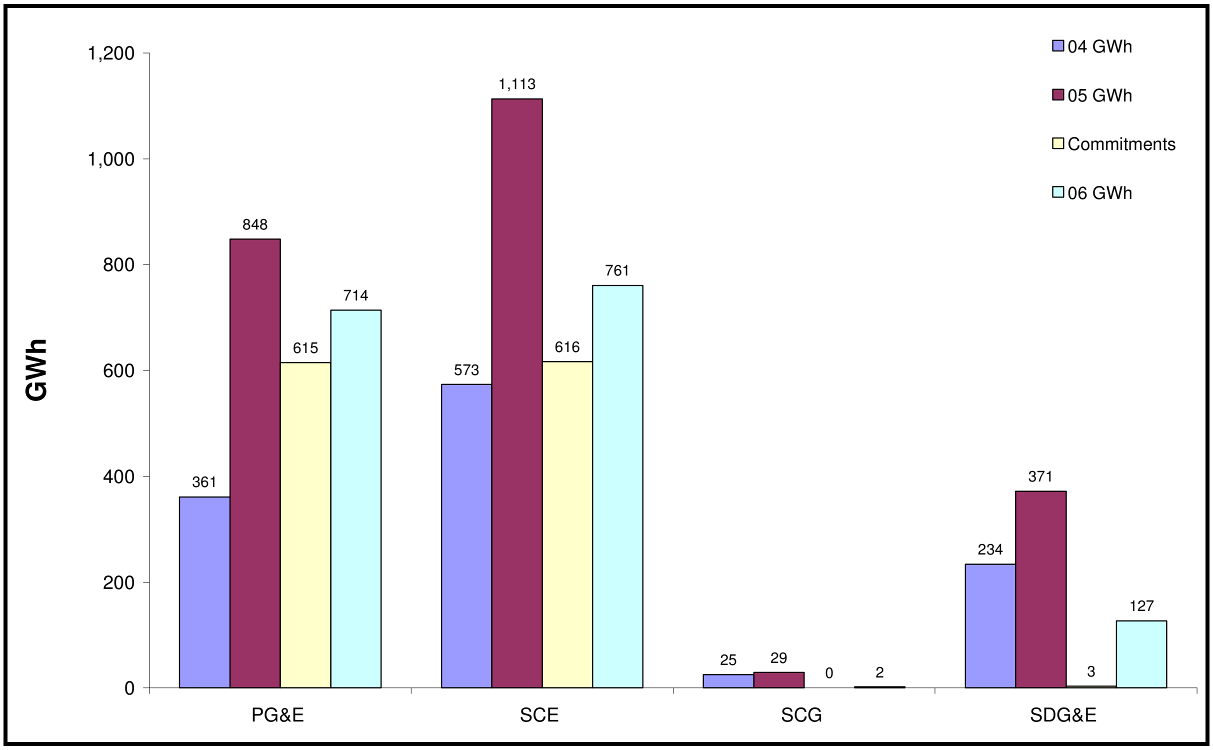
8 KEMA-Xenergy. Data from the *California Statewide Residential Sector Energy Efficiency Potential Study, Volume 1 of 2*. April 2003.

9 Annual funding and savings values from the California Energy Commission Staff Paper *Funding and Energy Savings From Investor-Owned Utility Energy Efficiency Programs in California for Program Years 2000 Through 2004*. August 2005.

10 KEMA-Xenergy, op. cit. April 2003.

Figure ES-1: Reported Workbook Energy Savings by California IOUs–2004-2006 (GWh)



The CPUC has established aggressive goals and funding schedules for the four California IOUs for 2004-2013. The 2004-2010 energy efficiency goals for the IOUs are listed in Table ES-1.[11] Comparing the reported ex ante accomplishments listed in Figure ES-1 with the goals listed in Table ES-2, PG&E met its 2004/2005 program cycle goal of 1,488 GWh with claimed savings of 1,824 GWh, SCE met its goal of 1,652 GWh for the 2004/2005 program cycle with claimed savings of 2,302 GWh, and SDG&E's 608 GWh of claimed ex ante accomplishments exceeds its 536 GWh goal for the 2004/2005 program cycle.

[11] The IOU savings goals are from the California Energy Commission *California Energy Demand 2006-2016 Staff Energy Demand Forecast*. September 2005.

Table ES-2: First-Year Impacts of California IOU 2004-2010 Energy Efficiency Goals

	PG&E			SCE		SCG	SDG&E		
	GWh	MW	MM Therms	GWh	MW	MM Therms	GWh	MW	MM Therms
2004	744	161	9.8	826	167	9.6	268	50	1.8
2005	744	161	9.8	826	167	9.6	268	50	1.8
2006	829	180	12.6	922	207	14.7	281	55	2.7
2007	944	205	14.9	1046	219	19.3	285	54	3.1
2008	1053	229	17.4	1167	246	23.3	284	54	3.7
2009	1067	232	20.3	1189	249	27.2	282	54	4.1
2010	1015	220	21.1	1176	247	28.3	273	52	4.5

Data courtesy of CEC. The IOU savings goals are from the *California Energy Demand 2006-2016 Staff Energy Demand Forecast*, August 2005.

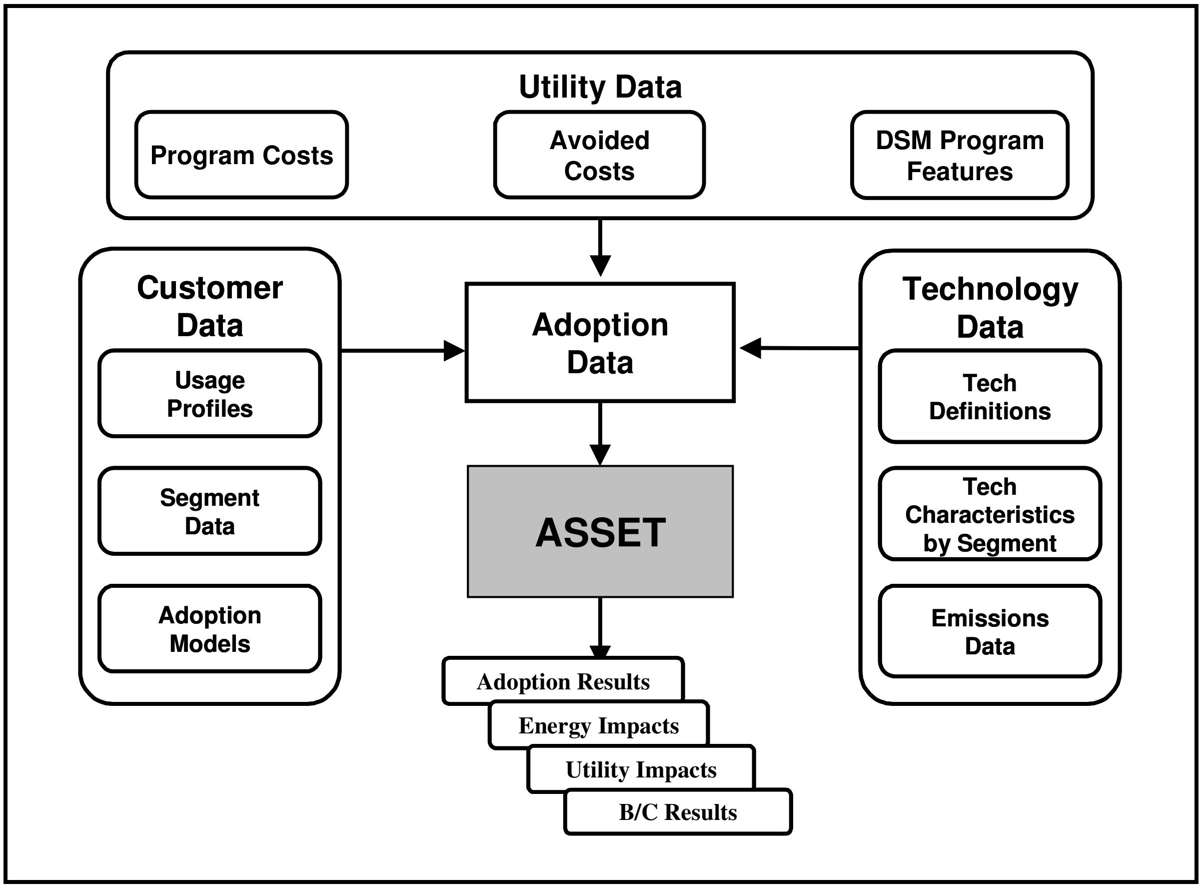
Meeting the future goals will be a challenge given current program designs, high efficiency measures included in IOU programs, and the maturity of many high efficiency measure saturations. Meeting future goals will require the utilities to continue operating their existing energy efficiency programs effectively while finding new program delivery mechanism to expand programs in existing and emerging technologies and segments that have not previously been the primary focus of their energy efficiency programs. The goals set by the CPUC reinforce the importance of this study, which provides guidance to the utilities on where the savings opportunities exist.

ES.3 Methodology

The analysis was conducted using a model developed by Itron called ASSET.[12] Figure ES-2 depicts the overall framework of the ASSET model. As shown, the model requires utility data, information on customer characteristics, and technology data. Utility data include utility program costs, avoided costs of energy and demand, and program features. Customer characteristics encompass size (number of homes, floor stock, etc.), load profiles, and various aspects of adoptions-related behavior (awareness, willingness, etc.). Technology features include costs and lifetimes as well as savings associated with applications by specific customer segments.

[12] The model was developed by Regional Economic Research, Inc. (RER). RER was acquired by Itron in 2003.

Figure ES-2: Overview of ASSET Framework



Inputs used to implement the ASSET analysis were developed from a variety of sources. The Database for Energy Efficiency Resources (DEER) was the primary source of information for efficiency measure impacts and costs. The residential and commercial existing forecasts used impacts and costs from the 2005 DEER database.[13] This information was supplemented by other sources, such as utility submittals, Unit Energy Consumption estimates from the Residential Appliance Saturation Survey (RASS) and Energy Use Indexes from the California Commercial End-Use Survey (CEUS), where necessary.[14,15] The *CPUC Policy Manual* was the primary source of measure lifetime information. Technical feasibility was based on professional judgment, supplemented by survey data on specific related end-use characteristics. Indicators of applicability of specific measures were derived from the RASS and the CEUS. Legal and market availability of measures were based on a review of codes and standards as well as professional judgment relating to commercialization of new

[13] Itron, Inc. *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study: Final Report.* Prepared for Southern California Edison. December 2005.

[14] KEMA-Xenergy, Inc. *California Statewide Residential Appliance Saturation Study.* Prepared for the California Energy Commission. June 2004.

[15] Itron, Inc. *California Commercial End-Use Survey.* CEC-400-2006-005. Prepared for the California Energy Commission. March 2006.

technologies. Base shares and technology densities of measures were estimated based primarily on the Residential New Construction Baseline Study of Building Characteristics (RNCBS), California Residential Market Share Tracking Study (RMST), RASS, and CEUS.[16,17,18,19]

Table ES-3: Input Data Sets and Purpose

Input Data Set	Purpose
2005 DEER	Commercial and residential cost and energy savings.
RASS 2004	Residential base share and technology density for non-lighting measures. Residential UECs were sometimes combined with percentage savings from DEER to determine savings per home.
RMST 2004	Residential base share for lighting.
CLASS 2005	Residential technology density for lighting. Residential share of high efficiency technology
CEUS 2006	Commercial base share and technology density. Commercial EUIs.
CEC floorstock forecast 2007	Commercial and residential forecast of existing floorstock and housing count and new construction by forecasting climate zone
E3 Avoided Costs 2006	Residential, Commercial, and Industrial avoided costs
LBNL Industrial Data	Industrial measure costs, savings, feasibility, and saturations
1998 Manufacturing Energy Consumption Survey (EIA)	Industrial end use shares
Quantum Consulting analysis of DR Evaluation	Industrial load shapes
Utility billing data	Industrial usage

ES.4 Uncertainty

Numerous and significant elements of uncertainty pervade all potential studies. These uncertainties should be carefully considered when reviewing the point estimates output from any forecasting model. The point estimates should be viewed as the likely values in a possible range of foreseeable potential estimates.

The uncertainty associated with potential studies begins with the uncertainty that accompanies the baseline distribution of equipment, the energy usage of existing equipment, and the expected savings and costs associated with high efficiency measures. Some of these uncertainties have been reduced with the recent California RASS (2004), the CEUS (2006),

[16] Itron, Inc. *Residential New Construction Baseline Study of Building Characteristics – Homes Built After 2001 Codes*. Prepared for Pacific Bas and Electric. August 2004.

[17] Itron, Inc. *California Lamp Report 2004.* Prepared for Southern California Edison. June 15, 2005.

and the ongoing update of the DEER database. These data were supplemented with information from the 2004/2005 Single family and the SPC evaluations, the utility work papers, and the on-going update to the DEER database. The continual evolution and updating of these and other data work to ensure that while the potential study used the most recent information available at the time, careful review of the findings are necessary and periodic updates of the potential estimates are required to keep the findings informed by the most recent research.

A second, and potentially more important source of uncertainty associated with potential studies is the forecast's assumptions concerning consumer behavior when utilities adopt aggressive incentives and marketing campaigns. The current forecasting models lack empirical data to determine adoption parameters under such campaigns. The models also have only limited information on the level of current consumer awareness and willingness to adopt high efficiency measures, let alone how this awareness will be impacted by aggressive utility marketing campaigns. This lack of information leads to significant increases in uncertainty when increases in program incentives and marketing attempt to move program potential toward economic potential.

The calibration process works to reduce the uncertainty of the short term forecast, tying the estimates to the recent program activity (2004-2005 program year). This process allows the model to estimate how changes in incentive levels, rates, and customer awareness will impact customer adoption behavior. The calibration process, however, can introduce uncertainty if future programs differ substantially in their delivery mechanism or if the public's underlying acceptance of energy efficiency or their concern about the environment changes. The calibration process ensures that the model reflects our current understanding of likely future events, if input assumptions change suddenly, the calibrated model will not anticipate these changes.

Additional uncertainty is added to the analysis when net savings estimates are presented. Determination of the naturally occurring savings in the market requires the researcher to determine if multi-year market effects are included or excluded in the estimates of the potential that would be naturally occurring in the market place without utility programs. The findings reported in this study generally do not include the ongoing market effect associated with the continuation of IOU programs beyond 2006. A scenario is presented in the body of the report, however, that assumes that the continuation of IOU programs leads to a higher level of awareness in the general population, leading to a higher level of naturally occurring potential.

Potential studies are also subject to uncertainty associated with the value of economic inputs. Changes in utility rates, avoided costs, or the forecasted growth in housing stocks, floor stocks, or industrial usage can lead to modifications of the technical, economic, and market estimates of energy efficiency potential. The study used the 2007 utility rates and the real value of the 2006 E3 avoided costs. While the influence of minor changes in the utility rates and the avoided costs can be analyzed with scenario analyses, these scenarios where not chosen for this study. The influence of changes in the housing stock, floor stock, and industrial usage are often limited due to the relative size of the new construction forecast of potential savings. For example, the decline in new housing starts in California has led to a substantial fall in the new construction forecast of potential savings within this study. The fall in residential new construction potential, however, is minor relative to the potential in other sectors.

These and other uncertainties increase the need for careful scenario analyses to assess the importance of alternative assumptions and to provide a range of potential estimates. The results presented in this report are the product of several meetings with the PAC to determine the measure list to be analyzed, to discuss measure savings and costs, and to determine the scenarios that would help reduce uncertainties and frame the range of energy and demand savings potential available to the IOUs with technologies that are currently available in the market place.

ES.5 Summary of Results

Table ES-4, Table ES-5, and Table ES-6 summarize the results of the study. These results are further illustrated in Figure ES-3 through Figure ES-11. The results presented in the executive summary represent total annual gross market and naturally occurring savings obtained by 2016 from measure adoptions through 2016.[20] The savings potential is reported at the generation level.[21] The first reporting year for the potential estimates is 2007. The analysis is calibrated to the average of the 2004/2005 IOU program accomplishments, including committed savings. The calibration year is the start year for all analysis; the model estimates the market savings associated with current 2006 programs but restricts the output of potential to 2007 and beyond. Savings are presented in both gross and net form. The savings estimates presented in the tables are gross estimates in the sense that they are not adjusted for naturally occurring adoptions. Naturally occurring market savings are presented

[20] The results through 2026 are presented in the body of the report. These results are not the focus of the executive summary due to the higher level of uncertainty associated with a mid-term forecast relative to the shorter 10-year forecast.

[21] Each utility has provided Itron with their line loss assumptions. The IOUs have both the generation and the meter level savings.

for the current incentive and the Mid and Full incentive analysis.[22] Net savings potential can be determined by subtracting the naturally occurring market savings from the gross savings potential. Savings estimates illustrated in the figures are net savings values. All savings estimates presented in this report are net of known changes in standards, in that they change the base measure and incremental savings in years when known standards changes are scheduled to occur.

Electric Energy Potential

Table ES-4, Figure ES-3, and Figure ES-4 present the estimates of the total electric energy potential in 2016 for measures adopted from 2007 to 2016 and still installed in 2016. The results listed in Table ES-4 illustrate that continuing current IOU programs is estimated to lead to a market savings potential of 11,346 GWh by 2016. Of this, 4,634 GWh is naturally occurring potential, leading to a net current market savings potential of 6,712 GWh by 2016. If incentives increase to halfway between 2006 levels and full incremental costs (the Mid scenario), total market gross potential would increase to 16,747 GWh by 2016, resulting in 12,032 GWh of net energy potential. Under the most aggressive scenario, in which incentives cover the full incremental cost of measures, gross total market potential is 21,610 GWh and net total market potential is 16,895 GWh by 2016.[23]

Table ES-4 also presents results for scenarios restricted to measures with a TRC $\geq$ 0.85. Implementing this restriction is intended to approximate the rule that the IOUs implement cost-effective portfolios of energy-efficient measures.[24] Restricting measures to those that are nearly cost-effective reduces the estimates of potential for all sectors except commercial and industrial new construction. The TRC restrictions lead to the largest reduction in potential in the existing residential sector. TRC restrictions work to eliminate residential high efficiency air conditioning measures that are not cost-effective with current prices and codes and standard rules.

[22] The naturally occurring savings for the Mid and Full incentive analyses can be higher than the naturally occurring for the current estimates if additional measures not in the IOU programs were added to the Mid and Full scenarios. Additional measures were added to the existing residential and commercial sectors to determine the savings potential associated with measures likely to be included in future programs. The naturally occurring savings estimate for the residential and commercial new construction sectors is zero due to the design of the new construction packages and their claimed savings. These packages, and their claimed savings, were designed based upon baseline studies that determined as-built characteristics.

[23] The energy savings potential presented in this report is at the generation level.

[24] The TRC restriction implemented in this analysis was set at 0.85 to reflect the fact that ASSET implements the TRC restriction at the measure while the actual cost-effectiveness rule is at the portfolio level. The IOUs may want to incentivize measures that are not yet cost-effective in hopes of moving the market and to enable them to install nearly cost-effective measures while they are at a site installing other devices.

Table ES-4: Total California IOU Market Electric Energy Potential by Sector–2007-2016 (GWh)

	Gross Base Incentive	Naturally Occurring Base	Gross Base Incentive, TRC Restricted	Gross Mid Incentive	Gross Mid Incentive, TRC Restricted	Gross Full Incentive	Gross Full Incentive, TRC Restricted	Naturally Occurring Mid and Full
Residential Existing 2007-2016	5,205	2,024	4,908	8,034	6,828	10,165	7,976	2,077
Commercial Existing 2007-2016	3,357	1,486	3,321	4,961	4,675	6,552	5,891	1,513
Industrial Existing 2007-2016	1,846	986	1,802	2,419	2,276	2,972	2,771	986
Residential New Construction 2007-2016	55	NA	34	80	51	118	74	NA
Commercial New Construction 2007-2016	699	NA	699	1,059	1,059	1,597	1,597	NA
Industrial New Construction 2007-2016	184	139	184	194	194	205	205	139
Total	11,346	4,634	10,949	16,747	15,082	21,610	18,514	4,715

Commercial and residential new construction savings were determined relative to a baseline study of as-built homes and buildings. This method leads to a determination of *net*, not *gross* savings. For reporting purposes, we have listed these savings in the gross column and listed NA in the naturally occurring savings columns, since the naturally occurring savings are incorporated into the as-built savings calculations. The naturally occurring savings are higher for the residential and commercial Mid and Full scenarios than the Base due to an expansion of the measure list. The potential savings listed in the table are at the generation level.

Figure ES-3 illustrates the estimated distribution of net market energy savings potential if the utilities continue with their 2006 incentives through 2016. These estimates indicate that the residential existing and new construction sectors account for approximately 46% of the total market energy savings potential while the non-residential sector is distributed such that 36% of the estimated potential is in the commercial sector and 18% is in the industrial sector. The energy efficiency potential in existing homes and buildings accounts for 92% of the estimated potential, while the new construction sector accounts for 8%.

Figure ES-3: Distribution of Total California IOU Net Market Energy Potential with Base Incentives–2007-2016 (GWh)

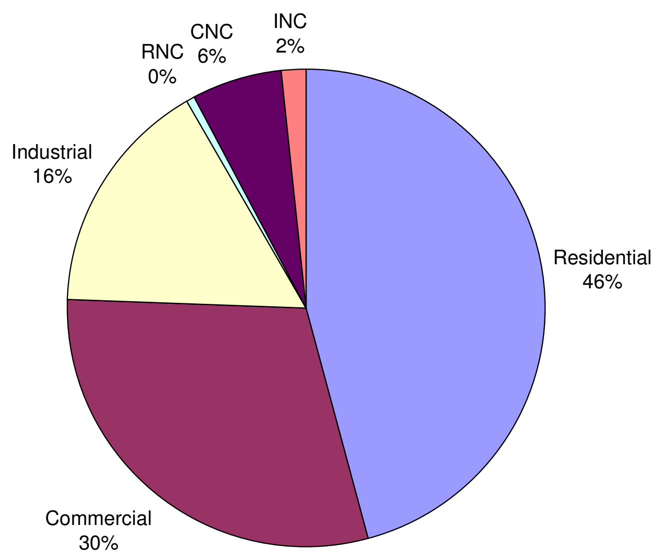


Figure ES-4 illustrates the distribution of net market total electric energy potential in 2016 by sector for measures adopted from 2007 through 2016 and still installed in 2016. Under each scenario, the potential in the existing residential sector is larger than the potential in any other sectors. The quantity of potential in the existing and new residential sectors, however, is more sensitive to the TRC restriction than the potential in any other sectors. In particular, the gross existing residential potential is reduced by over 2,000 GWh (22%) when the TRC restrictions are applied to the Full incremental cost scenario. The potential in the residential new construction sector is reduced by approximately 40 GWh (37%) due to the TRC restrictions. In comparison, the existing commercial potential is reduced by approximately 600 GWh (10%) when the TRC restrictions are applied to the Full scenario. The sector-dependent impacts of the TRC restrictions reinforce the importance of the run-time assumptions for commercial and residential sectors. The longer run times in the commercial sector make several air conditioning measures cost-effective in the commercial sector that are not cost-effective in the residential sector.

Figure ES-4: Total California IOU Net Market Energy Potential by Sector–2007-2016 (GWh)

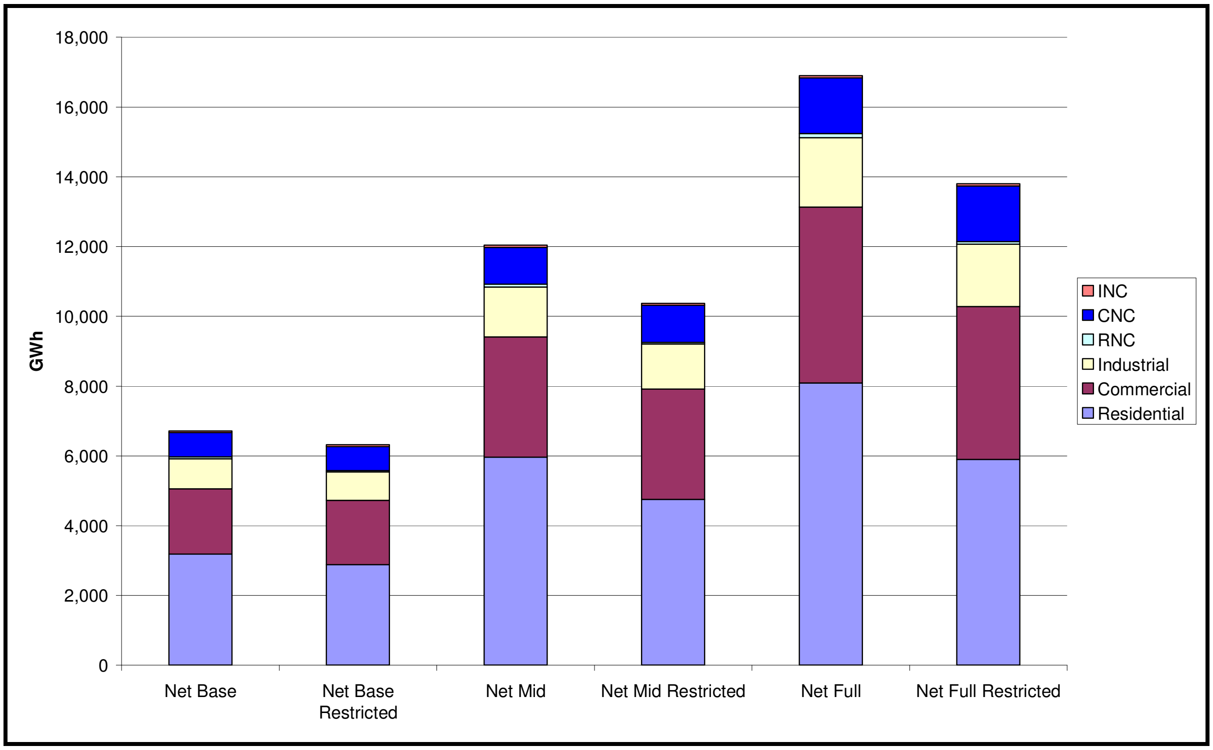
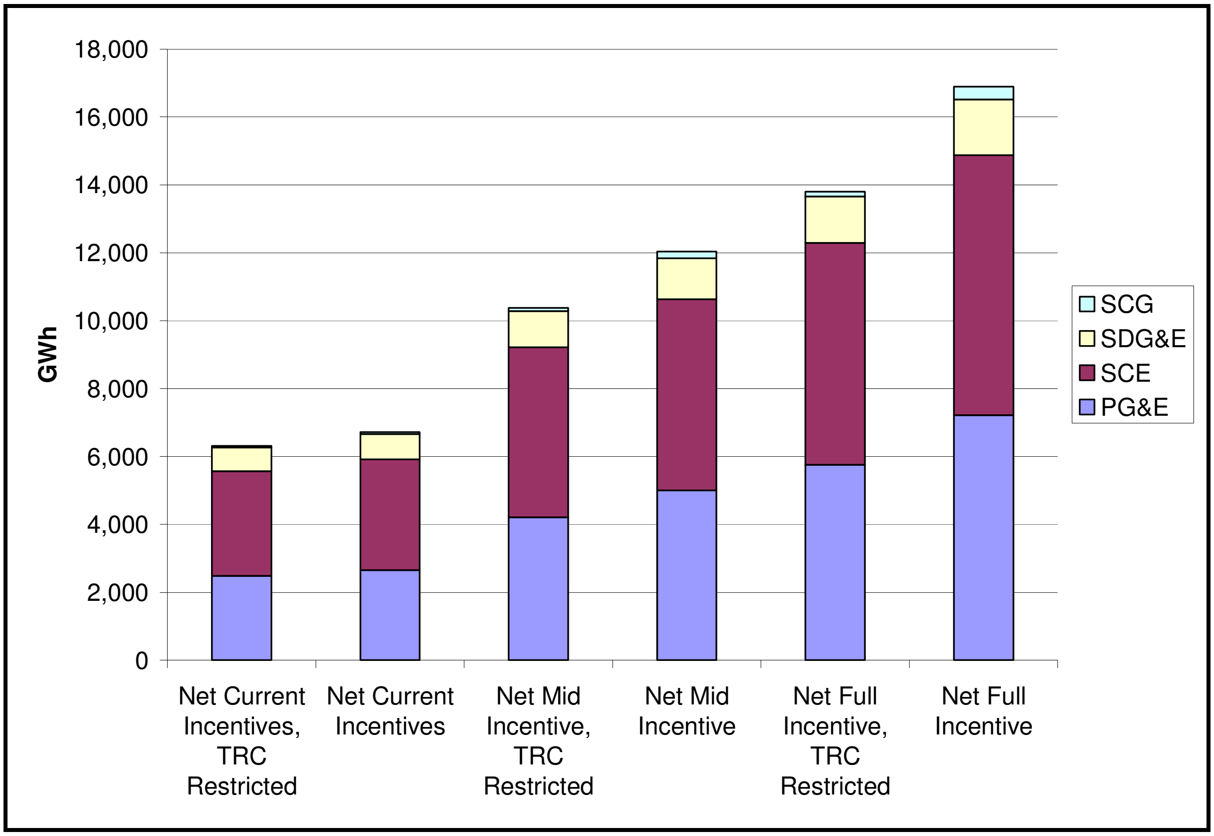


Figure ES-5 illustrates the distribution of net market total electric energy potential in 2016 by IOU for measures adopted from 2007 through 2016 and still installed in 2016. If current incentives and programs are continued, SCE would account for slightly less than 50% of the electric energy potential (3,265 GWh), while PG&E's program accomplishments would account for approximately 40% (2,652 GWh) and SDG&E 10% (738 GWh). Increasing incentives to full incremental costs and expanding the measures covered by the programs increases PG&E's share of potential to 43% (7,217 GWh) and reduces SCE's share to 45% (7,655 GWh). With full incentives, SDG&E's share remains at approximately 10% (1,639 GWh). SCG's electric energy potential with full incentives is approximately 2% (385 GWh). SCG's electric savings potential is associated with residential measures that are largely gas savings devices that also provide limited electric savings.[25]

[25] The three largest gas savings measures, which also contribute to electric savings, are duct sealing, insulation, and dishwashers.

Figure ES-5: Total California IOU Net Market Energy Potential by IOU–2007-2016 (GWh)



Peak Demand Potential

Table ES-5 and Figure ES-6 present the peak demand savings potential estimates in 2016 for measures adopted from 2007 through 2016 and still installed in 2016. As shown, the total gross market potential for peak demand reductions if the current incentives and programs are continued is 2,232 MW. The corresponding net market potential is 1382 MW. Increasing program incentives to full incremental measure costs and increasing the measures covered by the programs leads to a gross market peak demand potential of 4,771 MW and a net market potential of 3,912 MW. As shown in Figure ES-6, 45% of the base market potential for demand savings is associated with measures installed in existing residential homes, with another 31% and 13% relating to the existing commercial and industrial sectors, respectively.

Table ES-5: Total California IOU Market Peak Demand Potential by Sector–2007-2016 (MW)

	Gross Base Incentive	Naturally Occurring Base	Gross Base Incentive, TRC Restricted	Gross Mid Incentive	Gross Mid Incentive, TRC Restricted	Gross Full Incentive	Gross Full Incentive, TRC Restricted	Naturally Occurring Mid and Full
Residential Existing 2007-2016	974	369	862	1,623	1,172	2,377	1,396	375
Commercial Existing 2007-2016	700	301	696	1,032	980	1,338	1,244	305
Industrial Existing 2007-2016	298	157	291	393	369	485	450	157
Residential New Construction 2007-2016	55	NA	39	83	60	122	88	NA
Commercial New Construction 2007-2016	175	NA	175	269	269	418	418	NA
Industrial New Construction 2007-2016	29	22	29	30	30	32	32	22
Total	2,232	850	2,093	3,430	2,879	4,771	3,627	859

Commercial and residential new construction savings were determined relative to a baseline study of as-built homes and buildings. This method leads to a determination of *net*, not *gross* savings. For reporting purposes, we have listed these savings in the gross column and listed NA in the naturally occurring savings columns, since the naturally occurring savings are incorporated in the as-built savings calculations. The naturally occurring savings are higher for the residential and commercial Mid and Full scenarios than the Base due to an expansion of the measure list. The potential savings listed in the table are at the generation level.

Figure ES-6: Distribution of California IOU Total Net Market Peak Demand Potential with Base Incentives–2007-2016 (MW)

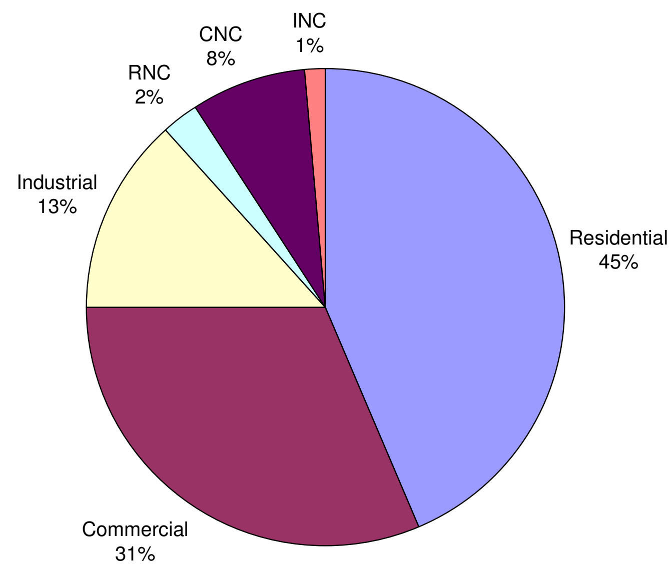


Figure ES-7 illustrates the total net coincident peak demand potential by sector for measured adopted from 2007 to 2016 and still installed in 2016. For all scenarios, the coincident peak demand potential in the existing residential sector is larger than the demand potential in any other sector. The existing residential gross demand potential under full incentives is approximately 1000 MW larger than the existing commercial gross demand potential. The full restricted gross demand potential for the existing residential and commercial sectors differs by only 150 MW. The measure-level TRC restrictions significantly reduce the existing residential demand potential while having only a minor impact on the existing commercial demand potential. TRC restrictions eliminated most of the residential HVAC measures, leading to a substantial reduction in demand potential when compared to the residential Mid and Full incentive scenarios.

Figure ES-7: Total California IOU Net Coincident Peak Demand Potential by Sector–2007-2016 (MW)

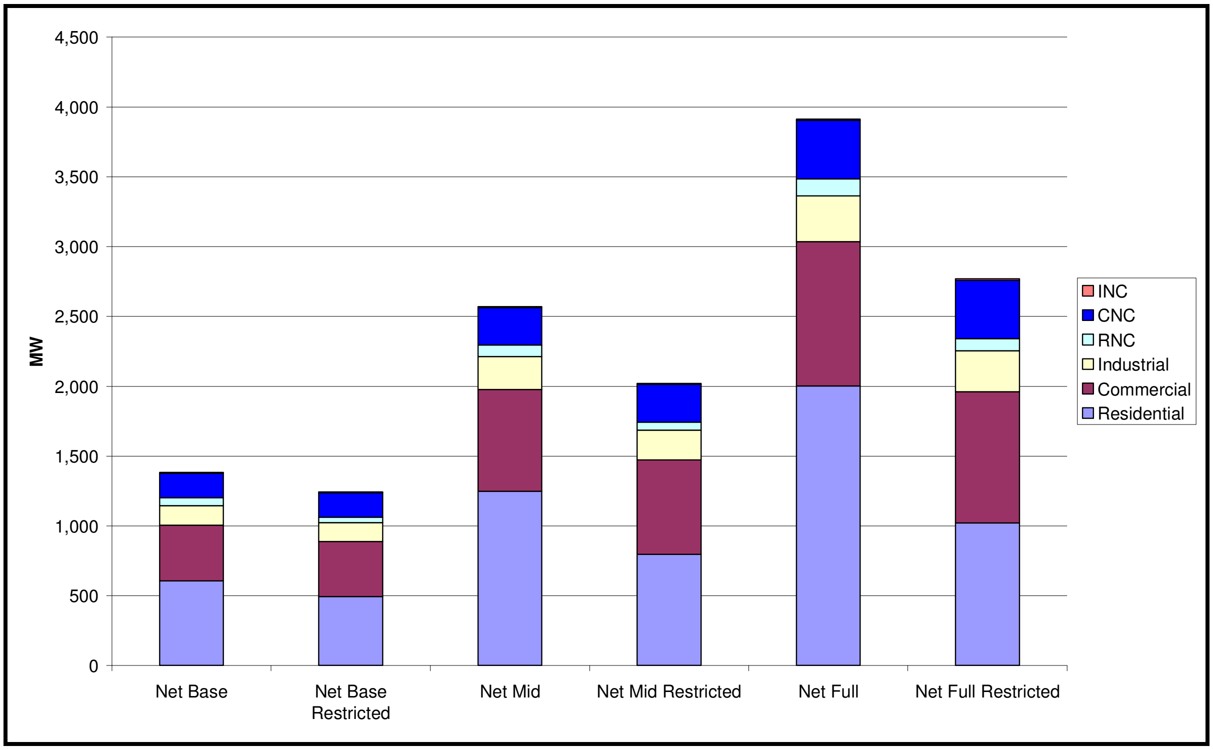
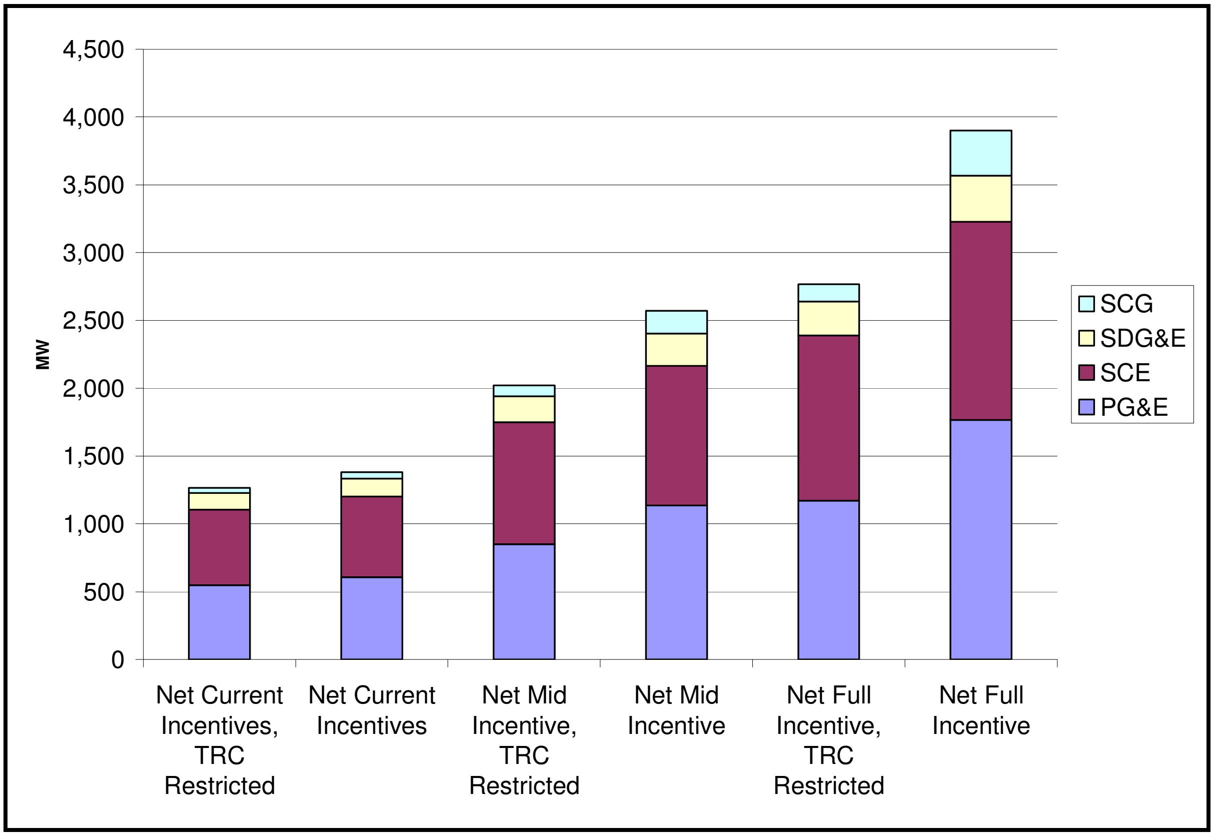


Figure ES-8 illustrates the total net market peak demand potential by IOU for measures adopted from 2007 to 2016 and still installed in 2016. If the current incentives and programs are continued, PG&E is estimated to contribute 44% of the total peak demand potential (607 MW), closely followed by SCE at 43% (596 MW). SDG&E's estimate of current market peak demand potential is 133 MW or 10% of the total peak demand potential. Increasing incentives to full incremental costs increases PG&E's potential to 1,767 MW or 45% of the total IOU peak demand potential. SCE's full incremental cost peak demand potential is 1,461 MW (37% of the total), SDGE's full peak demand potential is 341 MW, and SCG's full peak demand potential is 331 MW.

Figure ES-8: California IOU Net Market Electric Peak Demand Potential by IOU–2007-2016 (MW)



Natural Gas Potential

Table ES-6, Figure ES-7, Figure ES-8, and Figure ES-9 depict the potential for natural gas savings by 2016 for measures adopted from 2007 to 2016 and still installed in 2016. As shown, the total gross current market potential for annual gas savings is 171 million therms by 2016 while the total net current market potential is 89 million therms. Of the gross potential, 153 million therms of annual savings pass a TRC test of 0.85 or higher. The gross full market potential for natural gas savings by 2016 is 607 million therms while the TRC restricted potential is 327 million therms. The large reduction in full market potential between the non-restricted and the TRC restricted scenarios is due to a significant reduction in the residential potential. As illustrated in Figure ES-7, 44% of the market potential for natural gas savings under the Base incentives market scenario comes from existing residential construction and 33% comes from the existing industrial sector.

Table ES-6: Total California IOU Market Natural Gas Potential by Sector–2007-2016 (Millions of Therms)

	Gross Base Incentive	Naturally Occurring Base	Gross Base Incentive, TRC Restricted	Gross Mid Incentive	Gross Mid Incentive, TRC Restricted	Gross Full Incentive	Gross Full Incentive, TRC Restricted	Naturally Occurring Mid and Full
Residential Existing 2007-2016	76	39	62	222	93	371	117	44
Commercial Existing 2007-2016	13	9	12	27	15	36	17	10
Industrial Existing 2007-2016	56	33	56	92	92	146	146	33
Residential New Construction 2007-2016	14	NA	12	24	19	38	29	NA
Commercial New Construction 2007-2016	11	NA	11	18	18	17	17	NA
Industrial New Construction 2007-2016	0	0	0	0	0	0	0	0
Total	171	82	153	383	237	607	327	87

Commercial and residential new construction savings were determined relative to a baseline study of as-built homes and buildings. This method leads to a determination of *net*, not *gross* savings. For reporting purposes, we have listed these savings in the gross column and listed NA in the naturally occurring savings columns, since the naturally occurring savings are incorporated in the as-built savings calculations. No gas measures were analyzed in the industrial new construction sector. The naturally occurring savings are higher for the residential and commercial Mid and Full scenarios than the Base due to an expansion of the measure list. The potential savings listed in the table are at the generation level.

Figure ES-9: Distribution of California IOU Total Market Natural Gas Potential with Base Incentives–2007-2016 (Millions of Therms)

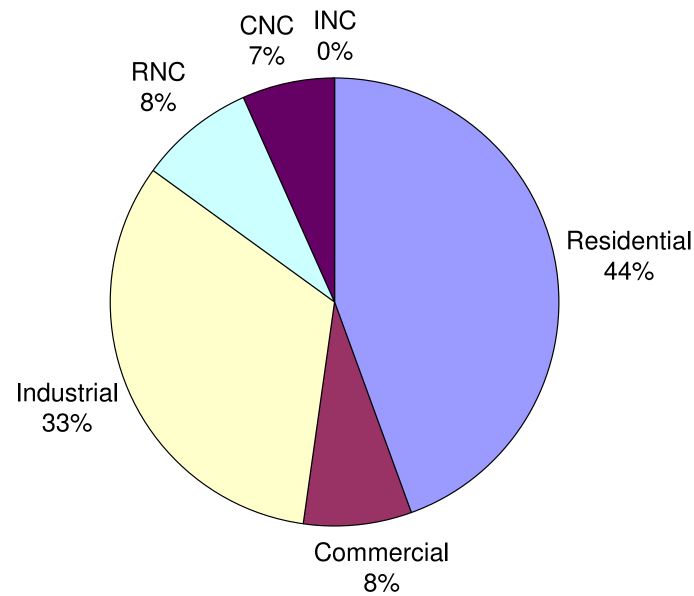


Figure ES-10 illustrates the net natural gas potential in 2016 by sector for measures adopted from 2007 to 2016 and still installed in 2016. The importance of the measure-level TRC restrictions within the residential sector is clearly illustrated by the results. The existing residential potential is larger than the existing industrial potential in the Base, Mid, and Full scenarios. The existing industrial potential, however, is higher than the existing residential potential in the TRC Restricted Base, Mid, and Full scenarios. The longer run times of the industrial sector have led to much higher cost-effectiveness than in the residential sector.

Figure ES-10: Total California IOU Net Natural Gas Potential by Sector–2007-2016 (Millions of Therms)

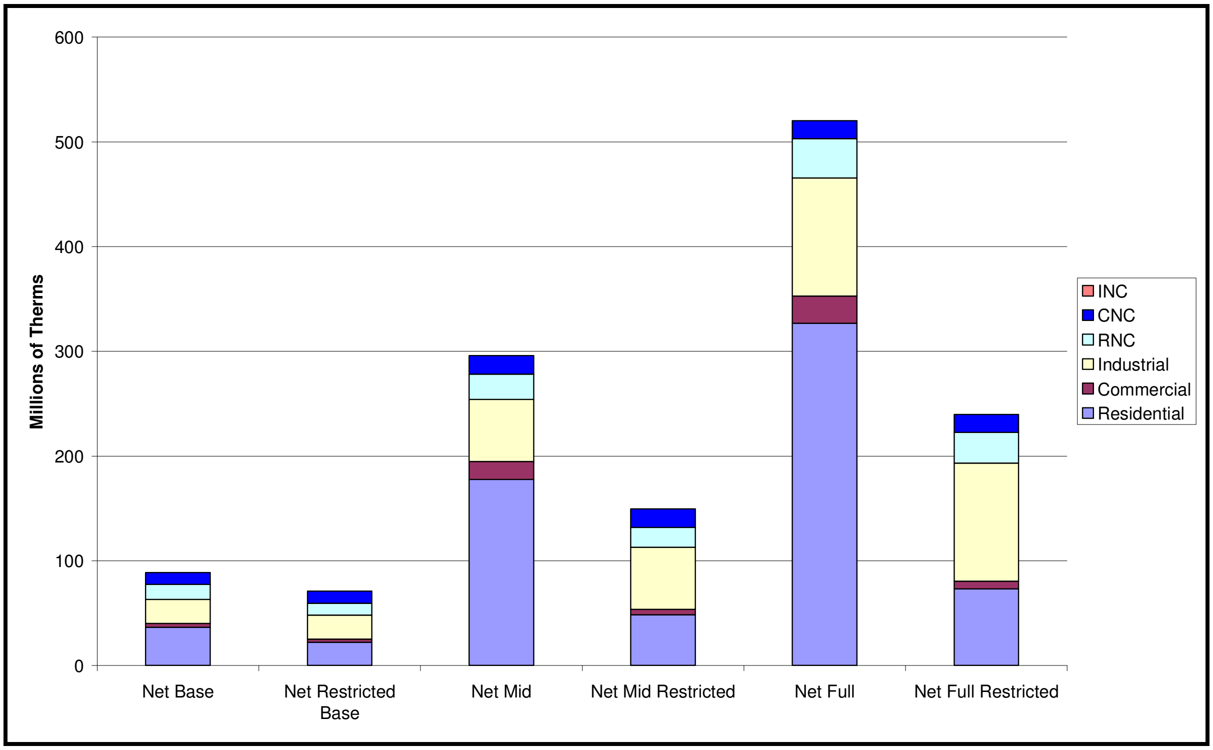
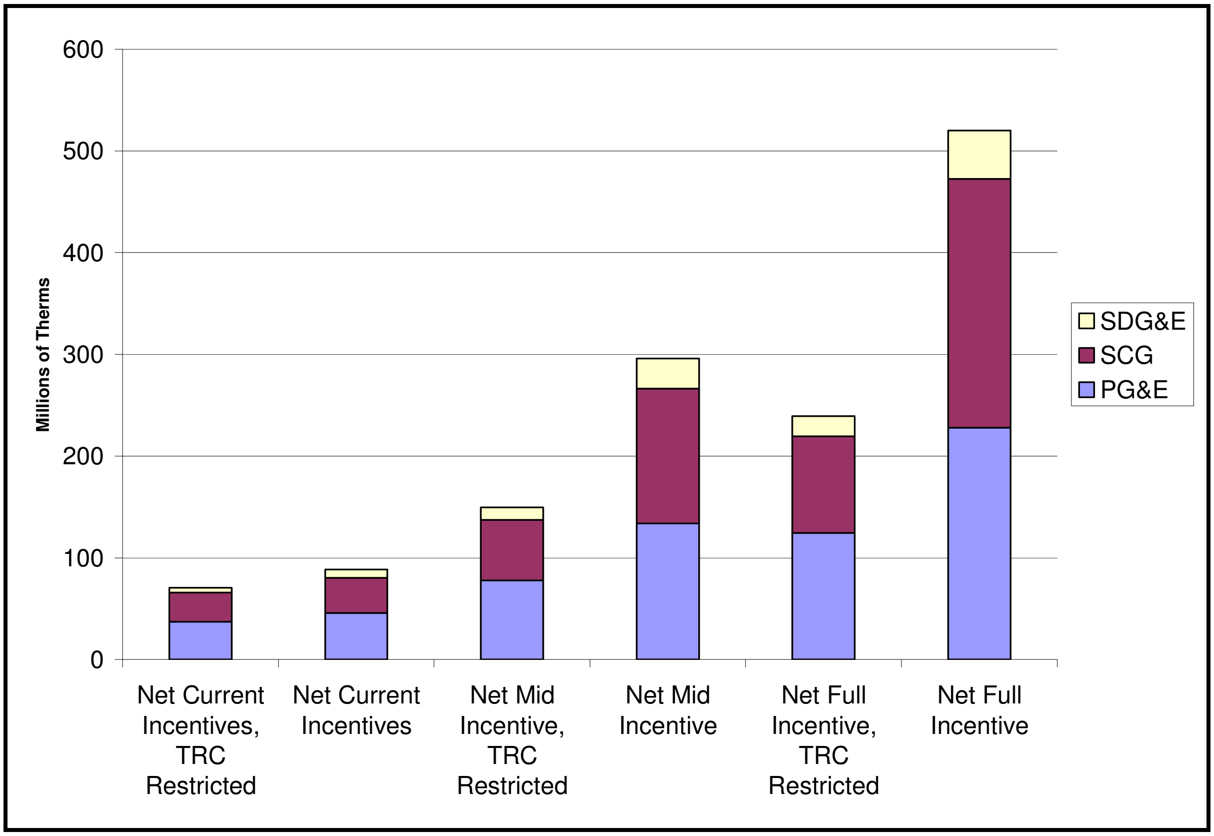


Figure ES-11 illustrates the IOU natural gas potential in 2016 for measures adopted from 2007 to 2016 and still installed in 2016. If the IOUs continue their current incentives and programs, the TRC restricted natural gas potential estimates indicate that PG&E has 53% (37 million therms) of the remaining potential while SCG has 40% (29 million therms) and SDG&E has 7% (5 million therms). Increasing incentives to cover full incremental measure costs and expanding the measures list leads to PG&E's estimate of TRC restricted full potential rising to 125 million therms, SCG's potential rising to 95 million therms, and SDG&E's potential rising to 20 million therms.

Figure ES-11: Net California IOU Market Natural Gas Potential by IOU–2007-2016 (Millions of Therms)



ES.6 Caveats

Any study of this nature is subject to a number of caveats. Several important caveats affecting this study follow.

Scenario Simulations Rather than Forecasts. Each of the simulations of market potential presented in this report reflects a specific set of assumptions about incentive levels and TRC restrictions. None of these scenario-specific simulations should be considered a forecast of what is likely to occur over time, since program designs, incentive levels, rates, and rebated measures are constantly evolving and adapting to the existing context. Given the blending of various elements and the major increase in program budgets in the 2006-2008 period, we expect program accomplishments over these years to resemble the simulated results of the average incentives or full incentives scenarios, rather than the current incentives scenario.

Market Saturation and Diminishing Program Accomplishments. One of the primary findings of most potential studies is that the simulated total annual program accomplishments under each of the scenarios tend to diminish over time as the markets for energy efficiency measures becomes more highly saturated. One way to interpret the high level of measure saturation forecast by this study is that the maintenance of high levels of annual program accomplishments will necessitate enhancements in the mix of measures offered by these programs over time.

Sensitivity of Simulations to Program Activity. Comparisons of the various market potential scenarios provide indications of the sensitivity of program accomplishments to the level of program activity. As indicated by the titles of the market potential scenarios, the aggressiveness of program designs is represented by the levels of incentives. This aspect of the analysis is subject to two important caveats. First, relatively little empirical work has been done to estimated customer responses to variations in incentive levels, so the results are subject to a significant degree of uncertainty. More research needs to be conducted on this point. Second, program interventions go far beyond financial incentives, and undoubtedly affect awareness of energy efficiency options as well as willingness to purchase those options at a given incentive level.

General Market Conditions. All of the market potential scenarios depicted in this report assume a given set of future market conditions (other than incentive rates). Obviously, key market conditions like retail rates, avoided costs, and technology costs may follow a very different path than assumed for the purposes of this study. As these conditions change, simulations will need to be revisited.

1

Introduction

This report summarizes the estimates of gross and net energy savings potential from energy efficiency measures in California. The study estimates the potential electric energy, coincident peak demand, and natural gas potential in the existing and new residential, commercial, and industrial sectors. The Energy Efficiency Potential Study was conducted by Itron, Inc. (Itron), with assistance from KEMA, under the management of PG&E. The study was overseen by a Project Advisory Committee (PAC) consisting of representatives from Pacific Gas and Electric (PG&E), Southern California Edison Company (SCE), Southern California Gas Company (SCG), San Diego Gas And Electric Company (SDG&E), the California Public Utilities Commission (CPUC), and the California Energy Commission (CEC).

The study focuses on the estimates of gross and net market potential for 2007-2016 and 2007-2026 resulting from the installation of energy efficiency measures funded through publicly funded energy efficiency programs. The geographic area covered by the study includes the service areas of the four major investor-owned utilities (IOUs): PG&E, SCE, SCG, and SDG&E. Previous similar studies were completed in 2002 and 2003 by KEMA-Xenergy (KEMA) and 2006 by Itron.[1] The energy savings potential considered in this study results from the installation of high efficiency measures for retrofit, replace-on-burnout, conversions, and new construction situations. Energy savings resulting from changes in behavior, or requiring major redesign of existing systems, were not included in the scope of this work.

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[1] KEMA-Xenergy, Inc. *California Statewide Commercial Sector Energy Efficiency Potential Study. Final Report. Volumes 1 and 2*. July 2002.
KEMA-Xenergy, Inc. *California Statewide Residential Sector Energy Efficiency Potential Study. Final Report. Volumes 1 and 2*. April 2003.
KEMA-Xenergy, Inc. *California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study, Final Report. Volumes 1 and 2*. May 2003 (revised July 2003).
All prepared for Pacific Gas & Electric Company.
Itron, Inc. *California Energy Efficiency Potential Study, Volumes 1 and 2*. May 2006.

1.1 Overview of Study Objectives and Scope

The primary objective of the work underlying this report was to produce estimates of remaining potential energy savings that might be obtainable in the near (2007-2016) and foreseeable (2016-2026) future through publicly funded energy efficiency programs in the existing and new residential, industrial, and commercial sectors. Some key questions addressed with this research include the following:

- What is the remaining gross and net market potential for energy efficiency through 2016 and 2026?
- What is the marginal gain in energy efficiency market potential if program funding is increased?
- How does the potential for energy efficiency vary by market sector and climate zone?
- What are the program costs, incentives, measure costs, and avoided cost benefits associated with alternative funding scenarios?

The findings from this study will be used by the IOUs and their program planners to focus utility program offerings by technologies, sectors, and climate zones. The results will help locate areas where potential savings remain and determine which technologies offer the most efficient, cost-effective opportunities for energy savings. The results from this study will help the utilities assess and, to the extent possible, meet the energy saving goals set by the CPUC.

The CPUC has established aggressive energy saving goals for electric and natural gas savings for the IOUs for 2004-2013. Given the near-term and forward-looking nature of these goals, this study analyzed the remaining potential from commercially available energy efficiency measures in new and existing residential, commercial, and industrial buildings.

1.2 Types of Potential

This study analyzes the remaining technical, economic, market and program energy efficiency potentials for the IOUs. *Technical potential* refers to the savings potential that would be captured if all energy efficiency measures were installed in all feasible and applicable applications. This study uses a combination of the “phased-in” and “immediate” approaches to estimating technical potential. Measures modeled as retrofits or conversions (such as lighting) are immediately converted to the highest efficiency technology. Measures modeled as replace-on-burnout (such as air conditioning) are phased in as the old, low efficiency measures burn out.

Economic potential indicates the savings potential that would be achieved if measures were installed in all feasible and applicable cost-effective applications. In this context, cost-effectiveness is assessed using a total resource cost (TRC) test, which takes into account the value of savings as evaluated by the value of avoided costs and the incremental measure cost. The TRC test used to determine economic potential does not incorporate program costs associated with marketing and administering the program. Economic potential is not calculated under a market forecast of voluntary programs. Lacking program costs, additional measures may pass the TRC test to be included in the economic potential but they might be eliminated from a cost-effective market potential.[2]

Market potential denotes the savings that can be expected to result in the market from specific scenarios relating to program designs and market conditions. The results presented in this report for market potential under existing program designs have been calibrated to the average of actual program accomplishments for the 2004-2005 program cycle. This program cycle was the first two years of the new 10-year period in which the IOU energy savings goals were raised to foster the achievement of the new, higher energy efficiency savings. Market potential was estimated for 10 scenarios based on incentive levels, measure-level TRC restrictions, levels of awareness and willingness, and different base lighting technologies. The Base estimates of market potential over the planning period reflect the continuation of the incentives in effect during 2006. Another set of market potential estimates, called Full potential, was derived on the assumption that incentives are increased to cover full incremental measure costs. Yet a third set of estimates (the Mid scenario) was developed to reflect an average market scenario in which incentives are equal to the average between current (2006) incentives and full incremental costs.

Program potential is very similar to market potential. Program potential denotes the savings that result from specific program activities. Program eligibility restrictions can cause program and market savings to diverge. Program scenarios that limit program eligibility to measures with specific TRC values are likely to have program potential that differs from market potential.

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2 The program administrative and marketing cost associated with economic potential could be very high. To attain all of the cost-effective potential, program interventions would likely have to reach each end users directly for each measure, incurring significant marketing and transaction costs. This method of promoting energy efficiency would incur a substantial labor cost and would likely require substantial increases in incentives like those associated with the full incentive case, if not higher in some cases, to overcome market barriers other than direct incremental costs. The program marketing and administrative costs are included in TRCs calculated for the market potential estimates.

1.3 Organization of the Report

The Executive Summary provides a high-level summary of the results, the important differences between this study and the previous statewide potential studies, and a listing of the key factors contributing to the primary differences.

- Section 2 provides a brief description of California's energy consumption and recent changes and accomplishments in the utilities' energy efficiency programs.
- Section 3 describes the approach used in the study. The section also presents and compares key assumptions used in this analysis and the previous statewide analyses of energy efficiency potential.
- Section 4 presents estimates of total market and first-year program potential aggregated across all six sectors and four IOUs.
- Section 5 presents estimates of technical, economic and market potential for existing residential housing.
- Section 6 offers estimates of technical, economic and market potential for existing commercial buildings.
- Section 7 summarizes estimates of potential for the existing industrial sector.
- Section 8 summarizes estimates of potential for residential new construction.
- Section 9 summarizes estimates of potential for commercial new construction.
- Section 10 summarizes estimates of potential for industrial new construction.
- Section 11 compares the estimates of potential for the existing and new residential, commercial, and industrial sectors to those from the previous Itron 2006 and KEMA 2002/2003 potential studies.
- Section 12 discusses conclusions and implications of the study results and provides recommendations.
- Appendix A describes the energy efficiency measures analyzed in this study.
- Appendix B provides the technical supply curves.
- Appendix C provides input definitions.
- Appendix D provides output definitions.
- Appendix E provides the residential new construction methodology.
- Appendix F provides the commercial new construction methodology.
- Appendix G provides the industrial new construction methodology.
- Appendix H presents a glossary.

2

Energy Usage and Efficiency Program Background

This section presents a brief background of California's energy usage, energy efficiency programs, and a description of recent changes in these programs. The very brief discussion of energy usage helps to ground the energy efficiency savings forecast as a percentage of estimated usage. The description of energy efficiency program accomplishments and future goals forms the basis for the starting point for this study.

2.1 Background on California Electricity Usage

Electricity consumption for PG&E, SCE, and SDG&E, and the annual growth rate of consumption over the 1990 to 2005 period are listed in Table 2-1. Consumption grew during the 1990s, while growth slowed significantly during the 2000-2005 period, which includes the 2000-2001 energy crises and the development and implementation of new energy efficiency goals for 2004-2013. During 2000-2005, PG&E and SCE experienced very limited growth in consumption while SDG&E's consumption grew more rapidly. This is consistent with the underlying economic activity in the utility's service territories. The economy in the Bay Area struggled following declines in the technology sector during the early period of 2000-2005, while San Diego's economy remained relatively strong with increased population growth.

Table 2-1: Electricity Consumption by Utility Planning Area – 1990-2005

Year	PG&E		SCE		SDG&E	
	Consumption GWh	Annual Growth Rate	Consumption GWh	Annual Growth Rate	Consumption GWh	Annual Growth Rate
1990	86,803		82,069		14,926	
2000	101,331	1.56%	99,146	1.91%	19,294	2.60%
2005	101,460	0.03%	99,261	0.02%	19,910	2.28%

Data from *California Energy Demand 2008-2018 Staff Revised Forecast*, California Energy Commission (CEC), November 2007. The data include loads served by private supply but do not include energy losses.

While California's consumption of electricity has grown, California has worked to reduce energy consumption by developing energy efficiency programs. These programs have focused on achieving energy savings with new building standards, new appliance standards, and incentives to encourage the replacement of inefficient technologies with high efficiency measures. These programs have contributed to Californians having the lowest per capita energy usage among all 50 states. Table 2-2 lists the per capita electricity usage for five states. In 2005, California's per capita electricity usage was the lowest in the United States at 7,032 kWh. Wyoming had the highest per capita usage at 27,787 kWh.[1]

Table 2-2: Per Capita Electricity Usage in 2005

State	Per Capita Electricity Usage (kWh)	Ranking
Wyoming	27,787	50th
North Carolina	14,798	35th
Nevada	13,473	25th
Illinois	11,358	15th
California	7,032	1st

Data from the CEC web site, http://www.energy.ca.gov/electricity/us_per_capita_electricity_2005.html.

The divergence of California's per capita consumption from that of other states is illustrated in Figure 2-1. Over the last 30 years, the nation's per capita electricity usage has grown over 45%, while California's per capita electricity usage has remained flat.[2] The break in per capita consumption in California and the rest of the U.S. occurred in the 1970s. This period represents the beginning of large-scale energy efficiency programs in California.

Figure 2-2 illustrates the per capita electricity consumption in California for 1980-2005 and the CEC's forecast of per capita consumption through 2018. Per capita consumption through 2018 is forecast to remain relatively constant at the 2005 level.

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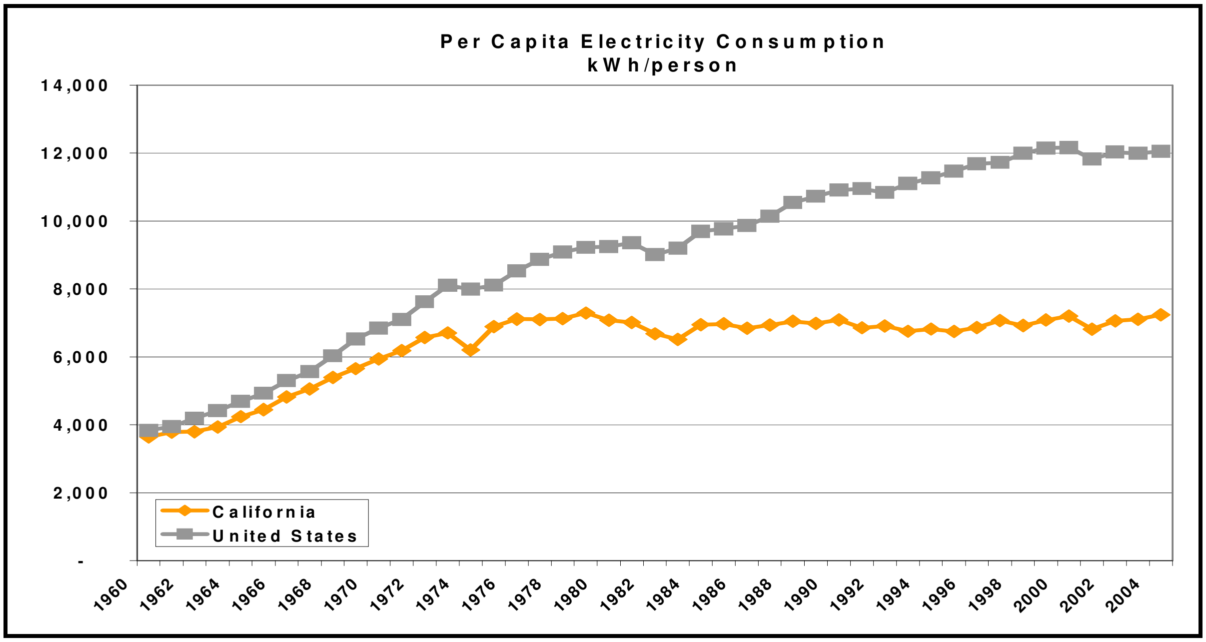
1 California Energy Commission, http://www.energy.ca.gov/electricity/us_per_capita_electricity_2005.html, U.S. per capita electricity usage, 2005.

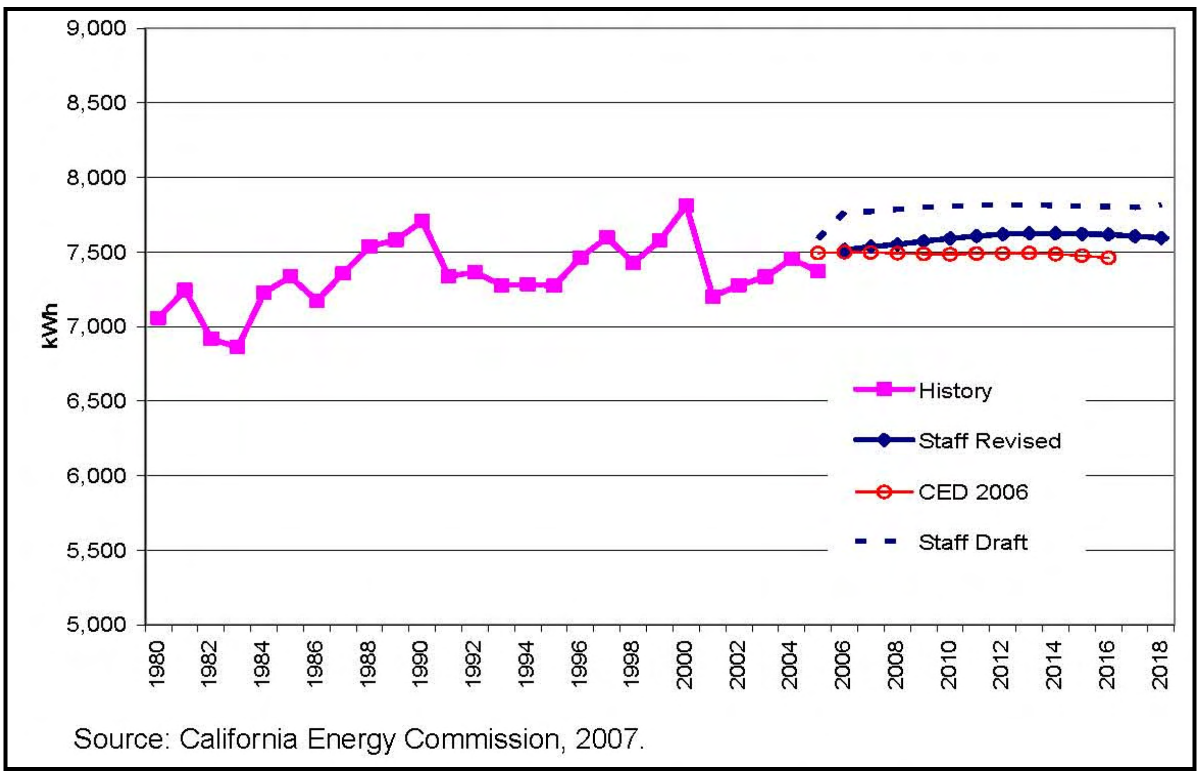
2 California Energy Commission. *2002–2012 Electricity Outlook.* 2001.

Figure 2-1: Per Capita Electricity Usage – 1960-2004



CEC Publication. February 2006. Figure courtesy of Mike Messenger.

Figure 2-2: Statewide Electricity Consumption per Capita

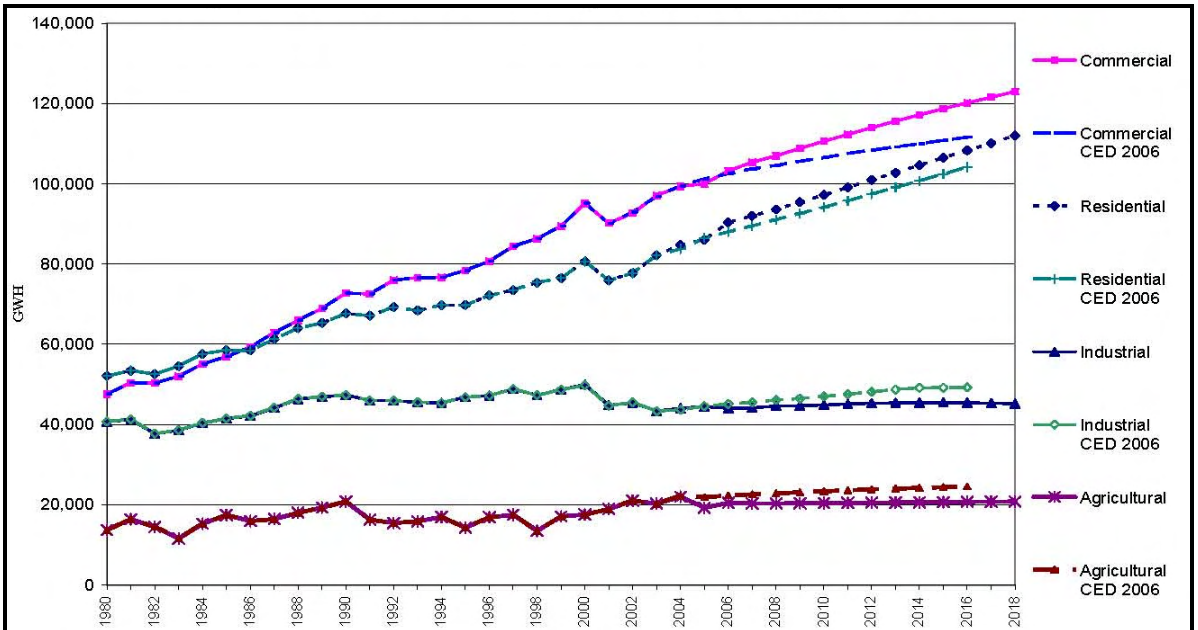


Data from *California Energy Demand 2008-2018 Staff Revised Forecast*, CEC, November 2007.

Examining the consumption of electricity helps to provide a benchmark from which to judge past energy efficiency achievements and future energy efficiency goals. Figure 2-3 illustrates past consumption trends and the CEC forecast of statewide electricity consumption by sector from 1980 to 2018. The figure shows that since the mid-1980s, the largest consumer of electricity has been the commercial sector, followed closely by the residential sector. During the 1980s and 1990s, the commercial sector's consumption of electricity grew by approximately 1.4% a year while the residential sector's consumption grew by approximately 1.7% a year. The industrial sector's annual growth rate has been much smaller than that of either the residential or the commercial sectors.

The revised CEC forecast of electricity consumption for 2006-2018 assumes that the commercial floorstock will grow faster and has revised the forecast of residential housing. The revised residential housing projections imply faster growth in warmer climate zones. The forecast also incorporates a higher forecast for personal income.

Figure 2-3: Statewide Electricity Consumption by Sector



Source: California Energy Commission, 2007.

Data from *California Energy Demand 2008-2018 Staff Revised Forecast*, California Energy Commission, November 2007.

An estimate of IOU electricity sales is listed in Table 2-3.[3] The CEC's estimates of electricity sales and consumption largely incorporate utility energy efficiency programs. The CEC "estimates that approximately 80-90% of the expected impacts are reflected in the models" or in direct adjustments to the forecast electricity consumption.[4] This issue is being addressed in the current IEPR proceedings. All parties are currently working together to determine the percentage of future energy efficiency program savings that are included in the CEC forecast of future consumption. Given the incorporation of current IOU energy efficiency program savings in the forecasts, unless the IOUs change the focus of their post-2008 programs, it is likely that the CEC forecast of consumption will continue to reflect a large share of the IOU energy efficiency program savings.[5]

Table 2-3: IOU Electricity Consumption Forecast (GWh)

Year	PG&E	SCE	SDG&E
2008	86,795	91,771	20,561
2013	92,773	99,440	22,173
2016	96,153	103,513	23,080

Data from *California Energy Commission California Energy Demand 2008-2018 Staff Revised Forecast*, November 2007. Numbers listed in the above table are a summation of the IOU bundled and direct access annual deliveries from Form 1.1c.

2.2 Background on California Energy Efficiency Program Impacts

The 2000-2001 energy crises led to an escalation of energy prices in California and to an increase in the importance of energy efficiency programs. Annual spending on energy efficiency programs by the major California IOUs for planning years 1995-1999 averaged less than $220 million per year (in 2000 dollars).[6] Energy efficiency expenditures by utilities increased significantly in 2000 and 2001, exceeding $300 million. Expenditures by utilities

3 The Electricity Consumption Forecast provided by the CEC is based on a breakdown of the IOU Planning areas. The forecasts do not include self-generation and line loses. Data from California Energy Commission *California Energy Demand 2008-2018 Revised Staff Forecast*, November 2007. The data are listed in Form 1.1c.

4 Information from California Energy Commission *California Energy Demand 2006-2018 Revised Staff Forecast*, November 2007, page 29.

5 The CPUC decision of October 18, 2007 (California Public Utilities Commission, *Interim Order on Issues Relating to Future Savings Goals And Program Planning For 2009-2011 Energy Efficiency and Beyond*, October 18, 2007) indicates that the IOUs are directed to significantly adjust the their energy efficiency portfolios, placing more emphasis on new construction and HVAC. If the IOUs make these adjustments, the CEC forecast will not be expected to incorporate as high a percentage of these savings in their forecasts of future consumption.

6 KEMA-Xenergy. Data from the *California Statewide Residential Sector Energy Efficiency Potential Study, Volume 1 of 2.* April 2003.

fell below $300 million for 2002 and 2003 before rising again in 2004 and 2005. Total annual spending for energy efficiency programs by IOU for the 2004-2005 program cycles is listed in Table 2-4. Annual program year costs average $435 million during this period, with both PG&E and SCE exceeding $300 million over the 2004-2005 period.[7]

Table 2-4: Recorded Costs for the 2004-2005 Program Years

IOU	Recorded Filing Costs ($1000s)
PG&E	$369,705
SCE	$325,996
SCG	$60,471
SDG&E	$114,166
Total	**$870,338**

Annual first-year impacts from energy efficiency programs have risen with the increases in funding. Historically, first-year impacts averaged approximately 1,000 GWh, with nonresidential programs representing approximately 80% and residential programs claiming the remaining 20% of the savings.[8] Beginning with the 2004 program year, the CPUC established IOU goals for electric energy efficiency savings. These goals explicitly require the IOU to substantially increase their energy efficiency first-year annual savings.

Figure 2-4 and Figure 2-5 illustrate that the IOUs have significantly increased their energy efficiency program savings when compared with the historic average of 1,000 GWh. For the 2004-2005 program cycles, the average first-year net claimed savings was 2,364.5 GWh. In 2004, the IOUs claimed first-year net electricity savings of 1,134 GWh. In 2005, the first-year net claimed savings rose to 2,361 GWh while the committed first-year net savings for the 2004-2005 program cycles were 1,234 GWh.

In the 2004-2005 program cycles, the sector-level distribution of energy savings also shifted, with existing residential programs claiming approximately 40% and existing commercial programs claiming 48% of savings. This represented a major change in the focus of California energy efficiency programs from nonresidential programs to a more balanced emphasis between the two sectors. The large increase in residential claimed savings appears to be the result of a significant increase in residential lighting programs.[9]

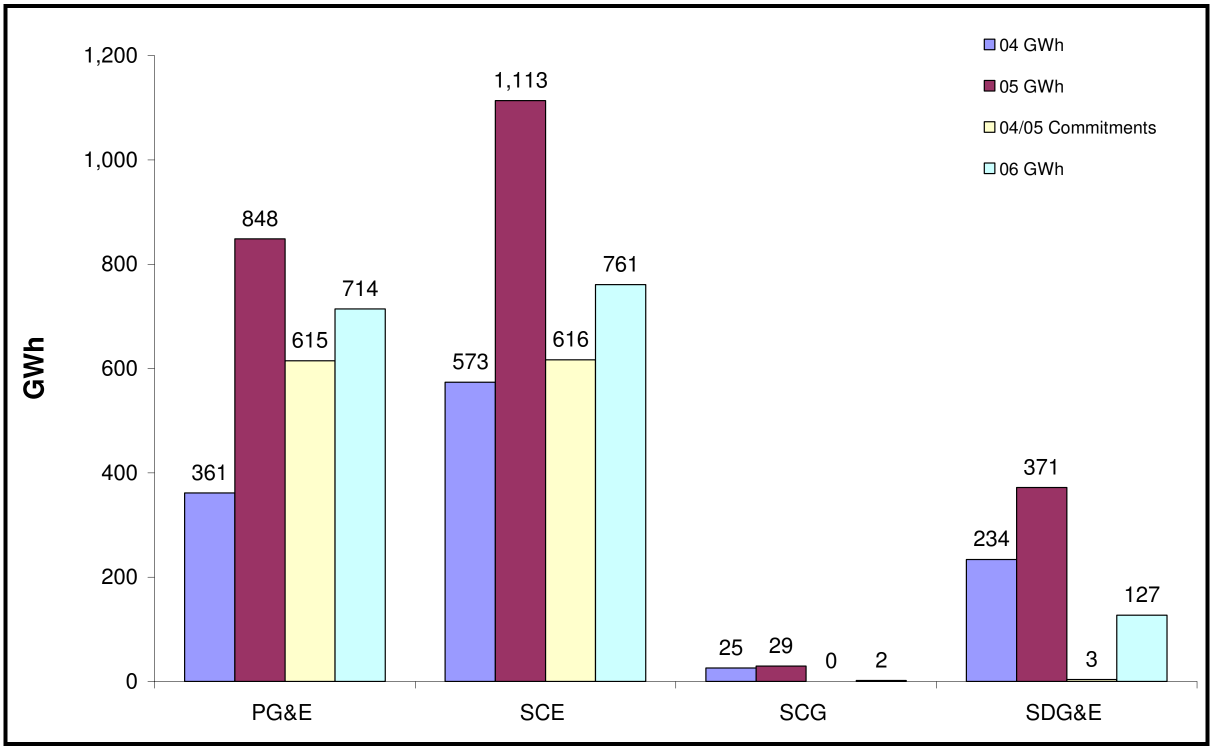
7 These are program year dollars and include both spent and committed. Spent dollars over the 2004-2005 program year period totals $672 million. Data from the *Where are We Now* presentation at the CPUC May 3 workshop, Itron.

8 KEMA-Xenergy, op. cit. April 2003.

9 CEC, op. cit, August 2005.

At the peak of the energy crisis in 2001, the IOUs claimed first-year peak savings of 475 MW. Figure 2-6 illustrates the 2004-2006 annual net first-year peak demand savings for the four California IOUs. During the 2004-2005 program year, the average annual net first-year peak demand savings were 463 MW with 254 MW savings in 2004, 456 MW savings in 2005, and 216 MW of committed savings. During the 2004-2005 program years, the peak demand savings were evenly split between the existing residential and the existing commercial sectors (see Figure 2-7)

Figure 2-4: First-Year GWh Savings by Utility for Energy Efficiency Programs



Data from the Itron *Where are We Now* presentation at the CPUC May 3, 2007 workshop.

Figure 2-5: IOU Sector-Level Electric Energy Efficiency Savings for Program Years 2004–2005

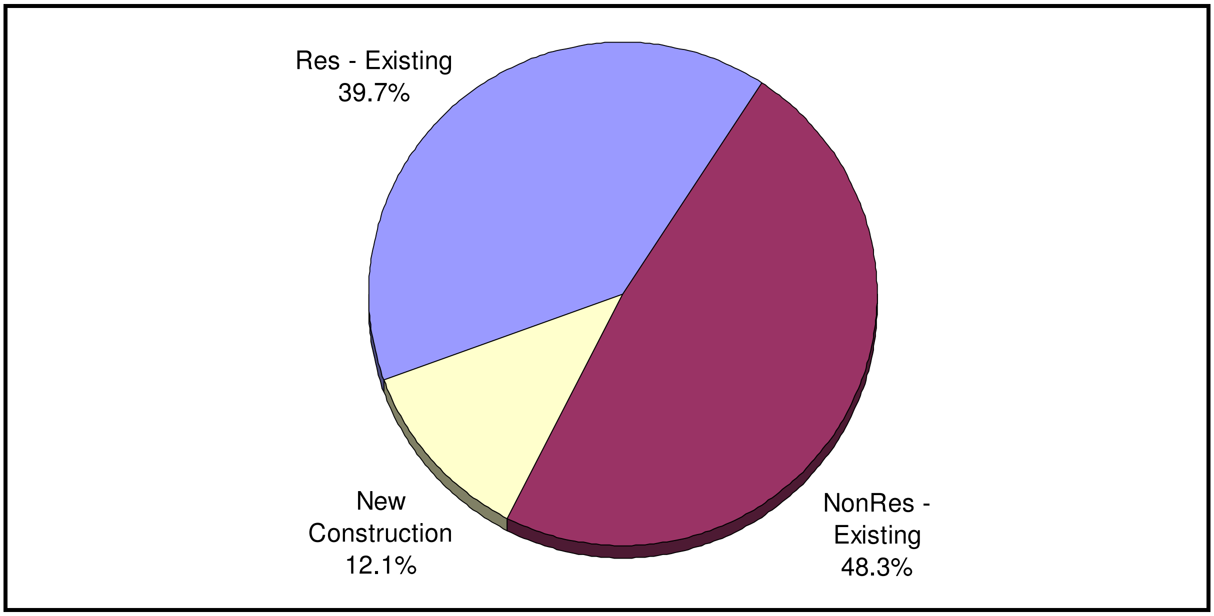
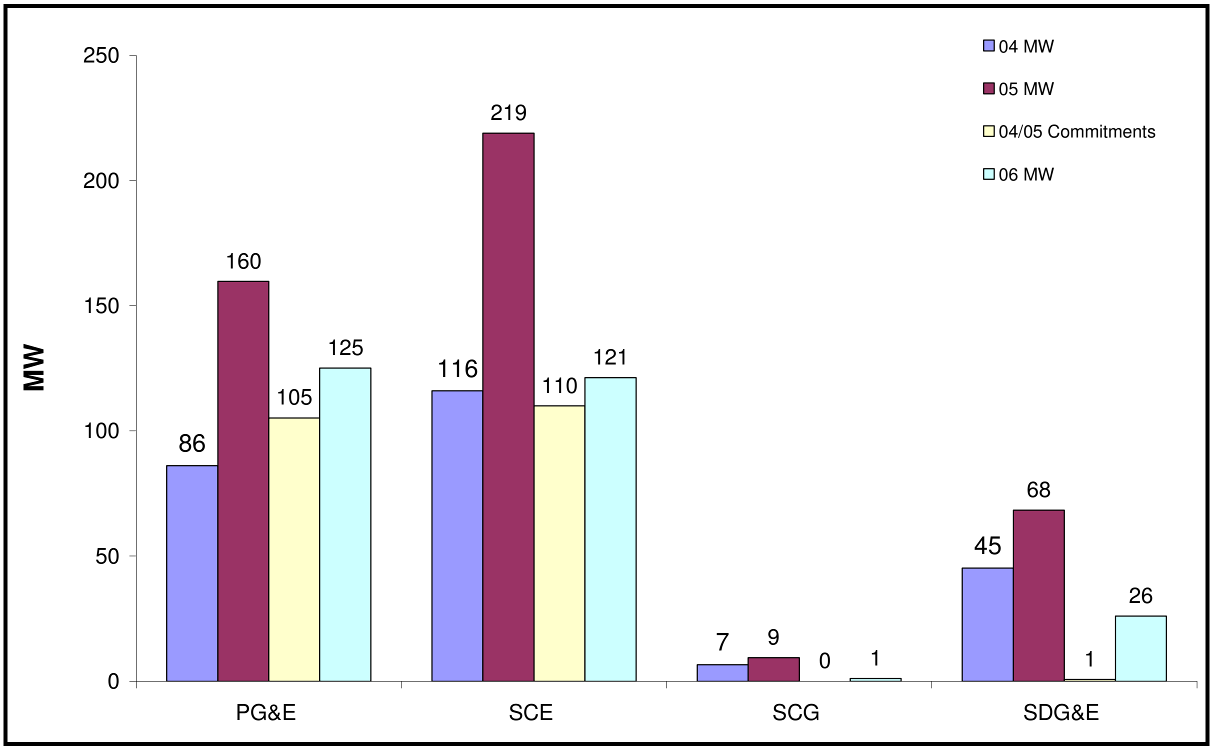
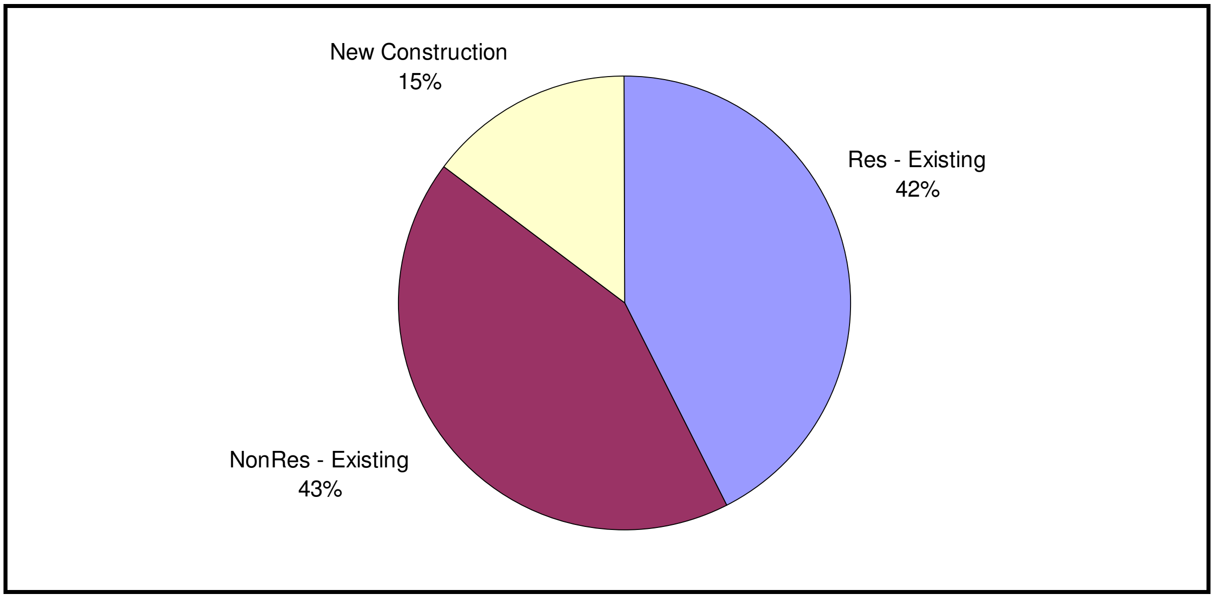


Figure 2-6: First-Year Peak Savings of Utility Energy Efficiency Programs



Data from the Itron *Where are We Now* presentations at the CPUC May 3, 2007 workshop.

Figure 2-7: IOU Sector-Level Peak Demand Efficiency Savings for Program Years 2004–2005



Data from the Itron *Where are We Now* presentations at the CPUC May 3, 2007 workshop.

The increase in energy efficiency program funding in 2004 and the energy savings attributable to these programs are expected to continue for the near and foreseeable future. The adoption of aggressive savings goals by the CPUC and the authorized commensurate funding increases for the IOUs ensures that California will continue to experience the higher level of energy efficiency savings. The 2006-2013 energy efficiency goals for the IOUs are listed in Table 2-5.[10] Meeting these goals will require that the utilities continue operating their existing energy efficiency programs effectively while expanding these and new programs into technologies and segments that have not previously been the primary focus of the energy efficiency programs.

[10] The IOU savings goals are from the Order Instituting Rulemaking to Examine the Commission's future Energy Efficiency Policies, Administration and Programs. Decision 04-09-060 September 23, 2004. The goals for 2012 and beyond are currently under review.

Table 2-5: First-Year Net Impacts of 2006-2013 Energy Efficiency Goals

	PG&E			SCE		SCG	SDG&E		
	GWh	MW	MM Therms	GWh	MW	MM Therms	GWh	MW	MM Therms
2006	829	180	12.6	922	207	14.7	281	55	2.7
2007	944	205	14.9	1,046	219	19.3	285	54	3.1
2008	1,053	229	17.4	1,167	246	23.3	284	54	3.7
2009	1,067	232	20.3	1,189	249	27.2	282	54	4.1
2010	1,015	220	21.1	1,176	247	28.3	274	52	4.5
2011	1,086	236	22.0	1,164	245	29.9	263	50	4.9
2012	1,173	255	23.0	1,151	241	32.3	222	42	5.3
2013	1,277	277	25.1	1,139	240	35.8	215	41	5.7

The IOU savings goals are from the Decision 04-09060, September 23, 2004.

The aggressive energy efficiency goals set by the CPUC reinforce the importance of this study. The KEMA 2002/2003 Statewide Potential Study (KEMA 2002/2003 study) was the foundation for the energy savings goals, listed in Table 2-5 above. The Itron 2006 Statewide Potential Study (Itron 2006 study) was designed to estimate the remaining energy efficiency potential and to help determine where the most efficient energy savings could be found to meet the CPUC goals. This study is intended to update the inputs to the model and expand the high efficiency measure list to provide a more up-to-date estimate of the remaining energy efficiency potential.

The current study estimates the remaining energy efficiency potential available under current program design and incentive levels. The study calibrates estimates of market potential to the average of the 2004-2005 program year energy efficiency accomplishments, as provided by the IOUs. These program accomplishments represent the energy efficiency savings achieved under the first and second years of CPUC-mandated increases in savings and funding. Calibrating to the average of the 2004 and 2005 accomplishments grounds the study to the current increase in funding and to the relative relationship between the utilities' commercial and residential programs. Using the average of the 2004 and 2005 program year accomplishments helps to ensure that the study results are not influenced by the "hockey stick" nature of program accomplishment within the commercial, industrial, and new construction sectors.[11]

[11] The 2006 Itron statewide potential study was calibrated to the 2004 program year accomplishments. The 2005 program year accomplishments were not available to be used for the 2006 study. Given the significant increase in commercial, industrial, and new construction accomplishments in 2005, the current study may more accurately reflect the market savings potential in these sectors when compared to the 2006 study.

The current study has benefited from recent statewide studies in both the residential and commercial sectors. This analysis uses data from the California Statewide Residential Appliance Saturation Survey (RASS) (2004) and the 2005 update to the RASS,[12] Commercial End-Use Survey (2006),[13] Database for Energy Efficiency Resources (DEER) (2005),[14] Avoided Costs and Externality Adders (2006), IOU 2004-2005 quarterly filings, and forecasts of housing stock and commercial building floorspace provided by the CEC. The recent statewide studies provided the latest input data on technology saturations, savings impacts, and avoided costs. Recent information on technology saturations is crucial when analyzing the remaining potential in sectors with mature energy efficiency programs.

This report also presents market potential estimates that increase both the number of measures incentivized and the levels of incentives. Incentive levels analyzed include setting incentives equal to full incremental measure costs (Full cost analysis) and to the average of current incentives and full incremental costs (Mid scenario-level incentives). The measures added to the Full cost and Mid scenario analyses were chosen by the project team after analyzing previous program accomplishments, past potential studies, the 2005 DEER, and through discussion with IOU representatives on future program plans. The measure-augmented Full incremental cost and Mid scenario results represented an estimate of potential savings associated with programs as they could be designed.

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[12] KEMA-Xenergy, Inc. *California Statewide Residential Appliance Saturation Study.* Prepared for the California Energy Commission. June 2004.

[13] Itron, Inc. *California Commercial Energy Use Survey.* CEC-400-2006-005. Prepared for the California Energy Commission. March 2006.

[14] Itron, Inc. *2005 DEER (Database for Energy Efficient Resources) Update Study.* Prepared for the California Energy Commission. August 2005.

3

Approach and Key Assumptions

This section describes the approach and key assumptions used in the potential analysis. In addition, key issues relevant to the analysis are discussed and comparisons are made between this study (Itron 2008 study), the 2006 Itron potential study (Itron 2006 study), and the 2002/2003 KEMA-Xenergy potential study (KEMA 2002/2003 study). The comparison of key assumptions helps to focus attention on the factors that influenced the three research efforts.

3.1 Overview of Approach

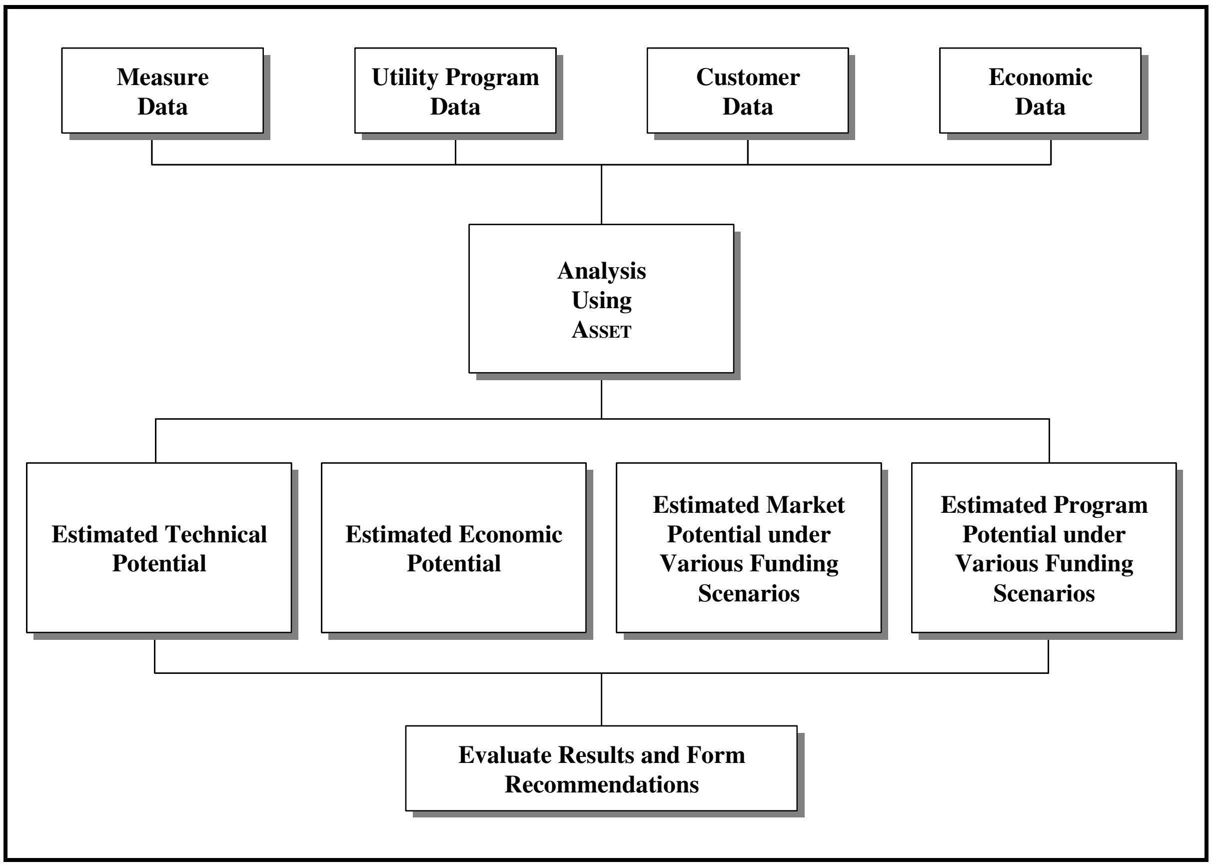
The overall approach involved the following seven general steps, each of which is described in more detail below.

- Collect and develop input data for the model,
- Estimate technical potential,
- Estimate economic potential,
- Estimate market potential under different incentive funding scenarios,
- Estimate program potential under different program restriction scenarios,
- Estimate naturally occurring potential under the assumption that incentives are not available, and
- Evaluate results and develop recommendations.

The market, program, and naturally occurring potential estimates are the most important results from this study. Estimating technical and economic potential can provide important information with which to bind a discussion of society's theoretical possibilities, but the goal of the study is to better understand the remaining market, program, and naturally occurring potential. The study's focus is to determine the influence of alternative funding scenarios and program restrictions on measure adoption, total savings, and cost-effectiveness over time. This information will be used by the utilities to better design their programs, by the CPUC to inform the goals-setting process, and by the California Energy Commission (CEC) to better understand the costs of reducing energy usage and greenhouse gas emissions using energy efficiency measures under alternative program scenarios.

Figure 3-1 illustrates the relationship of the seven tasks listed previously. While the figure implies that the process flows smoothly from top to bottom, the analysis using ASSET is an iterative process. The simulation of the market and program potential with current utility programs may take multiple rounds to calibrate. The findings from the market and program potential may lead to various funding and program restriction scenario simulations. The relationship between naturally occurring, program, and market potential may lead to parameter adjustments and multiple simulations to ensure that their relationships reflect the current understanding of the implied net-to-gross ratios. Once the market and program potential is forecast, the findings from the naturally occurring, program, market, economic, and/or technical potential forecast may influence which measures policy makers decide to retain in their programs, the incentive to be implemented, and the program restrictions to be applied to specific measures.

Figure 3-1: Overview of Study Approach



3.2 Estimating Technical Potential

Technical potential is a measure of where installation of an energy-efficient measure is considered applicable and feasible regardless of cost or acceptability to the customer. Technical potential is a theoretical construct of the technical upper bound of potential; it does not reflect a level of potential that is achievable through voluntary energy efficiency programs.[1] Applicability limits installation to situations where a qualifying end use or technology is present (e.g., water heater blankets for electric water heaters require an electric water heater to be present). Feasibility limits installation to situations where installation is physically practical (e.g., available space, noise considerations, and lighting level requirements are considered, among other things).

The installation time in this analysis is treated differently for retrofit and conversions versus replace-on-burnout situations. For retrofit and conversion situations, the model specifies the installation during the first year of the simulation. For replace-on-burnout situations, the model specifies the installation as the old measure requires replacement.

Technical potential was calculated as follows:

$$TP_{res} = \sum_i \left(Sav_i \times App_i \times Fes_i\right)$$

where

TP_{res} = technical potential
Sav_i = estimated energy savings for measure *i*
App_i = applicability factor for measure *i*
Fes_i = feasibility factor for measure *i*

3.3 Estimating Economic Potential

Economic potential includes the further consideration of measure costs. Economic potential is the modeling simulation in which the most efficient technology option that is cost-effective is selected, subject to applicability and feasibility.[2] Avoided costs and measure costs were used to conduct a total resource cost (TRC) test to determine economic potential from a

---

1 Given that technical potential is a theoretical construct representing the maximum level of feasible and applicable potential it is not associated with a program funding or program accomplishment level. The lack of program applicability to technical potential implies that technical potential does not break into program and naturally occurring potential, technical potential is gross savings potential.

2 Economic potential is a theoretical construct representing the maximum level of feasible and applicable potential. It is not associated with a program funding level. Economic potential is gross savings potential.

societal perspective.[3] Technically feasible installations that pass the TRC test are included in economic potential.

The measure cost used is the *full cost* (full incremental cost). For a conversion or retrofit measure, the incremental cost is the full installation cost of the measure including the labor cost to install it. For a replace-on-burnout measure, the incremental cost is the difference in equipment cost from the base measure to the high efficiency measure. Labor installation costs are not included in incremental costs for replace-on-burnout measures.[4] For residential and commercial compact fluorescent lamp (CFL) screw-in lights, a negative maintenance cost associated with longer CFL lifetimes is included in incremental costs.[5]

The TRC test was calculated as follows:[6]

$$TRC = \sum_{1}^{N} \frac{\text{avoided cost}}{\text{measure cost}}$$

A measure passed the TRC test if the test exceeded one.

Using the TRC test, economic potential was calculated as follows:

$$EP_{res} = \sum_{i} \left(Sav_i \times App_i \times Fes_i \times B_i \right)$$

where

EP_{res} = economic potential
Sav_i = estimated energy savings for measure *i*
App_i = applicability factor for measure *i*
Fes_i = feasibility factor for measure *i*
B_i = binary variable indicating that measure i passed the TRC test

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3 Note that this is the same economic cost-effectiveness test used in the KEMA 2002/2003 study and the Itron 2006 study. Program costs are excluded from the analysis when determining economic potential. It is not possible to determine the program costs that would be necessary to reach the economic potential.

4 For replace-on-burnout measures, the labor costs are assumed neutral or the same for both the low and the high efficiency technology, leading to no increase in the incremental cost of the high efficiency measure.

5 The negative maintenance cost for CFLs simplified the calculation of payback for lighting measures with different lifetimes. The maintenance cost represents the yearly cost of incandescent not purchased during the extended life of the CFL.

6 The TRC calculation for economic potential does not include program cost. While calculating the program potential, there are no assumptions about program costs because there are no voluntary programs actually running. The economic potential is a theoretical construct, with no programs, no program costs, and no market barriers.

Like technical potential, economic potential is also a theoretical construct. Potential studies will often find a very close relationship between economic and technical potential, and the similarity is largely due to the pre-screening of the measures analyzed in potential studies. The construction of the measure list often begins with those measures currently incentivized by the utility, which are commonly restricted to measures that are cost-effective or nearly cost-effective. As with technical potential, the quantity or level of economic potential does not reflect the market barriers and customer adoption behavior that influence the level of potential available through voluntary market energy efficiency programs. For these reasons, economic and technical potential are not good measures to use when determining appropriate levels of market savings potential.

The calculation of the measure-level TRC used to determine economic potential does not include program costs. The economic potential determines the cost-effective applicable and feasible potential. The economic potential, however, is not determined while actually running a voluntary program. Due to theoretical nature of economic potential, there are no program costs included in the economic TRC. If a voluntary program was designed to attempt to capture the economic potential, it is likely that the program costs would be substantial. Adding the program costs to the calculation of the measure-level TRC would reduce each measure's TRC and would likely lead to a reduction in what would be the cost-effective potential, even if there were no market barriers.

3.4 Estimating Market and Program Potential

Market potential relates to the impact that can be expected to occur in the market place within a specified period and with a specified level of utility program activity. It takes into account a variety of factors such as customer cost-effectiveness, payback period, awareness and willingness to adopt (which in turn depends on various market barriers like risk perceptions, split incentives, limited rationality, etc.). To estimate market potential, the ASSET model estimates market outcomes under alternative market conditions, program configurations, and program restrictions. The model also incorporates barriers to technology adoption due to information costs, technology awareness, and customer perceptions about technology performance.

Program potential is the impact that can be expected to occur within a specified period due to a given level of program activity. The program and market potential may diverge due to program eligibility tests. The ASSET model also allows the user to impose program restrictions or program eligibility screening tests on individual measures. The screening rules can have fixed values (e.g., 1.0 implies that a technology passes the screen and 0.0 implies that it fails) or they can have expressions based on the cost and benefit variables constructed from technology and avoided cost data. If the rules are defined based on costs and benefits, they can be used to implement on-the-fly cost-effectiveness screening. When a program eligibility test is implemented, a measure that is ineligible for a program incentive will have no first-year program potential, but may still be purchased in the market and may therefore have market potential. The program savings will not accumulate for ineligible measures, while the measure will continue to accumulate market savings based on adoption models that use a non-incentivized utility program.

TRC restrictions for program eligibility can be user-specified at a predetermined, user specified TRC value. Program restrictions can allow measures that are slightly non-cost-effective (TRC > 0.85, for example) to be included in the program, or the user can choose to restrict the portfolio of measures to those that are cost-effective (TRC > 1). If all measures within the portfolio are required to be cost-effective, then the economic potential will always be greater than the program potential.[7] Given market barriers and the lack of program cost in the determination of economic potential, the cost-effective market potential will never equal the economic potential. Alternatively, if non-cost-effective measures are eligible for program incentives, it is possible for program and market potential to exceed economic potential.

Program eligibility restrictions within ASSET may also limit a measure's eligibility for a utility rebate at the end of the measure's live, or during the re-purchase decision. If the utility program does not allow customers to re-apply for rebates at the end of the measure's life, this restriction can be modeled within the ASSET framework using the auto replacement without incentive option. Assuming automatic replacement continues, the market potential augments the naturally occurring potential so that the net potential of automatic replacement is zero. With the automatic replacement of a measure, the customer does not receive a rebate; therefore, there is no first-year program potential.

3.5 Naturally Occurring Potential

Naturally occurring potential is the savings estimate associated with high efficiency adoptions that occur due to natural or normal market forces within a utility program. It takes into account a variety of factors such as customer cost-effectiveness, payback period, awareness, and willingness to adopt (which in turn depends on various market barriers such as risk perceptions, limited rationality, etc.). To estimate naturally occurring potential, the ASSET model estimates market outcomes under alternative market conditions, assuming that utility incentives are not available. The model incorporates barriers to technology adoption

7 If only cost-effective measures are eligible for a utility incentive, it is likely that the economic potential will also exceed the gross market potential. The market gross savings will include measures that are not cost-effective, but customers adopting these measures will not receive a utility incentive. The lack of incentive will lead to few adoptions for non-cost-effective measures.

due to information costs, technology awareness, and customer perceptions about technology performance.

Figure 3-2 illustrates the relationship between technical, economic, TRC-restricted market, and naturally occurring potential. The naturally occurring potential will be a subset of the restricted market potential. If the utility programs are limited to measures with a TRC greater than 1, the program potential will be a subset of the economic potential.[8] If utility programs are limited to measures with a TRC greater than 1, the total restricted market potential will likely be a subset of economic potential.[9] In California, however, the utility portfolio is required to be cost-effective but this is not required for the individual measures included in the portfolio. For non-cost-effective measures in the portfolio, market potential may exceed economic potential. Given the existence of non-cost-effective measures in the portfolio, it is possible that at extremely high rebates, the market potential can exceed the economic potential for a sector or for the utility.

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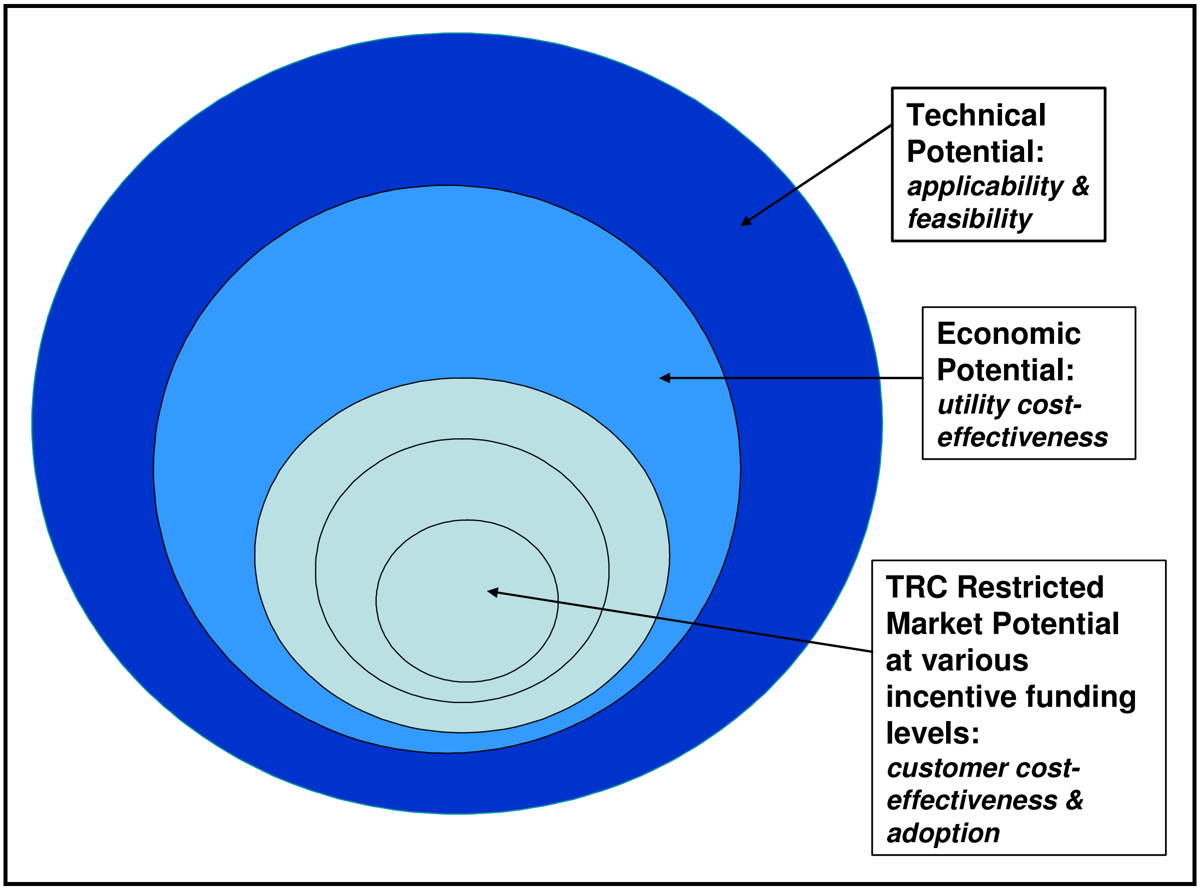
[8] Program potential is not included in the figure in order to limit the depicted potential and to restrict clutter. If the program offerings are not limited by TRC restrictions or automatic replacement assumptions, the program potential will equal the market potential.

[9] Individual measures within a TRC restricted market potential will have gross market potential exceeding their economic potential since non-cost-effective measures will still be available to and adopted by individual consumers. The total adoption of non-cost-effective measures without a utility rebate, however, is likely to be very small. Given other market barriers to adoption, the total TRC restricted market potential will be less than the total economic potential.

Figure 3-2: Relationship of Technical, Economic, and Market Potential



3.5.1 Modeling Adoption

ASSET uses models of adoption behavior to estimate adoption rates over time. These models incorporate estimates of awareness and willingness that change over time. Furthermore, the model includes control shares derived from the percentage of adopters reported for utility programs as an average across the 2004-2005 program years.[10] Using control shares to start the model at the average of the program accomplishments across the 2004-2005 program years calibrates the model estimates to current program activity.

As part of the forecasting process, the model's first year of energy adoptions are calibrated to the reported measure adoptions (called control shares in ASSET).[11] In some cases, this calibration process resulted in estimated energy savings that differ sharply from those

10 Note that in the KEMA 2002/2003 study, the model adoptions were calibrated to the average of program adoptions from 1996 to 2000. For the Itron 2006 study, the model adoptions were calibrated to the 2004 program accomplishments

11 The first year of energy savings modeled for this analysis was 2005. The first year of energy savings reported in the study was 2007. The first modeling year reflects the calibration years while the first year of reported savings was determined by the PAG.

reported by the IOUs.[12] This occurred either because 1) utility-reported per-unit or per-measure savings were different across utilities, or 2) utility-reported savings were different from DEER estimated savings.[13] In addition, utilities differed on whether adoptions were due to retrofit or replace-on-burnout. This assumption affected the resulting savings; retrofit adoptions generally claim higher savings given that the base case is the existing appliance.

3.5.2 Funding Scenarios

Three funding scenarios were examined. First, the current (Base) level of incentive funding for IOU energy efficiency programs in the 2004 to 2005 program years was considered. Second, a Full incremental cost funding level was analyzed in which the full incremental cost of measures was incentivized.[14] Third, an average or Mid scenario was analyzed in which the incentive funding level was the average of the current level and the measure's full incremental cost.

Each of the three funding scenarios is associated with a growth rate in customer awareness of energy efficiency measures. In general, the current incentive or Base scenario assumes that awareness grows at 3% per year, the Mid scenario assumes a growth rate of 4.5% per year, while the Full incremental cost scenario uses a 6% growth rate. The increase in the growth rate of awareness is tied to the assumption that increases in program marketing will accompany increase in incentives.

In addition to the three base funding scenarios, an additional full incentive funding scenario was analyzed. For this scenario, the incentives were increased gradually to full incentives. In 2005 and 2006 the incentives were set equal to 2005 and 2006 incentive levels; in 2007 the incentives were weighted 75% to actual 2006 levels and 25% to full incremental costs; in 2008 the incentives were equal to the mid or average levels; in 2009 the incentives were weighted 25% to actual 2006 levels and 75% to full incremental costs; and in 2010 the incentives were set to full incremental costs. This funding scenario is called the Full Gradual scenario and is intended to represent a more realistic ramp-up to full incentives than the instantaneous jump from current to full incentives.

3.5.3 Program Cost-Effectiveness Restriction Scenarios

Each of the three original funding scenarios was also estimated using a measure-level cost-effectiveness screen. Measures with a TRC less than 0.85 were not eligible to receive a

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[12] The calibration process does not explicitly include the energy savings potential associated with low income programs. The low income population, however, is included in the housing counts and in the calibration of all residential programs as this population participates in the general residential energy efficiency programs.

[13] Itron, Inc. *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study: Final Report.* Prepared for Southern California Edison. December 2005.

[14] Note: if current incentives exceed the full incremental cost, incentives were maintained at the current level.

utility incentive.[15] Measures with TRCs that jump above and below this level received an incentive in those years for which their TRC > 0.85 and did not receive an incentive in years for which their TRC is below the restriction.

Measures that do not pass the TRC restriction are not eligible for utility rebates. For measures ineligible for the utility rebates, there are no program adoptions and no first-year program potential. The measures are still available in the marketplace, however, and there will be market adoptions and gross market savings. The market adoptions and savings for program-ineligible measures are likely to be small due to the longer payback period associated with the loss of the program rebate.

3.5.4 Higher Naturally Occurring Scenario

The continuous implementation of utility programs has increased the public's awareness of high efficiency measures. The gradual increase in public awareness can lead to a higher level of naturally occurring potential and a lower net-to-gross ratio. To simulate the effect of higher levels of general knowledge, a scenario was analyzed in which public awareness grew at a faster rate than in the base assumptions. The faster growth in awareness leads to both a higher current market forecast and a higher naturally occurring forecast. This estimate of potential is called the Base-Restricted Higher Awareness scenario.

For all scenarios other than the higher awareness scenario, the awareness and willingness levels of the naturally occurring estimates are held constant at their starting values. This is intended to simulate the normal level of market adoptions if there are no utility programs or other media campaigns intended to increase the public's understanding of or willingness to adopt high efficiency measures. The higher naturally occurring scenario simulates the naturally occurring potential as ongoing utility programs are raising awareness and continuous media campaigns are increasing concerns about the effect of energy consumption on global warming.

3.5.5 CFL Lighting Scenario

The California legislature recently passed Assembly Bill 1109 (the Huffman legislation), which requires statewide energy consumption for indoor residential lighting to decline by 50% between 2007 and 2018 and by 25% for indoor and outdoor commercial lighting. In an attempt to provide the IOUs with a quick estimate of the impact of this legislation on their energy efficiency lighting potential, each of these scenarios was calculated without the CFL lighting potential for the existing residential and commercial sectors.

[15] The ASSET model allows the user to determine the TRC value associated with cost-effectiveness screening. The choice of 0.85 was determine in consultation with the PAG.

3.6 Modeling Issues and Key Assumptions

Model design, technology inputs, and utility energy efficiency program accomplishments can significantly influence the estimate of the remaining energy efficiency potential. This sub-section briefly discusses the model and assumptions used in this study, comparing them with those employed in the KEMA 2002/2003 study and the 2006 Itron study.

3.6.1 Use of ASSET

One of the objectives of the current analysis was to ensure that the potential for all sectors (existing residential, commercial and industrial, and all new construction sectors) was estimated within a single energy efficiency model. All sectors analyzed for this study used the ASSET model developed by Itron.[16] For the Itron 2006 study, the existing residential, existing commercial, and all new construction sectors were analyzed using ASSET while the existing industrial sector was analyzed using DSM ASSYST. The KEMA[17] 2002/2003 study used the DSM ASSYST model.

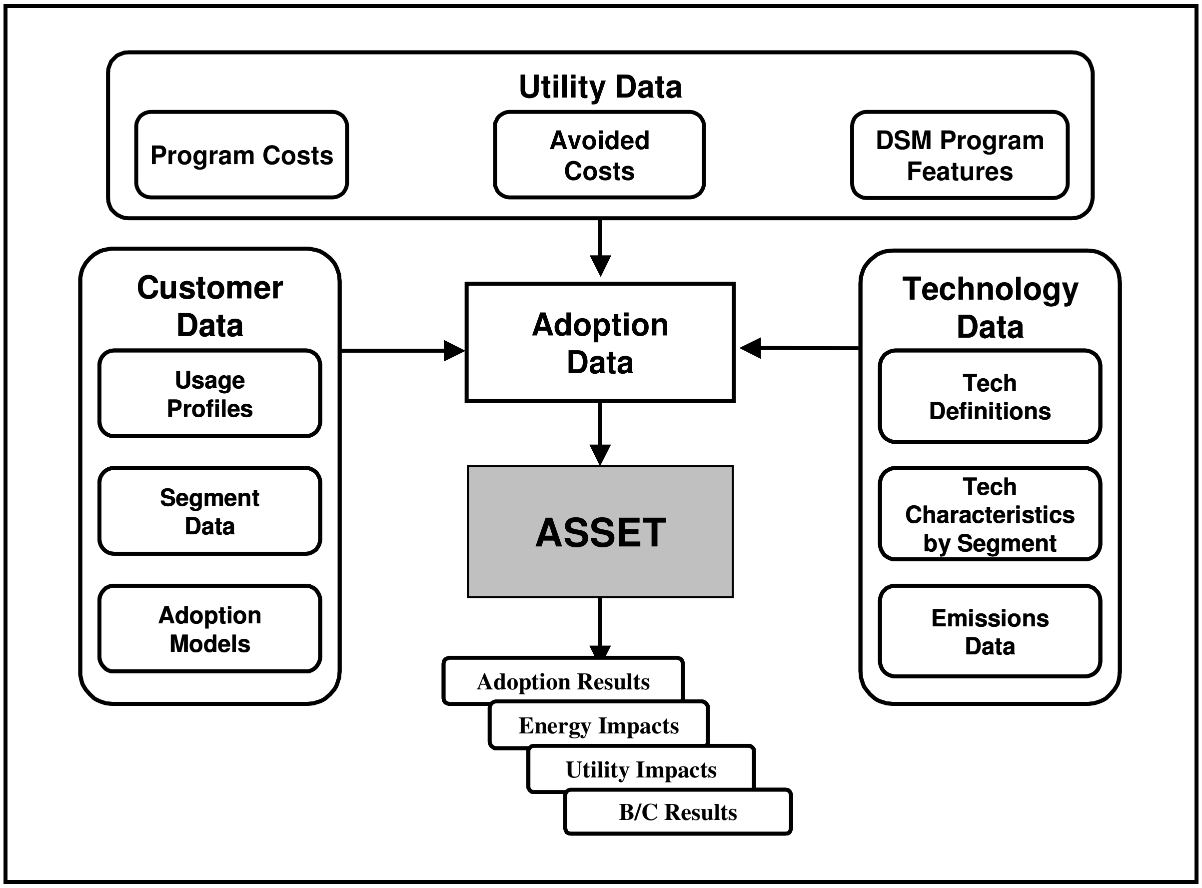
The ASSET model uses a payback-based logit model to characterize customer adoption of energy efficiency measures. DSM ASSYST uses S-shaped implementation curves that relate customer benefit-cost ratios to penetration rates of energy efficiency measures. While these models are based on different economic variables, they each provide the modeler with significant flexibility to associate customer adoptions with customer economics. Both models also require that the modeler have substantial information on costs, savings, and existing technologies.

Figure 3-3 depicts the overall framework of the ASSET model. As shown, the model requires utility data, information on customer characteristics, and technology data. Utility data include utility program costs, avoided costs of energy and demand, and program features. Customer characteristics encompass size (number of homes, floor stock, etc.), load profiles, and various aspects of adoptions-related behavior (awareness, willingness, etc.). Technology features include costs and lifetimes as well as savings associated with applications by specific customer segments. ASSET was developed to estimate DSM measure adoptions and the associated energy and demand savings over a specified forecast period.

[16] The model was developed by Regional Economic Research, Inc. (RER). RER was acquired by Itron in 2003.

[17] Similarly, Xenergy was acquired by KEMA in 2003. .

Figure 3-3: Overview of ASSET Framework



ASSET is designed to yield adoption forecasts for four distinct types of decision states.

- ***New Construction.*** For new construction decisions, adoption models give the fraction of new construction that adopts an option. The adoption rate is the same as the market penetration in new construction. Average saturation levels in the overall stock change as the new units are included in the overall totals.
- ***Replacement on Burnout.*** For replacement decisions, the total decay of all options in a competition group defines market size. In this case, the adoption models give the share of total group replacements for an option. Average saturation levels are impacted if the shares in replacement differ from the shares of total decay in the group.
- ***Equipment Conversion.*** For equipment conversion decisions, existing saturation levels define the size of the conversion market. In this case, the adoption models give the fraction of customers with a specific type of equipment who convert to an alternative option. Saturation levels change because the stock of the base option declines and the stock of the target option increase.
- ***Device Retrofit.*** For retrofit decisions, saturation levels are modeled relative to the fraction of customers who qualify for the specific device. In this sense,

saturation levels define the fraction of the applicable market that already has a measure installed. The adoption rate is a retrofit rate, giving the fraction of the applicable market that installs a device. Device saturation levels change as a direct result of device acquisition.

These distinctions are related to the difference between event-driven and discretionary decisions. In particular, new construction and replace-on-burnout decisions are analyzed using event-driven models, and equipment conversion and device retrofit actions are analyzed using models that account for the discretionary nature of the decisions.

The following are some features of ASSET that make it particularly suitable for use in this study.

- ASSET incorporates both physical barriers to adoption (technology applicability and feasibility) and market barriers to adoption (customer awareness, customer willingness, and supply-side availability) in order to impose realistic limits on market potential estimates.
- ASSET offers a variety of adoption models to estimate market adoption rates based on technology and customer characteristics. Specific modeling frameworks are provided for four different types of decisions: new construction, replacement at time of burnout, equipment conversions, and retrofit actions. Multiple modeling frameworks for the same technology can be implemented simultaneously.
- ASSET incorporates a fully articulated stock accounting system. This system keeps track of the inventory of all base technologies and DSM measures over time, thereby adjusting the remaining potential for adoptions as well as base technology and measure decay. The stock accounting system allows the base technologies to decay and re-enter the forecast.
- ASSET is capable of modeling both binary and multinomial decisions involving technologies. It does this through the definition of competition groups (groups of competing technologies) and the integration of multinomial adoption models.
- ASSET is designed to recognize changes in codes and standards over time. Technologies and/or efficiency levels prohibited by codes/standards in future periods are made unavailable for the purposes of modeling adoptions.
- ASSET allows the user to specify the rate at which energy efficiency measures are replaced in kind at the end of their lifetimes.
- ASSET offers the ability to do "on-the-fly" measure screening. This means that cost-effectiveness tests can be conducted automatically in each forecast period to determine the measures for which interventions will be conducted. This capability allows the recognition of changes in cost-effectiveness stemming from variations in market conditions, alterations in standards, and other factors.

3.6.2 Model Parameters

The ASSET model requires input information on the payback period for the energy efficiency technology and on the influence of payback on the probability of adopting the technology. The pre-existing payback parameters were derived from a residential and commercial market research study conducted for Northern States Power Company (NSP) and the resulting conjoint analysis of these data.[18] The conjoint analysis was designed to assess the tradeoffs that customers make in deciding to replace their existing measures with more efficient technologies. The major purpose of the conjoint analysis was to develop the payback parameters so that they could be used in ASSET technology adoption models.

The payback parameters used for this analysis were a combination of the parameters derived from the NSP conjoint study and adjustments to these parameters that were based on professional experience and available data.[19] The team analyzed the gross and net savings estimates calculated using the NSP parameters and adjusted the parameters in models whose savings estimates were inconsistent with recent and on-going analyses.

The ASSET program uses the measure payback, the payback parameter, and the utility's program accomplishments or quantity of adoptions to calibrate the adoption model for the first year of the program forecast. The payback parameter determines the influence of the economic variable—payback—on achieving the quantity of adoptions. To calibrate the model to the utility's achievements, the ASSET program calculates the impact of non-economic technology attributes that influence the probability of technology adoption—the calibration factor. The non-economic attributes captured by the calibration factor could include the quality of light for a CFL relative to an incandescent, the noise level of a high efficiency appliance relative to existing technology, and the perception of quality for the high efficiency measure relative to existing measures. The non-economic factors captured by the calibration factor are assumed constant over the forecast period.

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[18] These data come from *Northern States Power Company Customer Survey Final Report* prepared by RER and Opinion Dynamics Corporation, March 1995. While the parameter estimates from the conjoint analysis are dated, to the best of our knowledge, this research has not been replicated more recently in California or elsewhere. Increases in energy prices have reduced payback lengths, Middle Eastern conflicts have introduced concerns about the supply of energy, and global warming may have increased concerns about the environment and energy usage; all of these changes may have led to changes in the payback parameter in unexpected and conflicting ways. A new conjoint or double-bounded analysis of the influence of rebate levels on consumer choices would help to reduce the level of uncertainty surrounding these parameters. Alternatively, a time-series analysis of energy efficiency measure adoptions, rebate levels, and measure costs would add to our understanding of the influence of economic variables on energy efficiency measure adoptions.

[19] The Itron 2006 study relied exclusively on the NSP payback parameters. The PAG decided that these parameters should be adjusted for this study to reflect new information relating to adoption behavior.

Forecasts of the market scenario with changing incentive levels are accomplished by changing a measure's payback while leaving the payback parameter and the calibration factor constant. For example, increases in rebate levels will reduce the payback period and increase the probability of adoption. Increases in rebate levels do not change the payback parameter; instead, increases in rebates reduce the length of the payback period. Increases in rebates do not change the non-economic attributes of the technology, nor do they change the calibration factor.

3.6.3 Study Scope

The KEMA 2002/2003 study focused on the electric and natural gas energy efficiency potential in the existing residential and commercial sectors. The Itron 2006 study expanded the previous focus to include both the existing and new construction markets for the residential, commercial, and industrial sectors, and for emerging technologies. The current potential study includes both the new and existing residential, commercial, and industrial sectors and incorporates a limited number of emerging technologies. All three studies have used retrofit and replace-on-burnout models to estimate the remaining potential associated with installation of energy efficiency measures in existing construction. None of the studies addresses the potential associated with customer behavioral changes.

The KEMA 2002/2003 study analyzed the net and gross potential over a 10-year period (2003-2012). The Itron 2006 study assessed the gross energy efficiency potential over a 13-year period (2004-2016). The current Itron 2008 study focuses on the net and gross potential over a 10-year period (2007-2016), while providing information on potential through 2026.

The KEMA 2002/2003 study restricted energy efficiency measures and practices to those that were commercially available in 2002. The Itron 2006 study of current market potential in the existing and new construction sectors restricted the forecast to measures and practices included in the accomplishments reported in the utilities' 2004 quarterly filings. The forecast of market potential under rebates exceeding current rebate levels includes additional commercially available measures. The current study of market potential also focuses on measures included in the accomplishments reported in the IOUs' 2004-2005 quarterly filings. A limited number of additional measures were added to the Full and Mid forecasts to provide an estimate of the potential associated with measures that may be added to the utility portfolios.

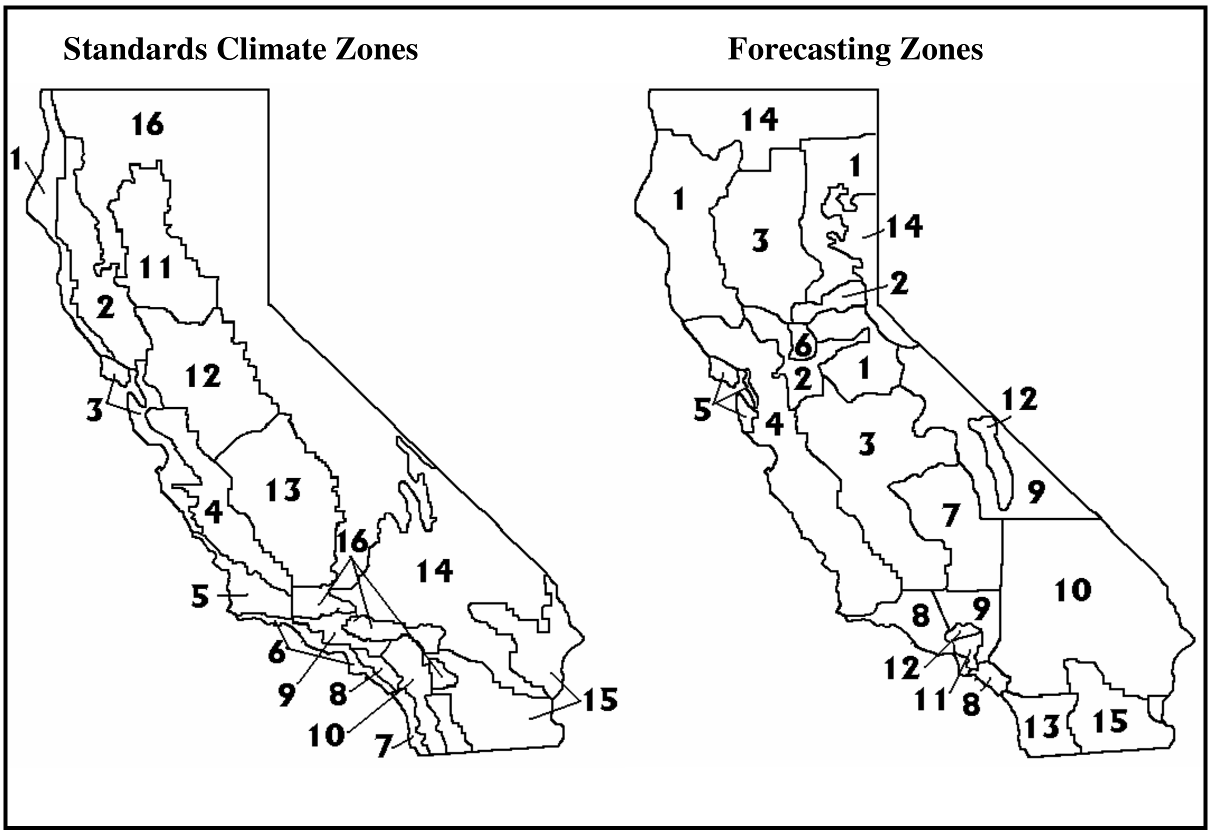
3.6.4 Geographic Scope

While this study is designed to support decision-making with respect to statewide energy efficiency programs, it is by necessity limited partially to the service areas of four IOUs: PG&E, SCE, SCG, and SDG&E.

The KEMA 2002/2003 study presented results by the CEC forecasting weather zones. These are very different from the CEC Title 24 Standards weather zones. These two sets of CEC climate zones are designed to serve two separate purposes, with the Title 24 Standards climate zones providing greater breadth of climate diversity. The forecasting climate zones serve the purpose of disaggregating utility service territory into zones while the Title 24 Standards climate zones are blind to utility service boundaries. Figure 3-4 illustrates the geographic representations of the two sets of CEC zones.

For this study and the Itron 2006 study, the analysis was conducted using CEC Title 24 Standards climate zones. The choice of climate zones was driven by two factors: the availability of other input values and the desire to produce weather-sensitive forecasts intended to assist the program planning process.[20] The disaggregated, weather-sensitive nature of the Standards climate zones provides greater diversity for the impacts of weather-sensitive measures.

Figure 3-4: Comparing Climate Zones



20 The avoided cost forecasts approved for this study were derived by the Standards climate zones. See Energy and Environmental Economics, Inc. *A Forecast of Cost-Effectiveness Avoided Costs and Externality Adders.* Prepared for the California Public Utilities Commission, Energy Division. January 2004.

The analysis requires that results be aggregated to the utility service area even though the CEC Title 24 Standards climate zones are not uniquely associated with utility service areas. Therefore, separate utility-specific analyses were conducted as necessary within a climate zone. In addition to performing analyses by unique climate zone and utility service area, PG&E Climate Zone 3 was split in order to separate PG&E congestion zones. Table 3-1 contains a listing of climate zone to utility service area/congestion zone used for this analysis.

Table 3-1: Title 24 Standards Climate Zone by Utility

	PG&E	SCE	SCG	SDG&E
Climate Zones	CZ1 CZ2 CZ3A CZ3B CZ4 CZ5 CZ11 CZ12 CZ13 CZ16	CZ6 CZ8 CZ9 CZ10 CZ13 CZ14 CZ15 CZ16	CZ4 CZ5 CZ6 CZ8 CZ9 CZ10 CZ13 CZ14 CZ15 CZ16	CZ7 CZ10 CZ14

3.6.5 Development of Scenarios

The KEMA 2002/2003 study analyzed market scenarios with alternative rates and funding levels. The Itron 2006 study assumed rates were constant at the 2004 level, focusing on three alternative funding levels. The current study provides information on 10 alternative scenarios, including three alternative funding levels, a program cost-effectiveness restriction, a gradual funding increase, an increase in naturally occurring potential, and a restriction on lighting potential.

The KEMA 2002/2003 forecast analyzed Low, Base, and High energy cost scenarios. The influence of energy prices on the remaining potential forecast was of particular interest during and immediately following the 2001 energy crisis. The Low energy cost scenario analyzed potential if rates were below their 2001 crisis levels, while the Base case started with the 2001 rates, allowing rates to decline to their pre-crisis level by 2006. The high cost scenario assumed energy prices remained at their 2001 level through out the forecast period.

The funding levels analyzed in the KEMA 2002/2003 study used a base of the average energy efficiency program funding of 1996-2000, the pre-crisis period. The choice of the Base funding level for the 2002/2003 study was predicated on the hypothesis that the high level of funding and conservation behavior during the 2001 crisis was not likely to continue during the post-crisis period. The three additional funding levels analyzed assumed funding increases of 50%, 100%, and a maximum achievable funding level.

The Itron 2006 study analyzed three incentive scenarios. The first entailed running the inputs with the level of incentives and costs relative to the 2004 energy efficiency programs. This "current" level of funding scenario included all energy efficiency measures that the utilities had rebated and claimed program accomplishments for in the 2004 program year. The second and third scenarios included models with full incremental cost and mid-level incentives. These Full and Mid incentive scenarios included all the energy efficiency measures analyzed in the study, including some that were not rebated during the 2004 program year.[21]

The current analysis, like the Itron 2006 study, analyzes the current, Mid, and Full incentive scenarios. The current funding scenario included all energy efficiency measures that the utilities rebated in the 2004-2005 program years. The Full and Mid incentive scenarios increased incentives and the measure list to incorporate possible future higher funding level and expanded measures. The Gradual Full incentive scenario was estimated to reflect a more gradual, possibly more realistic increase in incentives to full incremental costs.

The measures in the current IOU efficiency portfolios are required to pass a TRC test at the portfolio level. In this study, scenarios were analyzed that restrict the measures receiving a utility rebate to those with a TRC of 0.85 or above. This restriction allows measures that are not yet cost-effective to be included in the portfolio, but it works to eliminate from the program-level savings those whose cost-effectiveness is poor enough that they may need to be dropped from the portfolio. Measures that are not eligible to receive a utility incentive will still have market adoptions and market savings associated with their adoption outside the program, but these measures will not have program level-adoptions or savings.

The current analysis also estimated a scenario that examines the influence of increasing general population awareness and willingness to install energy efficiency measures on the forecast of both market and naturally occurring potential. The maturity of energy efficiency programs in California contributes to a significant and growing level of public energy efficiency awareness. The growing level of awareness is likely to lead to an increase in total adoptions of energy efficiency measures but also to a fall in net energy efficiency potential.

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[21] The list of energy efficiency measures included in the analysis was determined by the PAG, in consultation with Itron. This list is largely made up of measures included in the 2004 IOU energy efficiency programs. Not all utilities, however, include all of the measures offered in the programs of the other utilities. In addition, the PAG selected a handful of measures to be included that were not in the 2004 programs. The listed of measures added to the technical, economic, full incremental cost, and average cost scenarios are listed in chapters 4 and 5.

Given that IOU savings goals are based on net savings, this scenario provides an estimate of the impact of increasing market effects on the remaining level of market potential.

3.7 Develop Input Data for the Model

This study required the collection and development of a wide range of information to drive the model. In particular, the following categories of data were developed:

- Energy efficiency measure data,
- Utility program data,
- Customer data, and
- Economic data.

Each category is described briefly below. Appendix B provides a more detailed description of the model inputs.

3.7.1 Energy Efficiency Measure Data

Selecting Measures for the Analysis

One important determinant of the project's general scope is the set of energy efficiency measures to be included in the analysis. On one hand, it is critical for the list to be reasonably comprehensive so that the estimates of energy efficiency potential are meaningful. On the other hand, depending on the specificity of measure definitions, one could identify thousands of distinct measures, many of which would have insignificant potential. Another issue is that the ways of characterizing measures differ across programs, thus making it difficult to develop common definitions and lists.

Fortunately, choosing measures does not need to occur in a vacuum. To some extent, the utilities have already dealt with this issue in other contexts. For instance, the DEER Advisory Committee has approved a common set of significant measures for developing the DEER database. Moreover, various advisory committees have approved measure lists for the previous KEMA 2002/2003 and Itron 2006 studies. While these measure lists are based on somewhat different objectives, they are reasonably consistent with respect to their total coverage. This should not be surprising. The choice of measures for the two previous energy efficiency potential studies were partly based on a review of the old DEER database and the IOU program offerings, and the design of the current DEER database was based partly on a review of the previous potential studies and the IOU energy efficiency program measures. However, it should be noted that the specific measures included in the DEER and potential studies differ with respect to the specificity of measure definitions. Most importantly, the measures included in energy efficiency studies tend to be defined more generally than those contained in the DEER. In general, these studies generalized some measures, ignored others, and added measures not included within the DEER based on utility filings.

To finalize the set of DSM measures to be included in this statewide assessment of energy efficiency potential, the measures included in the Itron 2006 study were reviewed and compared to the measures in the KEMA 2002/2003 study, to those in the IOU 2004, 2005, and 2006 energy efficiency programs, and to measures included within the 2005 DEER. The first review looked for measures included in the previous potential studies that had been dropped from the IOU program offering. As expected, a limited number of measures had been dropped due to changes in codes and standards, the determination that the claimed savings significantly exceeded actual savings, and transformation of the marketplace. The second review looked at the IOU quarterly filings to determine which of the measures added to recent energy efficiency programs and not included in previous potential studies were likely to contribute significantly to the energy savings potential of the utilities. The project teams spent a considerable amount of time reviewing these measures to determine which should be added to this study.

Only energy efficiency measures and practices that provide long-term energy savings were considered for this study. In addition, only installable measures and practices (as opposed to energy conservation behaviors) were included in the analysis.

Table 3-2 presents the end uses included in the existing residential, commercial, and industrial analyses. Appendix A provides more detail about and a complete list of the individual measures installed in the existing construction sectors. The study analyzed 66 measures in the existing residential sector, 100 measures in the existing commercial sector, 161 measures in the existing industrial sector, two levels of residential and commercial new construction packages, and 41 individual high efficiency measures and two levels of high efficiency packages in the industrial new construction sector. Appendix E, F, and G provide more detail about the residential and commercial new construction packages and the industrial new construction measures.

Table 3-2: End Uses Included in Analysis

End Use	Description
Residential Electric	
HVAC	High efficiency central and room air conditioners, heat pumps, whole house fans, windows, infiltration control and attic and wall insulation
Lighting	Compact fluorescent lamps and hardwired fixtures, LED exit signs, occupancy sensors, photocells, T8 linear fluorescents, and torchieres
Water Heating	Water heaters, low-flow showerheads, faucet aerators, high efficiency clothes washers, dishwashers, and pipe wrap
Miscellaneous	One- and two speed pool pumps, high efficiency refrigerators and refrigerator and freezer recycling[22]
Residential Gas	
HVAC	High efficiency gas furnace, attic and window insulation, infiltration control, and duct repair
Water Heating	Water heaters, low-flow showerheads, faucet aerators, pipe wrap, clothes washers, and dishwashers
Commercial Electric	
HVAC	High efficiency air conditioning, chillers, chiller tune-up, motors, and DX tune-up
Lighting	Compact and efficient linear fluorescent lamps and hardwired fixtures, HIDs and metal halides, LED exist signs, time clocks, occupancy sensors, and photocells
Refrigeration	Controls, infiltration barriers, compressors, fan motors, and night covers
Food	Holding cabinet, steamer, high efficiency ovens
Miscellaneous	Copy machines, high efficiency computers, and vending machine controls.
Commercial Gas	
HVAC	Boilers and high efficiency furnaces
Food	High efficiency steamers, ovens and fryers
Miscellaneous	High efficiency water heating boilers, water heaters, and pool heaters
Industrial Electric	
Compressed Air	High efficiency compressed air controls, system optimizing, O&M, ASDs, and high efficiency motors
Fans	High efficiency fan controls, system optimizing, O&M, ASDs, and high efficiency motors
Drives	Optimizing, efficient printing drives, efficient drive controls, and ASD
Pumps	Controls, efficient optimizing, V-belts, O&M and pump motors
Lighting	Efficient linear fluorescents, CFLs, lighting sensors, and metal halides
Cooling	High efficiency air conditioning, chillers, tune-ups, window film, and cool roofs
Process	Controls, efficient desalters ,O&M, and transformers
Heating	Transformers, efficient scheduling and optimizing
Refrigeration	Efficient refrigeration, optimization, and controls
Miscellaneous	V-belts, membranes, and transformers
Industrial Gas	
HVAC	High efficiency boiler, insulation, heat exchanger, ducts, and EMS
Boiler	Improved process control, economizer, steam heat recovery, burner efficiency and leak repair
Process	Controls, heat recovery, efficient burners, efficient drying, and hoods

[22] During the early period of the forecast period, the two-speed pool pump becomes the base measure. Once the two-speed pool pump becomes the base measure, there are no high efficiency pool pumps included in the study.

Measure Characteristics

The model uses a number of other measure characteristics. A detailed measure list for the existing residential, commercial, and industrial sectors is provided in Appendix A. Details of the input measure characteristics used in this study are described in Appendix C. and the input databases for the existing residential, commercial, and industrial measures are available. Details of the output values are described in Appendix D and the output databases are available.

Technology Definitions. A set of technology definitions, in terms of various measure characteristics, was constructed. This included volumes (e.g., R-values), efficiencies (e.g., SEERs), sizes (e.g., lamp lengths), and other factors. Technologies were assigned to end uses for the purpose of summarization.

Measure Impacts and Costs. The DEER was the primary source of information for efficiency measure impacts and costs for all three statewide potential studies. This information was supplemented by other sources, such as utility submittals, where necessary.

The non-weather-sensitive portion of the DEER was updated after the KEMA 2002/2003 study. The DEER update included identification of the most currently available information on measure impacts and costs.[23] The measure impacts for residential lighting significantly changed between the 2001 and the 2005 DEER. Changes to residential lighting include a reduction in the assumed run hours and a change in the incandescent to CFL wattage specifications.[24]

Itron used the updated information where possible and obtained the IOUs' 2005 EE annual reports that described the utility DSM programs, measures, and assumptions. These utility filings were the primary source of measure impact and cost information after the DEER.

Measure Lifetimes. Measure lifetimes include the minimum lifetime, maximum lifetime, and the minimum conversion time for each measure.[25] The CPUC Policy Manual was the primary source of measure lifetime information used in all three studies. Several estimates of measure life have changed since the KEMA 2002/2003 study based on measurement and evaluation studies sponsored by the California Measurement Advisory Council (CALMAC). When found, these updated measure life estimates were used for this study. For residential CFLs, lifetimes were based on recent reviews of the technical literature.

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[23] Itron, Inc. *2004-2005 DEER,* op. cit.

[24] Ibid. Section 2.1.

[25] The minimum conversion time represents the minimum time before a customer who had just purchased a lower efficiency technology would consider purchasing a higher efficiency technology for the same measure.

Technical Feasibility. The technical feasibility of a measure refers to the percentage of households or commercial floorstock that could transform to a high efficiency technology. For residential lighting measures, this study used values taken from the recent California Residential New Construction study.[26] For other measures, the values were derived from professional judgment of the evaluators.

Applicability. For non-retrofit measures, this binary variable indicates whether a particular measure is applicable for a particular housing or building type (for example, exit signs are not applicable for a single family home). The model often dictates the value of applicability. For example, for replace-on-burnout measures, the applicability must be "1" if all measures are to be replaced with either a low or a high efficiency measure on burnout. For retrofit measures, this variable limits the size of the market to the percentage of homes or businesses with the qualifying equipment or configuration. Usually this fraction depends on technology and/or fuel type shares. Most of the applicability values for residential retrofit measures were derived from the RASS data while the commercial retrofit applicability values were derived from the CEUS data and the industrial retrofit applicability values were derived from research done by LBNL.

Availability. Both market and legal availability were specified for all measures.

The KEMA 2002/2003 study, Itron 2006 study, and this potential study used information on the latest availability and standards. This analysis incorporated several changes in standards that occurred between these reports. Changes in federal and state standards, which mandate improvements in the energy efficiency level of commercially available technologies, lead to reductions in the remaining market, economic, and technical energy efficiency potential.

Changes in federal standards incorporated in the Itron 2006 study include an increase in the base efficiency level for residential central air conditioners and heat pumps. SEER 10 measures are assumed to be commercially available until 2006, when the base technology changes from SEER 10 to SEER 13. New federal National Appliance Energy Conservation Act Standards (NAECA) for refrigerators increased the base efficiency by approximately 30% and reduced the savings per clothes washer by approximately 50%. Federal standards also increased the base efficiency for residential and commercial gas and electric water

[26] Values for screw-in CFLs were taken from the California Residential New Construction Study. Values for hardwired CFLs were derived as a percentage of the values for screw-in CFLs. See Itron, Inc. *Residential New Construction Baseline Study of Building Characteristics - Homes Built After 2001 Codes.* Prepared for Pacific Gas and Electric. August 2004.

heaters. In addition, the Energy Policy Act increased the base efficiency for commercial motors, leading to a cut in claimed savings of approximately 50%.[27]

This study incorporated the changes in standards included in the Itron 2006 study, while including updated changes in federal standards. Base and one-speed pool pumps are assumed to be commercially available until 2006, when the base technology changes from the base pool pump to the two-speed pool pump. This code change eliminates high efficiency pool pump measures. New federal clothes washer standards also increased the base efficiency for residential clothes washers, changing the base technology from an MEF of 1.04 to 1.26.

While it is likely that codes and standards will change over the life of the forecast, no assumptions were made about future codes and standards that have not yet been defined. The scenario that eliminates the energy savings potential associated with CFLs, however, attempts to illustrate the potential associated with legislation requiring a significant increase in residential and commercial lighting efficiency.

Base Shares. This variable represents the percentage of households that have the particular technology. Both the Itron 2006 study's and the current study's base share data benefited from the recent RASS and CEUS studies.

For the Itron 2006 study, residential lighting measures base share values were obtained from the California Residential Market Share Tracking study (RMST).[28] For the current study, residential lighting base share values were derived from a combination of the RMST and the California Lighting and Appliance Saturation Survey (CLASS).[29] For non-lighting measures, both the Itron 2006 study and the current study developed base share values from the RASS study (2004) where available.[30] For some measures, the RASS data are not a good source for base shares of high efficiency technology. In these cases, the values were amended using the evaluators' professional judgment.

For commercial measures, both the Itron 2006 study and the current study obtained base share values from the CEUS study (2006). The commercial lighting measure base share information available from the CEUS study was a significant improvement from the KEMA

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27 Information on changes in standards and energy savings are from Itron *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study: Final Report.* Prepared for Southern California Edison. December 2005.

28 Itron, Inc. *California Lamp Report 2004.* Prepared for Southern California Edison. June 15, 2005.

29 RLW Analytics. *2005 California Statewide Lighting and Appliance Efficiency Saturation Survey*. Prepared for California's IOUs. August 23, 2005.

30 KEMA-Xenergy, Inc. *California Statewide Residential Appliance Saturation Study.* Prepared for the California Energy Commission. June 2004.

2002/2003 study where the existing saturation of high efficiency lighting was a matter of relative uncertainty.[31]

The KEMA 2002/2003 study used the most recent, available data to determine base share values. Data sources included the 1997 California Baseline Lighting Efficiency Technology Report, the Statewide Survey of Multifamily Common Area Buildings (2000), utility-specific commercial end-use surveys for 1992 to 1998, DEER (2001), IOU quarterly filings from 1996–2000, and CEC forecasts of saturations.[32,33]

Intensities. For retrofit measures, the intensity is the energy savings associated with retrofitting the house or commercial building. For replace-on-burnout and conversion measures, the values were derived as the difference between the usage of low and high efficiency measures. In most cases, all three studies have used savings values taken from the DEER. Given the timing of the studies, different vintages of the DEER were used, with each study employing the version that was most recently available during its time.

The 2002/2003 KEMA studies and the current potential study have used interactive multipliers to reduce the intensities or savings associated with the installation of multiple measures within the HVAC, refrigeration, and water heating end uses. The interactive multipliers assume that customers install measures sequentially from those with the lowest TRC value to the highest TRC value. The installation of the first measure works to reduce the end-use usage. The installation of measures thereafter continues to lead to reduction in the end-use UECs and EUIs, leaving less energy usage to be eliminated with the installation of additional measures. The Itron 2006 study did not use interactive multipliers.

Technology Density. All three statewide forecasts have employed the most recent data on technology density. Technology density represents the number of installed units per household for residential measures. For commercial measures, this variable usually represents the number of units per thousand square feet of conditioned space. For industrial measures, this variable is usually one, reflecting the number of units per kWh.

The KEMA 2002/2003 forecast used data from multiple sources that included the 1997 California Baseline Lighting Efficiency Technology Report, the Statewide Survey of Multifamily Common Area Buildings (2000), and utility-specific commercial end-use surveys for 1992 to 1998.

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[31] Xenergy, Inc. *California Statewide Commercial Energy Efficiency Potential Study.* July 2002. See page A-15.

[32] Xenergy, Inc. *2001 DEER (Database for Energy Efficient Resources) Update Study.* Prepared for the California Energy Commission. August 2001.

[33] Xenergy, op. cit., July 2002 and KEMA-Xenergy, op. cit., April 2003.

For this study and the Itron 2006 analysis, the commercial sector estimates of technology densities were extracted from the recent CEC-sponsored California Statewide CEUS database. This database provided recent statewide data gathered from an in-depth on-site survey of commercial building equipment and characteristics. For the residential sector, both studies developed values of saturations and technology densities largely from the 2004 RASS database. The current study also used the 2005 CLASS database to develop residential lighting saturations and technology densities.

Automatic Replacement Fractions. ASSET allows for the use of assumptions with respect to the automatic replacement of technologies in kind. Assumptions concerning automatic replacement-in-kind fractions were used sparingly in the residential and commercial sectors and were based on the professional judgment of the evaluators. In the residential and commercial sectors auto replacement was restricted to high efficiency lighting fixtures. Lighting fixtures for the residential and commercial sectors include linear fluorescent change-outs from T12 to T8s and pin-based CFL fixtures. Automatic replacement-in-kind fractions were employed throughout the industrial sector. Using automatic replacement within the industrial sector reflects the larger nature of these projects and current limitations on rebated re-installs within projects of this size.

Automatic replacement in-kind assumes that the high efficiency is automatically replaced with the high efficiency measure and that the replacement does not receive a utility rebate. The automatic replacement has the effect of continuing or maintaining the gross market potential. Because the replacement occurs without a utility rebate, the naturally occurring potential will rise with the replacement to ensure that the net potential from the replacement is zero. The automatic replacement does not generate first-year program potential because the replacement occurred without a utility rebate.

Residential New Construction. For the residential sector, new construction values of saturations and technology densities were developed from the Residential New Construction Survey database. The current study directly used the data developed for the 2006 statewide potential study. A description of the development of the new construction packages is available in Appendix E.

Market Barriers. Market barriers to adoption include, but are not limited to, customers' understanding of the savings possibilities and the measure characteristics, vendors' knowledge of the measure and willingness to stock the measures, and customers' inertia or buying patterns that are hard to change. In the ASSET model, these barriers are characterized in terms of two key inputs: awareness and willingness. Willingness essentially summarizes all non-awareness barriers. Itron identified baseline estimates of willingness and awareness at the technology level using professional judgment and a review of information on high efficiency base shares.

For the 2006 analysis, the values of awareness and willingness typically start at a relatively high level (60 to 100%) and were assumed to grow at a rate of 2% per year. The willingness and awareness values for the 2006 analysis grow at a rate of 2% for all market scenario analysis. For the current study, the awareness and willingness values were re-evaluated. Given the utilities' recent emphasis on high efficiency lighting, typical starting values for these measures are relatively high (60 to 80%) and were assumed to grow at a rate of 3% per year for the current incentive market scenario. The typical starting values for many of the other measures were often slightly lower than the values used for lighting; these values were also assumed to grow at a rate of 3% per year for the current incentive scenario. The willingness and awareness values for the current study grew at a rate of 4.5% for the Mid incentive market scenario and at a rate of 6% for the Full incentive scenario.

The KEMA 2002/2003 study used an awareness variable within the DSM ASSYST model, with the baseline value based on professional judgment. The awareness variable used in the 2002/2003 study is not directly comparable to the awareness and willingness variables used in the ASSET analyses. The ASSYST value of awareness applies only to the fraction of the population that does not currently own the high efficiency measure, while the ASSET awareness and willingness variables apply to all the whole population. The baseline value used in the 2002/2003 study was 25%, regardless of efficiency measure, fuel type, or sector. The growth of awareness over time was dependent on the utility administrative and advertising budget. In the 2002/2003 study, increases in rebate levels are associated with increases in advertising and administrative budgets, leading to faster growth in awareness as rebate levels increase.

While the baseline awareness values used in DSM ASSYST are generally much lower than those used in ASSET, the populations to which these values are applied differ dramatically. If a measure has an initial high efficiency measure saturation of 50% and the 2002/2003 study assumes that awareness is 25%, it assumes that 62.5% of the total population is aware. This is the same as the ASSET studies assuming that the original level of awareness and willingness was 62.5%. Given the differing definitions of awareness, it is not clear how the initial values for this variable, or the differing growth assumptions, influence the differences in the 2002/2003 study and the current analysis.

3.7.2 Utility Program Data

Avoided Costs

When energy efficiency measures save energy, the utilities avoid having to provide power they would otherwise have had to deliver. This "avoided cost" reflects the hourly marginal costs for utility generation. For this study, avoided costs were derived from the Avoided

Cost Model developed by Energy and Environmental Economics, Inc (E3) for the CPUC.[34] The current E3 model includes both the energy costs and the T&D costs for each hour for the years 2006 through 2030. Line losses are directly reflected in the E3 avoided cost modeling through the model's inclusion of loss factors in its T&D avoided cost modeling. Reliability and environmental costs are also included in these estimates.

The Itron 2006 study used an older version of the E3 Avoided Cost Model.[35] The KEMA 2002/2003 study used a variety of statewide averages of avoided costs based on the authorized CPUC avoided costs for major IOUs.[36] The 2002/2003 study did not have access to reliability and price elasticity adders; these adders were developed by E3 at the request of the CPUC. On average, the CPUC statewide averages of avoided costs used in the 2002/2003 study were higher than the avoided costs used for the 2006 study.[37] The E3 avoided costs used in the current study are generally higher in the short term than the E3 avoided costs used in the 2006 study.

Avoided costs were obtained by geographic area and by hour for use in the analysis. Location-specific values were used to assess cost-effectiveness in the geographic zones employed in the study. Hourly values were mapped into time-of-use (TOU) period averages for use in the ASSET analysis.

IOU-specific TOU periods were used to represent the specific periods used by the individual utilities. The schedule of TOU periods was provided by each utility to the Itron team. The current definition of TOU periods differs from those used in the Itron 2006 study. For the 2006 study, the TOU periods were a derivative of PG&E's Hour Ending TOU Schedule, which was the same schedule used by the KEMA 2002/2003 study. The avoided costs by climate zone, TOU periods, and year are described in Appendix C and listed in the input databases by IOU.

Retail Rates

The current study obtained commercial and residential electric and gas rate data from the four IOUs. The study requested a forecast of rates from the utilities and the CEC. Neither the CEC nor the utilities was able to provided the study with a forecast of rates, stating that, given current uncertainties, it would be preferable to use the current rates and implement the

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[34] Energy and Environmental Economics, Inc. June 2006. op cit.

[35] Energy and Environmental Economics, Inc. January 2004. op cit

[36] California Public Utilities Commission. *Ruling on Cost-Effectiveness Issues.* A.00-09-049. ALJ Linda R. Bytoff. October 25, 2000.

[37] If the avoided costs used in the KEMA 2002/2003 study were higher than those used in the Itron 2006 study, this could contribute to the former study's high economic potential relative to the latter study.

model with an assumption of constant real prices. This is also the assumption used in the Itron 2006 study.

The KEMA 2002/2003 study considered uncertainty in electricity and gas retail rates and in avoided costs by producing estimates for a base case, a high case, and a low case. Neither the current study nor the Itron 2006 study included scenarios representing various levels of energy costs. The decision to forego this type of scenario was made by the project team after determining the importance of alternative scenarios that were undertaken.

For the residential analysis, general service rates for single family detached homes were obtained from each utility's rate department. The electric rates were current as of August 2006 and the gas rate was current as of February 2007.[38] Table 3-3 presents the residential electric and gas rates used in the study.[39]

Table 3-3: Residential Retail Rates Used in Analysis

	Summer Electric Rate (per kWh)		Winter Electric Rate (per kWh)		Gas Rate (per Therm)	
Utility	**Single Family**	**Multifamily**	**Single Family**	**Multifamily**	**Single Family**	**Multifamily**
PG&E	$0.2299	$0.1143	$0.2299	$0.1143	$1.3418	$1.1214
SCE	$0.2201	$0.1207	$0.2201	$0.1207	n/a	n/a
SCG	n/a	n/a	n/a	n/a	$1.1612	$0.9783
SDG&E	$0.2607	$0.1287	$0.2449	$0.1287	$1.4992	$1.2590

When comparing the residential rates used in the Itron 2006 study with the current analysis, the electric and gas rates have generally increased. A re-evaluation of the appropriate tier moved some segments for some utilities to lower tiers, while the general utility rate structure experienced an increase in tariffs between the studies.

Table 3-4 and Table 3-5 present a summary of the commercial electric retail rates used in the current study (energy and demand, respectively). Table 3-6 presents a summary of commercial gas retail rates used in the study. Appendix B presents a more detailed table that

[38] The rates listed in Table 3-3 through Table 3-6 are the rates used for 2007 and beyond. The rates used in 2005 and 2006 linearly adjust the rates from those that were in place in 2005 to those that are in the model for 2007.

[39] The appropriate residential tier distribution was re-evaluated for this study. When compared to the Itron 2006 study, the tiers used for this study were either the same tier or a lower tier.

breaks the rates down by commercial building type. The industrial potential analysis used the Large commercial rates.

Table 3-4: Commercial Electric Energy Retail Rates Used in Analysis

Utility, Size of Commercial Bldg.	Summer (per kWh)			Winter (per kWh)		
	Peak	Partial Peak	Off Peak	Peak	Partial Peak	Off Peak
PG&E, Small	$0.1479	$0.1367	$0.1139	n/a	$0.1075	$0.0909
PG&E, Large	$0.1429	$0.1051	$0.0759	n/a	$0.0967	$0.0793
SCE, Small	$0.1231	$0.1031	$0.0770	n/a	$0.1067	$0.0807
SCE, Large	$0.1264	$0.1056	$0.0783	n/a	$0.1077	$0.0811
SDG&E	$0.1549	$0.0955	$0.0698	$0.1546	$0.0955	$0.0698

Only SDG&E has a TOU structure with a winter peak period.

Table 3-5: Commercial Demand Retail Rates Used in Analysis

Utility, Size of Commercial Bldg.	Summer (per kW)			Winter (per kW)		
	Peak	Partial Peak	Off Peak	Peak	Partial Peak	Off Peak
PG&E, Small	$10.83	n/a	n/a	n/a	$5.64	n/a
PG&E, Large	$21.75	$3.51	n/a	n/a	$8.86	n/a
SCE, Small	$28.02	n/a	n/a	n/a	$7.35	n/a
SCE, Large	$25.22	$14.02	n/a	n/a	$8.31	n/a
SDG&E	$16.49	n/a	n/a	$15.36	n/a	n/a

Only SDG&E has a TOU structure with a winter peak period.

Table 3-6: Commercial Gas Retail Rates Used in Analysis

Utility, Size of Commercial Bldg.	Summer (per therm)			Winter (per therm)		
	Peak	Partial Peak	Off Peak	Peak	Partial Peak	Off Peak
PG&E, Small	$1.0492	$1.0492	$1.0492	n/a	$1.1185	$1.1185
PG&E, Large	$0.8477	$0.8477	$0.8477	n/a	$0.8662	$0.8662
SCG, Small	$1.1529	$1.1529	$1.1529	n/a	$1.1529	$1.1529
SCG, Large	$0.9317	$0.9317	$0.9317	n/a	$0.9317	$0.9317
SDG&E, Small	$1.0917	$1.0917	$1.0917	$1.1852	$1.1852	$1.1852
SDG&E, Large	$0.9175	$0.9175	$0.9175	$0.9225	$0.9225	$0.9225

Only SDG&E has a TOU structure with a winter peak period.

Program Designs and Achievements

The ASSET modeling framework requires very specific information at the measure level on each utilities' program offerings and achievements to date. Elements of information include the following:

- Administrative information, including program start date, end date, changes in codes (if applicable), segment-level availability, and program administrative costs,
- Measure-level incentive data, and
- Program accomplishments data, comprised of annual estimates of measure adoptions and/or measure-level first-year energy savings.

These data were collected directly from the participating utilities. To the extent possible, publicly available utility filings like the utilities' quarterly and annual energy efficiency plans and reports were used. In addition, detailed program-level results and impact studies were tapped as necessary to develop relevant information on program accomplishments. Insofar as the primary focus of this study is on the comprehensive set of programs offered in the utilities' service areas, it was also necessary to access filings and reports relating to third-party programs.

The KEMA 2002/2003 study used general information regarding IOU conservation programs from 1996 to 2000 in order to identify specific conservation measures for inclusion within the studies as well as to identify levels of achieved program accomplishments. While the analysis for the 2002/2003 study was primarily undertaken in 2001, the study authors and the advisory committee felt that the IOU energy efficiency program accomplishments in 2001 represented a period of "unprecedented changes in energy consumptions and behavior among consumers and businesses in California in response to the energy crisis."[40] It is possible that the 2002/2003 study's use of a four-year general accomplishment level led to the inclusion of measures that otherwise may have been absent from a single program year accomplishment, thus helping to ensure completeness. The use of the generalized 1996-2000 program year accomplishments, however, eliminates the impact of the high level of energy conservation achieved in 2001. The decision to use a four-year program average, eliminating the 2001 energy crisis, was based on the conclusion that the energy conservation and implementation of energy efficiency measures associated with the energy crisis would not continue into the future. The energy efficiency program accomplishments achieved in 2002 and 2003 show that this conclusion was well founded. In 2004, the CPUC increased energy efficiency program funding, and energy efficiency program savings goals, leading to an increase in program accomplishments.

The Itron 2006 study used information from the 2004 program year to identify measures, incentives, program costs, and accomplishments. Using information from a single program year may have resulted in measure accomplishment gaps, or lower levels of accomplishments in the commercial and new construction sectors, due to slower start-up periods for these programs. The 2006 study team, however, determined that it was better to use information from the first year of the new aggressive energy efficiency programs than to mingle the new program accomplishments with those representing older, less aggressive programs from 2002 and 2003.

The current study uses the yearly average results from the IOU quarterly filings from the 2004-2005 program cycle to set current levels of program accomplishments and to help determine which measures are included in the forecast of current potential. The measures list also includes new measures from the 2006-2008 program cycles and measures that may be included in future programs. The study uses the 2004-2005 program measures augmented by offerings from the 2006-2008 program cycle as the primary basis for determining the list of measures, which ensures that the study focuses on those measures currently included in the utility programs. Using the average program accomplishments from the 2004-2005 program cycle allows the study to incorporate recent increases in accomplishments and to account for possible changes in the distribution of accomplishments between the 2004 and 2005 program years.

The average level of program accomplishment in 2004 and 2005 is the model's calibration point. The initial calibration of the model can significantly impact the forecast of market potential. In 2000, the three California IOUs reported energy efficiency program accomplishments of approximately 1,200 GWh of savings. The commercial and industrial sector programs accounted for nearly 70% of the savings, while the residential programs

[40] Xenergy, op. cit. July 2002.

represented most of the remaining 30%.[41] This study was calibrated to program accomplishments from 2004 and 2005. In the program years 2004-2005, the three California IOUs claimed approximately 4,788 GWh of energy efficiency savings, for an average yearly value of 2,394. In addition, in the 2004-2005 program cycle, the claimed savings from the existing residential programs were approximately equal to those from the existing non-residential sectors.

The results presented in Section 4 provide information on the aggregate statewide energy efficiency potential. The results indicate that estimates from the current study are slightly higher for the commercial sector than those forecasts during the Itron 2006 study. In contrast, the current study's estimates of residential potential are slightly lower than the 2006 study. The higher commercial forecast is substantially influenced by the higher commercial calibration targets for this study when compared with the 2006 study. The higher commercial calibration targets are a direct result of using the average accomplishments from the 2004-2005 program year, where the commercial programs were allowed the time necessary to show more accomplishments that are complete. The small reduction seen in the residential market forecast from the current study relative to the 2006 analysis is influenced by program accomplishments and adjustments to the residential lighting density and per-unit CFL savings.

The adoption-modeling framework within ASSET allows for a variety of modeling approaches, such as payback requirement curves, diffusion models, and probability share models tempered within a framework of stock accounting. Utility and third-party program accomplishments were used to develop the baseline calibrating estimates of impact by measure. For residential lighting and appliance measures, these estimates were crosschecked against the results of the RMST study.

3.7.3 Customer Data

Customer data include TOU usage profiles, information on segment sizes, and adoption model parameters.

Usage Profiles. Usage profiles were defined for end uses and technologies and are currently characterized in ASSET in terms of energy fractions, peak factors, and coincidence factors for six TOU periods. Usage profiles were developed for the commercial sector using the results of building simulations conducted by Itron for the CEUS project. Residential shapes were obtained from Itron's library of residential end-use profiles. These latter profiles were

[41] KEMA-Xenergy, op. cit., April 2003.

developed using Itron's proprietary SitePro software system, which uses DOE-2 as an engine. The current study and the Itron 2006 study used similar usage shape information.[42]

The KEMA 2002/2003 study used energy and peak factors by major IOUs to develop estimates of energy and demand impacts for different TOU periods. Data sources for the commercial sector energy and peak factors varied by IOU service territory. For the SDG&E service territory, these factors were developed from a SDG&E EUI study performed by RER in 2000. For PG&E, KEMA used data from PG&E's 1998 Commercial Building Survey. For SCE, a combination of SDG&E and PG&E data was used. For the residential sector, KEMA used information from the CEC forecasting database for non-weather-sensitive measures and interim DOE-2 model-based datasets developed for the KEMA 2001 DEER update study.

Segment Data. Segment data include forecasts of key drivers, such as numbers of residential customers, commercial floorstock, and industrial energy usage. Base share estimates of commercial measures were derived from the CEUS study. Commercial floorspace by CEC building type information was obtained from the CEC by year and by forecasting climate zone for both total floorspace and new construction. For the residential sector, housing stock estimates by forecasting climate zone and housing type (single family, multi family, and mobile home) were obtained from the CEC by year for total units and new construction units. For the industrial sector, the current study used the forecast of usage used in the 2006 study.

3.7.4 Peak Demand Calculations

Within each season and time-of-use period, the peak demand multipliers are used to compute hourly loads at the time of customer peak within each period. The peak multipliers are inverse load factors, giving the ratio of load at the time of customer peak in a season and period to the average hourly load in that season and period. In this case, the demand multipliers are used as follows:

$$\text{PEAKKW}_{s,t} = \frac{\text{kWh}_{s,t}}{\text{HOURS}_{s,t}} \times \text{DEMAND}_{s,t}$$

where $\text{kWh}_{s,t}$ is energy consumption in the season and period, $\text{Hours}_{s,t}$ is the number of hours in the season and period, and $\text{DEMAND}_{s,t}$ is the inverse load factor used as the demand multiplier. For example, if the average cooling load in the summer on-peak period is 1.25 Watts/SqFt, and the cooling load at the time of customer peak averages 2.50 Watts/SqFt in the summer months, then the peak factor is 2.0.

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42 The usage shapes used in the current study and the 2006 study are not identical. Changes in the TOU periods used in the studies have led to changes in the applied shapes.

Within each season and time-of-use period, the system peak multiplier is used to compute load at the time of system peak within each season and period. The peak multipliers are applied to the customer peak demand values. This provides an adjustment for coincidence between the customer load at the time of system peak and the average customer peak demand in the season and period. In this case, the customer contribution to system peak is computed as follows:

$$\text{SysPeakKW}_{s,t} = \frac{\text{kWh}_{s,t}}{\text{Hours}_{s,t}} \times \text{Demand}_{s,t} \times \text{SysDemand}_{s,t}$$

where $\text{kWh}_{s,t}$ is energy consumption in the season and period, $\text{Hours}_{s,t}$ is the number of hours in the season and period, $\text{Demand}_{s,t}$ is the inverse load factor used as the demand multiplier, and $\text{SysDemand}_{s,t}$ is the system demand multiplier.

3.7.5 Economic Data

Economic data used in the analysis include discount and inflation rates. The following rates were used in the analysis.

- Discount rate: 5%
- Inflation rate: 3%

The incentive values, measure costs, program costs, and avoided costs are in 2006 dollars.

4

Energy Efficiency Potential

4.1 Introduction

4.1.1 Overview

This section summarizes the findings of the Itron 2008 study. The primary focus is to provide an aggregated presentation of the estimated energy efficiency potential across the three major electric (PG&E, SCE, and SDG&E) and three gas IOUs (PG&E, SCG, and SDG&E) in California. The gross and net potential for electricity and gas savings are presented aggregated across all six sectors at the California IOU level and at the separate IOU levels. Limited sector-level potential is presented. The sector-level savings, however, are the focus of later sections of this report. The six sectors analyzed include the existing and new residential, commercial, and industrial sectors. This section will present both the yearly values of total market potential and the first-year program potential.

The measures analyzed in this study are all commercially available. Sixty-six residential energy efficiency measures were included in the existing residential analysis. One hundred individual high efficiency measures were analyzed for the existing commercial energy efficiency analysis. One hundred and sixty-one high efficiency industrial measures were analyzed for the existing industrial sector. The residential and commercial new construction potentials were analyzed based on least cost packages. The industrial new construction potential was developed for three industrial and one commercial segment.[1] The sector-specific lists of high efficiency measures analyzed for this study are available in the sector-level sections of this report. This report does not explicitly attempt to analyze the energy efficiency potential in emerging technologies.

The use of least cost packages in the residential and commercial new construction sectors makes it difficult to disentangle the electric and natural gas savings when looking at SCE's service territory. The residential and commercial new construction packages were modeled under the assumption that SCE claimed the electricity savings for these packages and SCG claimed the gas savings from these sectors. For the presentation of total IOU level savings, the electricity savings from these programs are in SCE's potential and the gas savings from

[1] These three industrial and one commercial segment represent the same segments analyzed in the Itron 2006 study. The research plan for this study limited the industrial new construction analysis to these segments.

these programs are in SCG's potential. For this reason, the cost and benefits are only presented at the California IOU level for the aggregated overview.

The analysis was conducted for 21 electric climate zones and 23 natural gas climate zones (16 CEC Title 24 zones further divided into unique utility service areas). In addition, the analysis of market potential considered 10 scenarios. The results presented in this section will focus on nine of the 10 scenarios. The results from the CFL scenario apply to only the existing residential and commercial sectors and will be presented in the sections of the report that focus on those sectors. The scenario names and short descriptions are provided in Table 4-1. The scenarios are explained in more detail in Section 3 of this report.

Table 4-1: Scenario Summaries (see Section 3 for more information)

Scenario Name	Scenario Description
Base Incentive	Includes measures incentivized in the 2004-2005 program cycle with incentive levels that were available in 2006.
Mid Incentive	Includes all measures analyzed in the study with incentives halfway between those that were available in 2006 and full incremental costs.
Full Incentive	Includes all measures analyzed with incentives set to full incremental costs.
Base Incentive TRC Restricted	Base Incentive scenario with measures restricted to those with a TRC $\geq$ 0.85.
Mid Incentive TRC Restricted	Mid Incentive scenario with measures restricted to those with a TRC $\geq$ 0.85.
Full Incentive TRC Restricted	Full Incentive scenario with measures restricted to those with a TRC $\geq$ 0.85.
Full Gradual	Includes all measures analyzed with incentives increasing from 2006 levels to full incremental costs in 2010.
Full Gradual TRC Restricted	Full Gradual scenario with measures restricted to those with a TRC $\geq$ 0.85.
Base TRC Restricted Higher Awareness	The Base Incentive TRC Restricted scenario with a higher level of awareness for both the program and the naturally occurring analysis.
CFLs as Base Lighting	A recalculation of the previous nine scenarios assuming that CFLs are the base lighting technology.[2]

[2] This scenario was included due to the recent signing into California state law of the Huffman Bill (AB1109), which requires a 50% reduction in general purpose residential lighting, and 25% reduction in general purpose commercial lighting, from 2007 levels, by 2018.

4.2 California IOU Summary of Results

Table 4-2 through Table 4-11 present the California IOU electric and natural gas potential while Figure 4-1 through Figure 4-9 illustrate the estimates.[3] The potential estimates are presented at the California IOU total market, California IOU sector total market, and the California IOU first-year program potential. The total market savings are the savings from total adoptions still in place in the given year. The total market savings are presented for gross savings and naturally occurring savings. First-year program savings are the first-year savings from measures adopted under an IOU energy efficiency program. The first-year program savings are presented in net form.

First-year *program* savings estimates cannot be summed to determine total *market* savings. These two estimates of savings differ due to TRC restrictions, the automatic replacement of measures (see Section 3 for discussion of the automatic-replacement issue), and the treatment of savings at the end of service life and start of possible re-adoption.

TRC Restricted scenarios eliminate measures from IOU programs based on the measure level TRC. When a measure is eliminated from the IOU program due to the TRC eligibility test, the model continues to predict the market adoptions of the measure assuming that the measure is no longer eligible for an incentive. The energy savings associated with the adoption of measures that are not eligible for an IOU incentive will appear in both the gross and naturally occurring market savings, leading to zero net savings. Measures excluded from the program due to the TRC restriction do not have first-year program level savings.

If the measure is assumed to be automatically replaced (e.g., high efficiency lighting fixtures and measures in the industrial sector), the re-adoption of the measures does not lead to additional first-year program savings, but the savings continue in the total market estimates.[4] As the measure is automatically replaced, the replacement savings continue or are maintained in the gross potential estimates and re-adoption is counted in the naturally occurring market potential. Auto-replacement maintains the gross savings but does not add to net market potential.

If a measure is not automatically replaced (which applies to almost all measures in the forecast for this study, for example, CFLs), the measure will go back through the adoption

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[3] The energy savings potential presented in this report are at the generation level.

[4] High efficiency fixtures (T12-T8s and pin based CFLs) in the commercial and residential sectors are automatically replaced with the high efficiency measure. All measures in the industrial sector are automatically replaced. The industrial sector was treated differently than the residential and commercial sectors due to the site specific nature of industrial projects and that current utility programs do not allow industrial projects to re-apply for incentives for measures that were previously incentivized. Using automatic replacement in the industrial sector, but not in the commercial and residential sectors is also consistent with the 2006 Itron potential study.

model. If the measure is re-adopted, the measure savings will replace the end-of-life measure savings in the total market estimates and there will be no change in potential. If the measure is re-adopted, the measure's first-year savings will be added to the first-year potential. If the measure is not re-adopted, the measure savings will die in the market potential and total savings will fall.

Technical and economic potential are presented with the total market estimates. The technical and economic potential are relatively large in the first years of the forecast due to the instantaneous (and theoretical) nature of retrofit and conversion technical and economic potential. Due to the instantaneous nature of much of the technical and economic potential, these estimates are not presented with the first-year potential estimates.

4.2.1 California IOU Electric Energy Potential

This section presents the California IOU electric energy potential, summing together the potential from the three electric utilities. The results are first presented for the total *market* potential and then for the first-year *program* estimates.

Total Market Electric Potential

Table 4-2, Table 4-3, Figure 4-1, and Figure 4-2 illustrate the estimates of the total market electric energy and demand potential for 2007-2016 and in 2026. The Base scenario is an estimate of the energy efficiency potential associated with continuing the 2004-2005 IOU programs from 2007 through 2026. The gross market savings potential for the Base scenario is 11,330 GWh by 2016 and 15,821 GWh through 2026. The net Base scenario potential is 6,701 GWh in 2016 and 9,776 GWh in 2026. The Base scenario estimate of the net-to-gross ratio is 59% in 2016 and 62% in 2026.

The average yearly level of gross Base market potential for 2007-2016 is 1,135 GWh, while the yearly average for the final 10 years of the forecast is only 451 GWh. The significant drop in the per year average market potential between 2007-2016 and 2017-2026 is due to the achievement of potential during the first 10 years of the analysis and the static nature of the high efficiency measure list. Once potential energy savings are achieved within the total market forecast, devices will die and need to be replaced. The replacement of measures previously adopted under the program does not add to total market potential; it simply replaces or maintains the savings lost when the previous measure dies. Over the 20-year forecast period, the saturation of high efficiency measures grows, leaving fewer opportunities to install new measures. To have a constant or increasing yearly market average over a 20-year forecast, it would be necessary for the forecast to assume that new high efficiency measures became available (non-static measure list). It is certain that new measures will be developed and end users will likely adopt some of them. Although there is reason to be optimistic that energy efficiency innovations will continue in the future, it is not possible to know which specific improvements will materialize. The purpose of a bottom-up modeling effort such as this one is to characterize the costs, impacts, market saturation, and adoption of specific measures whose characteristics are currently known. The primary value of this study is in characterizing energy efficiency at a high level of detail over the short- to mid-term. This short- to mid-term focus is also the primary scope of this study. While the longer term results are available as model outputs, they are of more limited value. The modest remaining savings over the final 10 years of this forecast illustrate the importance of advancements in these yet unknown high efficiency measures to achieving longer-term societal energy efficiency goals.

A limited number of non-cost-effective measures are included in the current IOU energy efficiency programs. The IOU energy efficiency portfolio is designed to be cost-effective, but within the portfolio, the utilities are permitted to include some measures that are not cost-effective. These measures may be included for a number of reasons, including the utility's desire to test the actual savings associated with the product, attempts to move the measure's market price or acceptance, or because of the measure's perceived social benefit. The Base Restricted scenario limits measures to those with a measure-level TRC ≥ 0.85. The estimates from the Base Restricted scenario forecast the energy savings potential if the IOUs limit their portfolios to measures that are at least nearly as cost-effective. Restricting the measures in the Base scenario to those with a TRC > 0.85 does not lead to a large change in potential. The Base Restricted gross market potential in 2016 is 10,928 GWh, growing to 15,165 GWh in 2026. The Base Restricted gross market potential in 2016 is about 3.5% less than the non-restricted Base potential.

The Mid scenario estimates the potential associated with increasing incentives so that they are set to the average between current incentives and full incremental measure costs, and it augments the high efficiency measure list to include a limited number of measures, which were added to the 2006-2008 energy efficiency programs. The Mid scenario gross market potential is 16,738 GWh for 2007-2016 and 22,558 GWh for 2007-2026. The Mid scenario gross market potential is 48% larger than the Base forecast for 2007-2016 and 42% larger than the Base estimate for 2007-2026. Restricting measures to those with a TRC > 0.85 reduces the Mid Restricted scenario gross potential to 15,053 GWh for 2007-2016 and 20,125 GWh for 2007-2026.[5] The Mid Restricted scenario potential is about 10% less than the potential in the Mid scenario. The larger fall in potential between the Mid and Mid Restricted, when compared to the Base and Base Restricted, is largely due to the effect of increasing rebates on non-cost-effective measures that are currently in the IOU portfolios. Increasing rebates on non-cost-effective measures above their current, more restrained values often leads to a substantial increase in the adoption of these measures.

[5] The Mid Restricted scenario gross market potential is 38% higher than the Base Restricted potential for 2007-2016 and 33% higher than the Base Restricted scenario for 2007-2026.

Table 4-2: California IOU Total Gross Market and Naturally Occurring Energy Efficiency Potential – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	28,054	24,451	1,537	1,485	693	1,535	778	2,204	1,996	4,288	3,500	702
2008	32,029	28,124	3,010	2,915	1,332	3,048	1,546	4,801	4,296	7,350	6,272	1,350
2009	34,313	30,093	4,310	4,177	1,888	4,417	2,258	6,902	6,212	9,846	8,486	1,915
2010	36,354	31,799	5,540	5,367	2,396	5,748	2,959	8,744	7,889	12,073	10,426	2,432
2011	38,158	33,263	6,706	6,494	2,866	7,021	3,642	10,422	9,413	14,066	12,141	2,910
2012	39,894	34,660	7,803	7,552	3,304	8,218	4,302	11,960	10,803	15,890	13,705	3,355
2013	41,334	35,765	8,818	8,529	3,698	9,314	4,912	13,345	12,056	17,569	15,119	3,757
2014	42,704	36,808	9,759	9,433	4,056	10,311	5,481	14,632	13,215	19,083	16,409	4,123
2015	43,956	37,741	10,626	10,261	4,376	11,181	5,998	15,797	14,242	20,468	17,562	4,450
2016	44,880	38,347	11,330	10,928	4,629	11,873	6,424	16,738	15,053	21,608	18,472	4,710
2026	50,610	42,278	15,821	15,165	6,045	15,740	8,682	22,558	20,125	28,216	24,208	6,162

Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

Increasing funding to cover the full incremental cost of high efficiency measures increases potential to 21,608 GWh for 2007-2016 and 28,216 GWh for 1007-2026. The Full potential for 2007-2016 is 90% higher than the Base scenario forecast and the 2007-2026 Full estimate is 78% larger than the Base forecast. The Full net potential is 16,898 GWh for 2007-2016 and 22,054 GWh for 2007-2026. The net-to-gross ratio for the full incentive forecast is about 78%. Restricting measures to those with a TRC $\geq$ 0.85 reduces the Full Restricted gross potential to 18,472 GWh for 2007-2016, a 14% reduction compared to the non-restricted Full scenario. The Full Restricted scenario is 69% larger than the Base Restricted scenario for 2007-2016 and 60% larger than the 2007-2026 Base Restricted estimate.

The Full and Full Restricted scenarios assume that, in 2007, incentives are instantaneously increased to cover full incremental costs for all measures in the simulated portfolio and that these incentives are maintained until 2026. In addition, these scenarios assume that the utilities have increased their marketing efforts leading to a doubling of the yearly growth rate of awareness and willingness to adopt high efficiency measures when compared to the assumed growth for the Base and Base Restricted scenarios. The instantaneous increase in incentives from their 2006 actual values to full incremental costs in 2007 is forecast to lead to a large jump in potential from the adoption of retrofit and conversion measures.[6] The jump in first year potential is largely obscured in the total number listed above, but is observable in the first-year program potential presented below. The instantaneous, large increase in savings under the Full incremental cost scenario should be viewed as a theoretical result. We consider the Full and Full Restricted scenario potential increase during the first few years of the forecast period, to be infeasible due to real-world constraints on utilities, manufacturers, and consumers. Utilities are unlikely to instantaneously have the labor necessary to provide the needed information, application processing, and trade ally services. Manufacturers and retailers would likely lack the necessary products for such an instantaneous increase in the sale of high efficiency measures. Finally, end users are unlikely to have the available time to apply and install all of the measures assumed to be instantaneously adopted under the Full and Full Restricted scenarios.

The Full Gradual and the Full Restricted Gradual scenarios were added to the study to deal with some of the limitations associated with the Full and Full Restricted scenarios. The Gradual scenarios increase incentives from their 2006 values to full incremental costs over a four-year period. The gradual increase in incentives helps to smooth the spike in forecast adoptions of retrofit and conversion measures.

[6] The large jump in adoptions for retrofit and conversions drives the large increase in potential associated with the first few years of the Full and Full Restricted scenarios. Retrofits and conversions do not depend on the failure of existing equipment. Because the timing of these actions is not event driven, large increases in incentives can lead to unrealistic spikes in adoptions.

Gradually increasing incentives to their full incremental cost level works to eliminate some of the physical barriers associated with an instantaneous increase in incentives and the resultant increase in demand for high efficiency measures. Gradually increasing incentives, however, does not eliminate all of the barriers associated with higher incentives.

Many questions concerning the appropriate incentive level remain. Prior to implementing a system of full cost incentives, the utility, public, and regulatory bodies need to determine if it is in the best interest of society to have consumers assume none of the explicit cost associated with the adoption of high efficiency measures.[7] Choosing to purchase a high efficiency device when there is no customer responsibility for additional cost may not lead to the type of ownership and responsible behavior that is assumed by these models and desired by society. The appropriate use, correct maintenance, and valuation of measures may require that consumers take some responsibility for the purchase price, free commodities are seldom valued and used appropriately.

While the economic and technical potential are listed in Table 4-2, comparisons between the technical and economic forecast and the market forecast need to be made with care. The technical and economic forecasts will be substantial in the initial year of the forecast period, with only minor growth in subsequent years. Market potential develops over time. In addition, the technical and economic estimates are theoretical constructs that do not account for end user preferences and, based on over two decades of energy efficiency market experience, are not attainable through voluntary utility programs alone. The technical potential is an estimate of all feasible and applicable potential while the economic potential is the cost-effective technical potential. These estimates do not incorporate market barriers or inertia, two drags on the market adoption of energy-efficient technologies. In addition, the TRC test used to determine economic potential does not incorporate program costs. Economic potential is not calculated under a market forecast of voluntary programs. Lacking program costs, additional measures may pass the TRC test to be included in the economic potential but they might be eliminated from a cost-effective market potential.[8] The cost-effective market potential will be less than the economic potential due to market barriers and the lack of program cost when determining economic potential.

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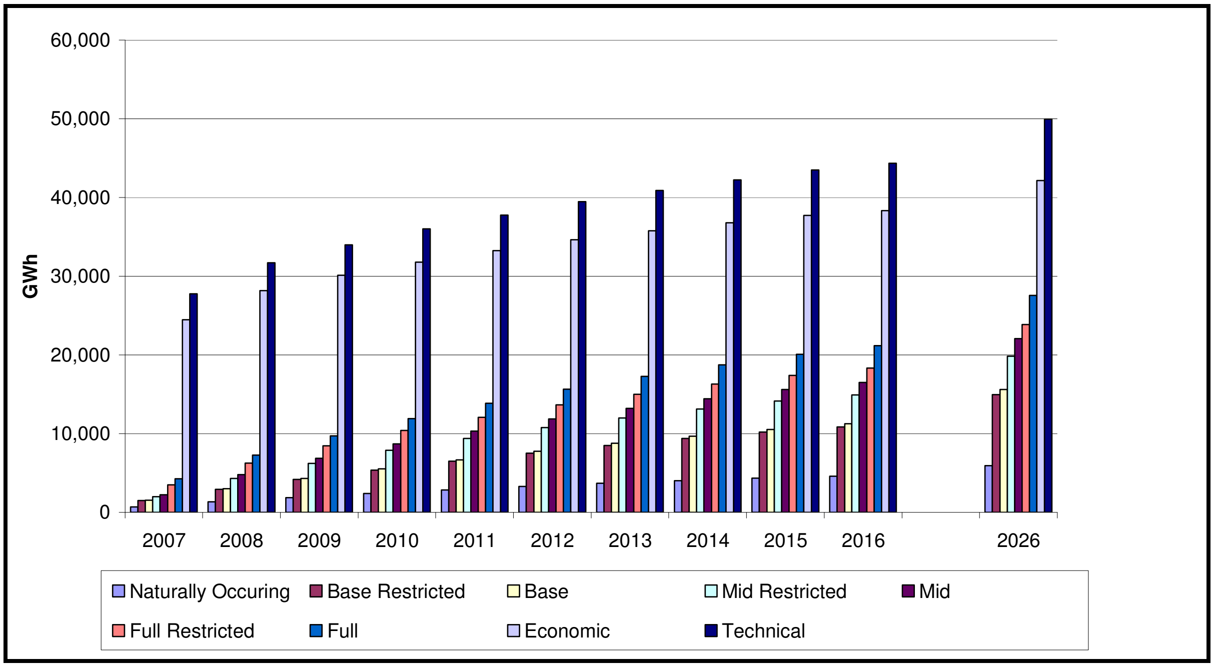
7 The consumer is paying the cost in the form of higher utility rates to pay the rebates. These costs, however, do not occur at the point of purchase, and are therefore not associated with the purchase of the measure by the consumer.

8 The program cost associated with economic potential could be very high. To attain all of the cost-effective potential, program interventions would likely have to reach each end user directly for each measure, incurring significant marketing and transaction costs. This method of promoting energy efficiency would incur a substantial labor cost and would likely require substantial increases in incentives like those associated with the Full incentive case, if not higher in some cases, to overcome market barriers other than direct incremental costs.

Figure 4-1: California IOU Total Gross and Naturally Occurring Energy Efficiency Potential – 2007-2016 and 2026 (GWh)



Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

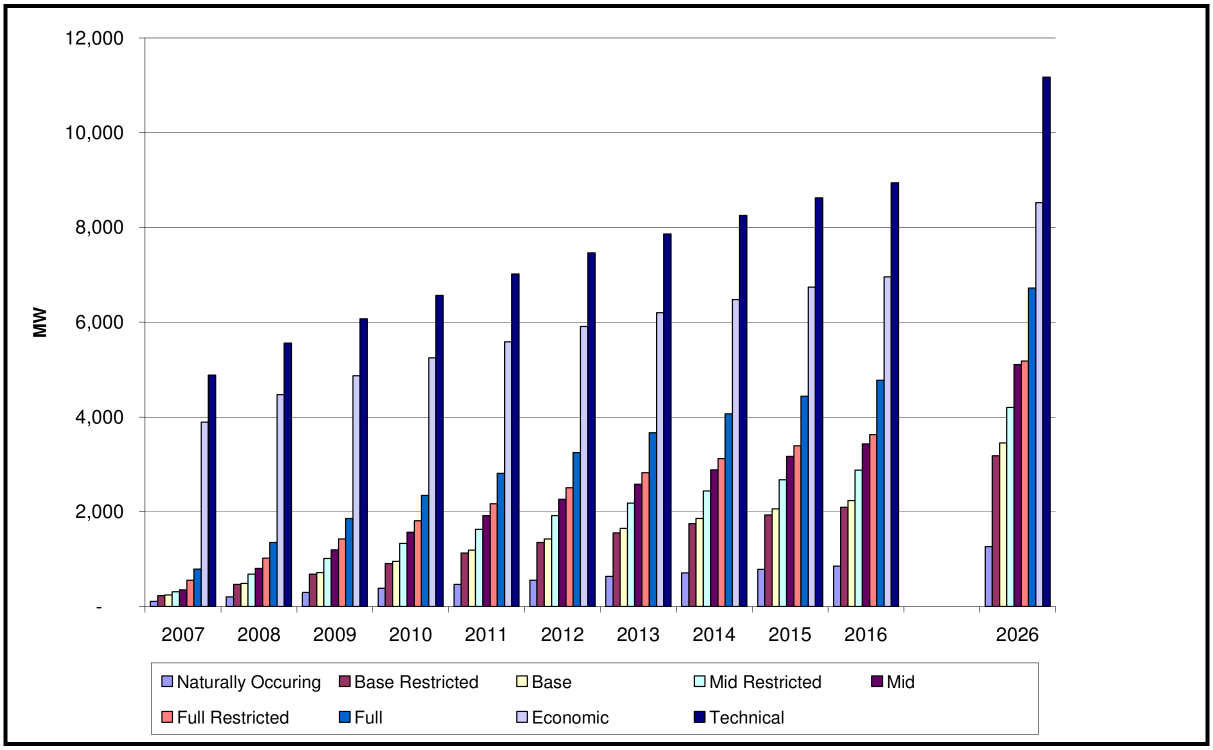
The Base scenario estimates of coincident peak demand potential are 2,229 MW for 2007-2016 and 3,442 MW for 2007-2026. The net Base coincident peak demand potential is 1,380 MW for 2007-2016 and 2,180 MW for 2007-2026. Increasing incentives to the Mid funding level increases potential by about 50% to 3,428 MW for 2007-2016 and 5102 MW for 2007-2026. Some of this increase in potential, however, is not cost-effective. Limiting the Mid scenario to those measures with a TRC ≥ 0.85 leads to 2,874 MW of potential savings for 2007-2016 and 4,195 MW for2007-2026. The TRC restrictions reduce the Mid Restricted forecast by about 17% relative to the Mid forecast.

Table 4-3: California IOU Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	4,865	3,863	240	229	105	240	121	349	305	785	550	106
2008	5,544	4,439	483	461	204	491	247	799	675	1,348	1,015	206
2009	6,055	4,842	713	679	295	738	371	1,193	1,009	1,858	1,422	298
2010	6,542	5,214	948	901	382	992	501	1,562	1,323	2,344	1,804	386
2011	6,999	5,553	1,187	1,125	466	1,243	633	1,919	1,625	2,806	2,161	471
2012	7,443	5,881	1,419	1,342	550	1,485	766	2,259	1,911	3,245	2,498	556
2013	7,845	6,170	1,642	1,549	631	1,716	893	2,577	2,178	3,666	2,816	638
2014	8,233	6,449	1,852	1,744	709	1,936	1,016	2,881	2,432	4,061	3,112	717
2015	8,603	6,709	2,052	1,927	783	2,136	1,133	3,169	2,667	4,434	3,385	791
2016	8,924	6,924	2,229	2,089	849	2,314	1,237	3,428	2,874	4,771	3,619	858
2026	11,155	8,491	3,442	3,172	1,262	3,355	1,849	5,102	4,195	6,717	5,170	1,276

Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

Figure 4-2: California IOU Total Gross and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)



Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

Market and Naturally Occurring Electric Potential with Higher Awareness

Table 4-2 and Table 4-3 list the results from the Base Restricted scenario with Higher Awareness. This scenario is a modification of the Base Restricted scenario; it assumes a higher level of knowledge of, and willingness to install, high efficiency measures (see Section 3 for a discussion of the role of "awareness" and "willingness" in the modeling process). Voluntary energy efficiency programs have encouraged Californians to adopt high efficiency technologies for approximately three decades. During this period, Californians' basic knowledge of energy efficiency measures and their willingness to install these measures has grown. The ongoing emphasis on expanding energy efficiency savings, and the growing public concern about global warming, may lead to a faster future growth in the willingness of consumers to adopt energy efficiency devices. In particular, it may lead to an increase in the normal adoption of these measures without utility rebates. The Base TRC Restricted Higher Awareness scenario attempts to model a California with a higher rate of growth in awareness and willingness. This scenario assumes a faster growth rate for the awareness than in the Base TRC Restricted scenario. In addition, this scenario assumes that the awareness and willingness of the naturally occurring estimate grows at a rate set equal to 75% of the growth rate of the program analysis.[9]

The faster growth in awareness and willingness leads to a higher level of gross market potential under the Base Restricted with Higher Awareness scenario than the Base Restricted scenario. The Base Restricted with Higher Awareness gross potential forecast is higher than the Base Restricted forecast by about 9% for 2007-2016. The more significant increase, however, is in the naturally occurring potential. The naturally occurring potential increases by about 46% between the Base Restricted and the Base Restricted with Higher Awareness (2007-2016). The implied net-to-gross ratio for the Base Restricted analysis are 58% for 2007-2016 and 60% for 2007-2026, while the net-to-gross ratio for the Base Restricted with Higher Awareness are 46% for 2007-2016 and 45% for 2007-2026.

If awareness and willingness continues to grow, achievable potential will grow. There will be growth in both gross potential and naturally occurring savings. The faster growth in naturally occurring potential, however, leads to a drop in net potential.

Sector-Level Total Market Electric Potential

Table 4-4 and Table 4-5 list the sector-level electricity potential for 2016 while Figure 4-3 and Figure 4-4 illustrate the sector distribution of potential for the Full Restricted scenario. In the Full Restricted scenario, the existing residential sector contributes 43% of the energy savings potential. This percentage is very similar to the existing residential sector's share of technical potential, 45%. Across all sectors, the Full Restricted scenario shares presented in Figure 4-3 are within 3 % of their technical share.

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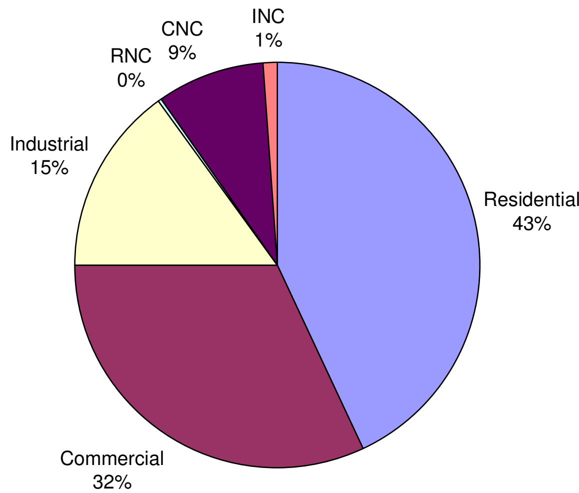
9 In all other scenarios, the awareness and willingness of the naturally occurring estimate is held fixed; it does not grow. For the Base TRC Restrict Higher Awareness scenario, the growing awareness and willingness for the naturally occurring analysis is intended to reflect the possible influence of market effects and growing awareness of global warming on the probability of adoption outside the program. The awareness and willingness of the naturally occurring estimate is never allowed to exceed 95%. The awareness and willingness of the program estimate commonly reaches 100% prior to the end of the forecast period. Note that even under high awareness and willingness; other measure-specific market barriers continue to inhibit measure adoption for many end users. Modeling reductions in measure-specific market barriers was not part of the scope of this study.

Table 4-4: Sector-Level California IOU Total Gross Market and Naturally Occurring Energy Potential – 2007-2016 (GWh)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	20,437	16,248	5,205	4,908	2,024	5,351	2,876	8,034	6,828	10,165	7,976	2,077
Commercial	14,101	12,514	3,357	3,321	1,486	3,708	2,223	4,961	4,675	6,552	5,891	1,513
Industrial	5,934	5,604	1,846	1,802	986	1,913	1,188	2,419	2,276	2,972	2,771	986
RNC	352	200	55	34	0	34	0	80	51	118	74	0
CNC	3,851	3,628	699	699	0	699	0	1,059	1,059	1,597	1,597	0
INC	298	298	184	184	139	181	139	194	194	205	205	139
Total	44,972	38,493	11,346	10,949	4,634	11,886	6,426	16,747	15,082	21,610	18,514	4,715

Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

Figure 4-3: California IOU Sector-Level Full Restricted Gross Energy Potential – 2007-2016 (GWh)



Comparing the technical, economic, and market coincident peak demand potential, the residential sector has 38% of the Full Restricted scenario potential, 50% of the Full scenario potential, 37% of the economic potential and 43% of the technical potential. The commercial sector has 34% of the Full Restricted scenario, 28% of the full potential, 34% of the economic potential, and 29% of the technical potential. These results illustrate the importance of the cost-effectiveness restrictions when evaluating the coincident peak demand potential. In the residential sector, many HVAC measures are not cost-effective due to recent changes in air conditioning standards, the high incremental cost of SEER 15 air conditioners, and the relatively short run times. The longer run times in the commercial sector help to ensure that most of the commercial HVAC measures are cost-effective.

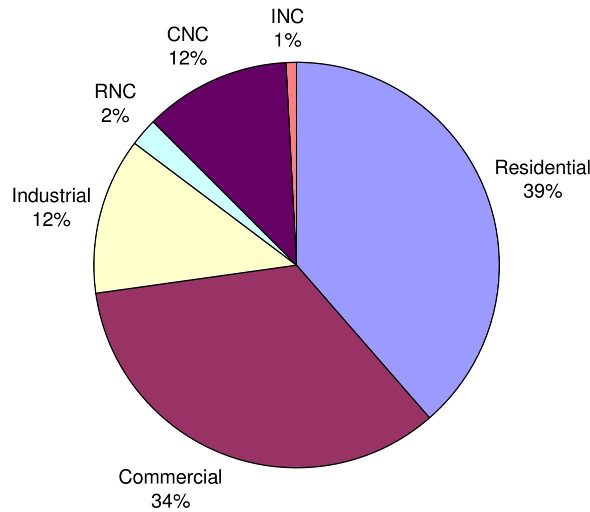
The share of new construction coincident peak demand potential is higher than its share of energy potential. The new construction residential packages are largely restricted to HVAC, shell, and water heating measures. These restrictions increase the relative importance of the residential new construction sector when analyzing coincident peak demand potential.

Table 4-5: Sector-Level California IOU Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 (MW)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	4,066	2,564	974	862	369	987	579	1,623	1,172	2,377	1,396	375
Commercial	2,597	2,346	700	696	301	778	448	1,032	980	1,338	1,244	305
Industrial	962	906	298	291	157	309	189	393	369	485	450	157
RNC	315	188	55	39	0	39	0	83	60	122	88	0
CNC	957	904	175	175	0	175	0	269	269	418	418	0
INC	44	44	29	29	22	28	22	30	30	32	32	22
Total	8,942	6,952	2,232	2,093	850	2,316	1,238	3,430	2,879	4,771	3,627	859

Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

Figure 4-4: California IOU Sector-Level Full Restricted Gross Coincident Peak Demand Potential – 2007-2016 (MW)



First-Year Net Electric Program Potential

The first-year net electric energy and demand program potential by scenario are listed in Table 4-6 and Table 4-7 and illustrated in Figure 4-5 and Figure 4-6. The Base scenario net program first-year potential ranges from about 845 GWh to 1,051 GWh between 2007 through 2016. Restricting measures to those with a TRC ≥ 0.85 reduces net first-year program potential to between 786 GWh and 988 GWh per year from 2007 through 2016.

The first-year program potential is the first-year savings associated with measures installed under the program. The potential listed in Table 4-6 and Table 4-7 are net potential; the naturally occurring potential has been subtracted from the gross potential. The first-year program potential includes the savings associated with measures installed under the program to replace a high efficiency measures that have died. The first-year program potential does not include the savings associated with high efficiency adoptions that do not receive a rebate. Measures may be adopted outside the program due to cost-effectiveness restrictions on the program or due to the assumption that the IOUs do not rebate the replacement of certain measures.[10] High efficiency adoptions outside the program are included in the market gross and naturally occurring potential.

Increasing funding to the Mid incentive level leads to a significant increase in first-year net program potential savings. The Mid scenario net program first-year potential averages about 1,650 GWh per year while the Mid Restricted scenario net program first-year potential averages about 1,450 GWh per year. Further increasing incentives to the full incremental cost level leads to a large initial increase in potential in 2007 (3,590 GWh) with savings flattening out thereafter (averaging 2,190 GWh). The large jump in potential reflects a large increase in the quantity of conversion and retrofit adoptions that are forecast to occur if incentives are instantaneously increased to full incremental costs. The large increase in savings in 2007 under the Full incremental cost scenario should be viewed as a theoretical result. The first-year increase shown is considered infeasible due to real-world constraints in the availability of labor necessary to provide the associated utility information and application processing and trade ally services, as well as lack of availability of the necessary products for such an instantaneous increase. In addition, in the real world, end-user awareness of the full incremental cost incentives would likely be diffused over several years rather than concentrated so heavily in the first year.

To address this issue, the Full Gradual scenario was developed. The Full Gradual scenario gradually increases incentives to reach a full incremental cost value in 2010. The Full Gradual scenario's net program first-year potential averages about 2,180 GWh per year while the Full Restricted Gradual scenario's net program first-year potential savings averaged about 1,820 GWh per year.

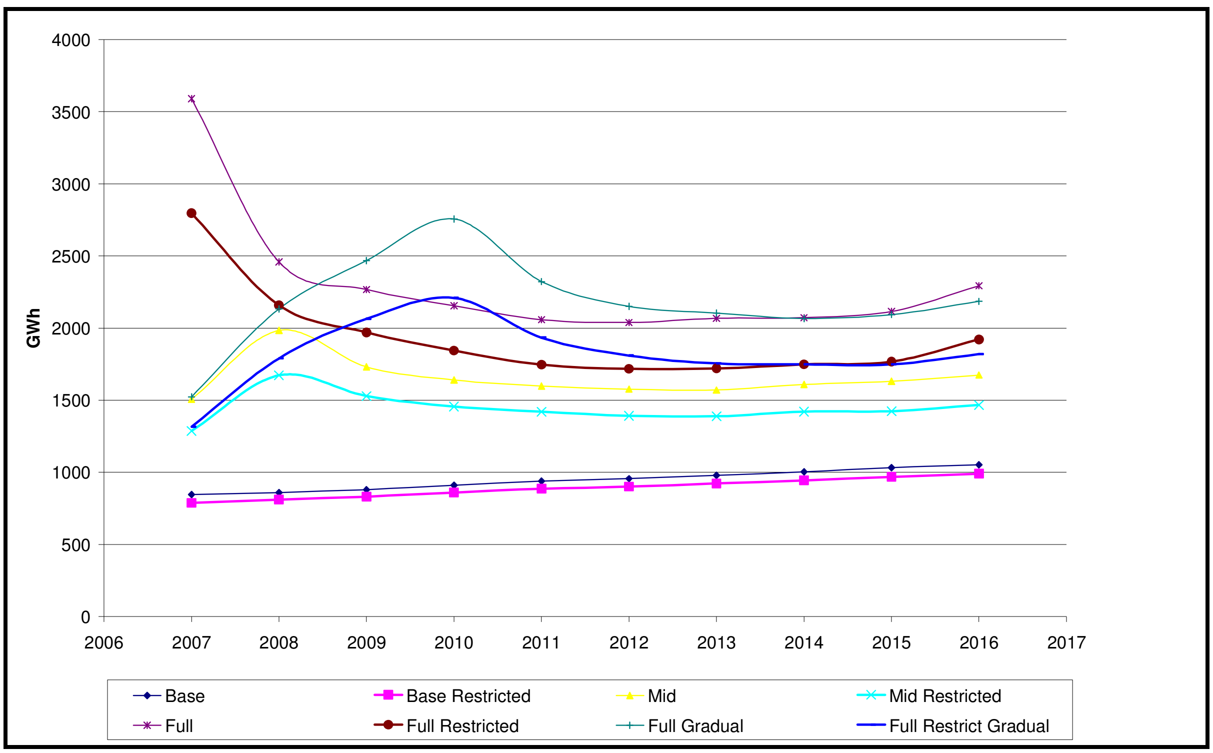
[10] The study assumed that the re-adoption of high efficiency measures was not incentivized in the industrial sector, and that lighting *fixtures* were automatically replaced with high efficiency fixtures and the replacements were not rebated. As noted previously, re-adoption was not assumed to be automatic for screw-in CFLs and other measures. In those cases, adoption was explicitly re-modeled at the end of the useful life.

Table 4-6: California IOU First-Year Net Program Energy Efficiency Potential – 2007-2016 and 2026 (GWh)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	845	786	754	1505	1282	3593	2789	1522	1312
2008	859	809	765	1982	1668	2459	2151	2131	1786
2009	878	830	779	1729	1525	2267	1964	2467	2060
2010	909	859	804	1639	1453	2154	1838	2758	2202
2011	938	885	812	1597	1417	2057	1741	2323	1928
2012	954	899	808	1575	1389	2038	1714	2151	1805
2013	978	920	813	1570	1385	2067	1717	2104	1751
2014	1001	942	813	1608	1418	2071	1745	2066	1745
2015	1031	967	800	1631	1422	2114	1765	2093	1745
2016	1051	988	823	1673	1465	2293	1918	2184	1817
2026	1239	1144	897	1919	1655	2477	2092	2460	2079

Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

Figure 4-5: California IOU First-Year Net Program Energy Efficiency Potential – 2007-2016 (GWh)



Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

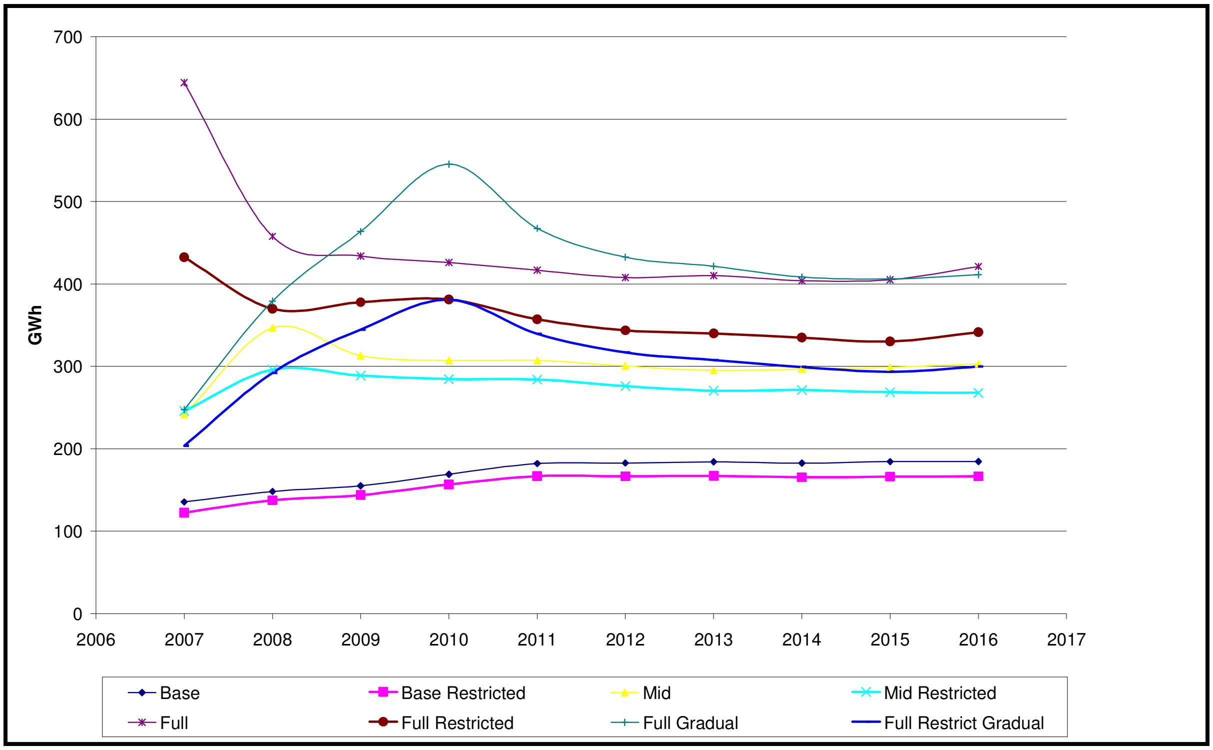
The Base scenario net program first-year coincident peak demand potential averages about 170 MW between 2007 through 2016. Restricting measures to those with a TRC ≥ 0.85, reduces net first-year program potential to about 160 MW per year between 2007 through 2016. Increasing funding to the Mid incentive level leads to a significant increase in first-year net program potential savings. The Mid scenario net program first-year potential averages about 310 MW per year while the Mid Restricted scenario net program first-year potential averages about 250 MW per year. The Full Gradual scenario gradually increases incentives to reach a full incremental cost value in 2010. The Full Gradual scenario net program first-year coincident peak demand potential savings averaged about 420 MW per year while the Full Restricted Gradual scenario net program first-year demand potential savings averaged about 315 MW per year.

Table 4-7: California IOU First-Year Net Program Coincident Peak Demand Efficiency Potential – 2007-2016 and 2026 (MW)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	135	122	118	243	197	680	442	249	205
2008	148	137	129	356	272	470	369	388	298
2009	155	143	138	324	261	457	349	492	353
2010	169	156	143	317	258	448	339	585	394
2011	182	166	143	317	258	439	326	497	353
2012	183	166	141	311	250	430	316	459	330
2013	184	167	142	305	244	432	314	447	320
2014	182	165	143	307	245	426	310	433	311
2015	184	166	138	309	243	428	305	430	304
2016	184	166	140	313	247	444	317	435	306
2026	217	190	152	330	276	430	372	429	373

Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level.

Figure 4-6: California IOU First-Year Net Program Coincident Peak Demand Efficiency Potential – 2007-2016 (MW)



Refer to Table 4-1 for a description of the scenarios. The savings potential estimates are at the generation level

4.2.2 California IOU Natural Gas Potential

Table 4-8 through Table 4-10 lists the natural gas potential while Figure 4-7 through Figure 4-9 illustrates the natural gas potential. The gross market potential is listed for 2007-2016 and 2026 while the net first-year program potential focuses only on the first 10 years of the forecast period.

Total Market Natural Gas Potential

Table 4-8 lists the total gross market and naturally occurring natural gas potential for 2007-2016 and 2026. The Base scenario natural gas gross market potential is 171 million therms for 2007-2016 and 329 million therms for 2007-2026. Restricting measures to those that have a TRC $\geq$ 0.85 leads only to a slight reduction in potential. The Base Restricted scenario potential is 153 million therms for 2007-2016 and 294 million therms for 2007-2026. These results imply that the design of the current IOU natural gas programs includes only a limited number of non-cost-effective measures and that the measures are not currently responsible for substantial savings.

Increasing incentives to halfway between current and full incentive, the Mid scenario increases potential savings to 383 million therms for 2007-2016 and 726 million therms for

2007-2026. Restricting the Mid scenario to measures with a TRC > 0.85 reduces potential to 237 million therms for 2007-2016 and 475 million therms for 2007-2026. The savings potential of the Mid Restricted scenario is approximately 35% less than the Mid scenario. Increasing incentives leads to a dramatic increase in the adoption of non-cost-effective measures. In particular, many of the residential natural gas measures are not cost-effective, and the utilities need to determine which residential natural gas measures should receive an increase in incentives. Further increasing incentives to the Full increment cost level while restricting measures to those with a TRC > 0.85 leads to 327 million therms of potential for 2007-2016 and 595 million therms for 2007-2026.

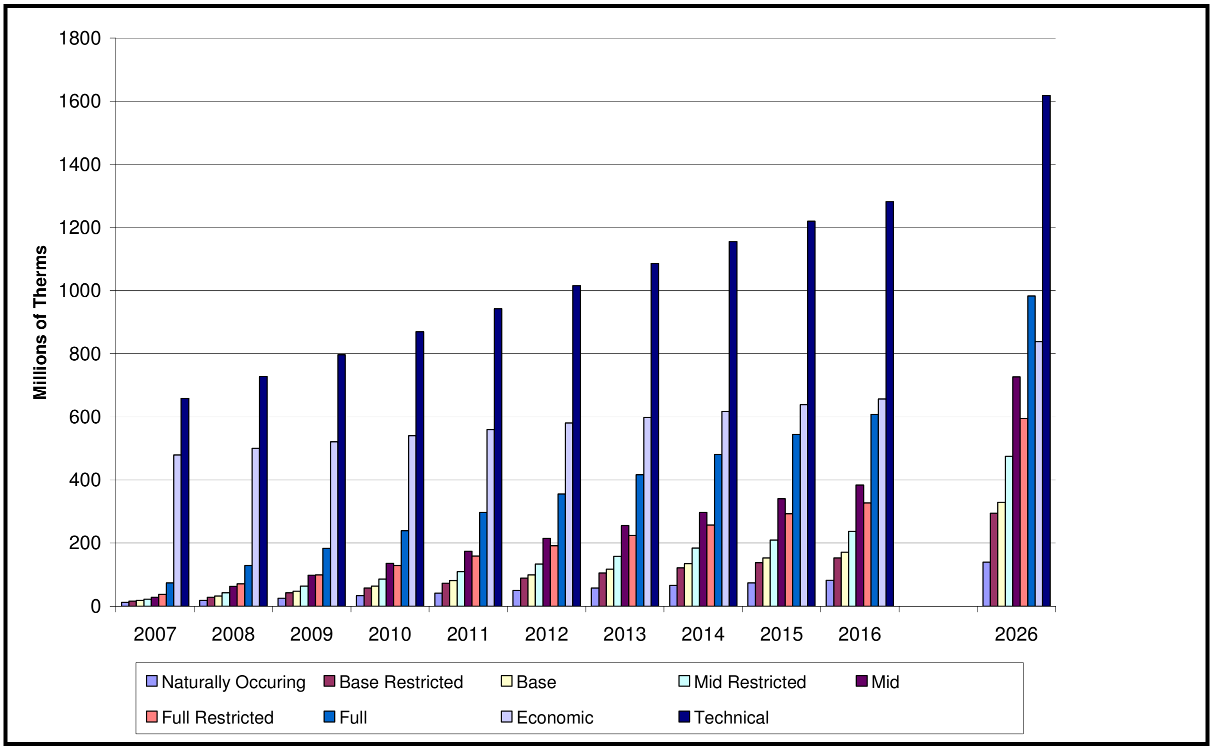
Table 4-8: California IOU Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	659	479	17	16	11	16	12	28	22	73	37	12
2008	727	500	32	29	18	30	20	63	43	128	70	19
2009	796	520	47	42	25	45	29	98	63	183	99	27
2010	869	539	63	57	33	61	39	135	85	239	128	35
2011	942	559	81	73	41	78	50	174	109	296	159	43
2012	1015	580	99	89	49	96	62	214	133	356	191	52
2013	1086	597	117	105	58	114	74	255	158	417	223	61
2014	1155	616	135	121	66	133	87	297	184	480	257	70
2015	1220	638	153	137	74	152	99	340	210	544	292	79
2016	1282	656	171	153	82	171	112	383	237	608	327	88
2026	1618	838	329	294	140	322	212	726	475	982	595	148

Refer to Table 4-1 for a description of the scenarios

Figure 4-7 illustrates the market total natural gas savings potential listed in Table 4-8. The data presented in the chart further emphasize the importance of controlling for cost-effectiveness when designing natural gas energy efficiency programs. For 2007-2026, the Full scenario potential exceeds the economic potential by approximately 150 million therms. Comparing the Full Restricted scenario with the economic potential, however, indicates that the TRC Restricted Full potential is 71% of the economic estimates.

Figure 4-7: California IOU Total Gross and Naturally Occurring Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios.

Sector-Level Total Market Electric Potential

The sector-level natural gas potential is presented in Table 4-9 and Figure 4-8. Under the Full Restricted scenario, the existing industrial sector is estimated to capture 45% of the natural gas potential while the existing residential sector's share is 36% and the existing commercial sector's share is only 5%. Once again, the natural gas potential results reinforce the importance of the cost-effectiveness tests. Comparing the Full and the Full Restricted potential, the existing industrial share under the Full scenario is only 24% while the existing residential share is 61%. Over half of the existing residential potential under the Full scenario, however, is not cost-effective while all of the industrial potential is.

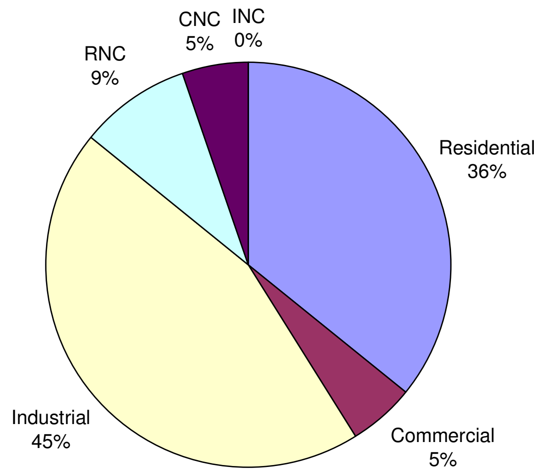
The industrial new construction natural gas potential is zero because the natural gas potential was not analyzed for this sector. The Mid scenario commercial new construction potential is higher than the Full scenario commercial new construction potential because the high efficiency packages analyzed for this sector allow fuel switching potential. As incentives increase from Mid to Full, commercial customers are forecast to obtain more of their high efficiency energy savings from electricity and less from gas.

Table 4-9: Sector-Level California IOU Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 (Millions of Therms)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	664	131	76	62	39	70	57	222	93	371	117	44
Commercial	70	45	13	12	9	13	11	27	15	36	17	10
Industrial	391	391	56	56	33	65	43	92	92	146	146	33
RNC	100	52	14	12	0	12	0	24	19	38	29	0
CNC	57	37	11	11	0	11	0	18	18	17	17	0
INC	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,282	656	171	153	82	171	112	383	237	608	327	88

Refer to Table 4-1 for a description of the scenarios.

Figure 4-8: California IOU Sector-Level Full Restricted Gross Natural Gas Potential – 2016 (Millions of Therms)



First-Year Natural Gas Program Potential

The first-year net gas program savings by scenario are listed in Table 4-10 and illustrated in Figure 4-9. The Base scenario net program first-year savings potential averages about 10 million therms and is growing over time. Restricting high efficiency measures to those with a TRC ≥ 0.85 reduces net first-year program savings potential to about 7 million therms. The low net first-year program potential savings are in part attributable to the high naturally occurring savings listed in Table 4-8.

Increasing funding to the Mid incentive level leads to a significant increase in first-year net program savings potential. The Mid scenario net program first-year potential averages about 32 million therms per year while the Mid Restricted scenario net program first-year savings potential averages about 14 million therms per year. Further increasing incentives to the Full incremental cost level leads to a large initial increase in potential in 2007 (64 million therms) with savings potential flattening out thereafter (averaging 54 million therms). The large jump in potential reflects the large quantity of conversion and retrofit adoptions that are forecast to occur if incentives are instantaneously increased to full incremental costs. The large increase in potential in 2007 under the Full incremental cost scenario is unlikely to be technically possible from a utility rebate-processing point of view and a technology market availability point of view.

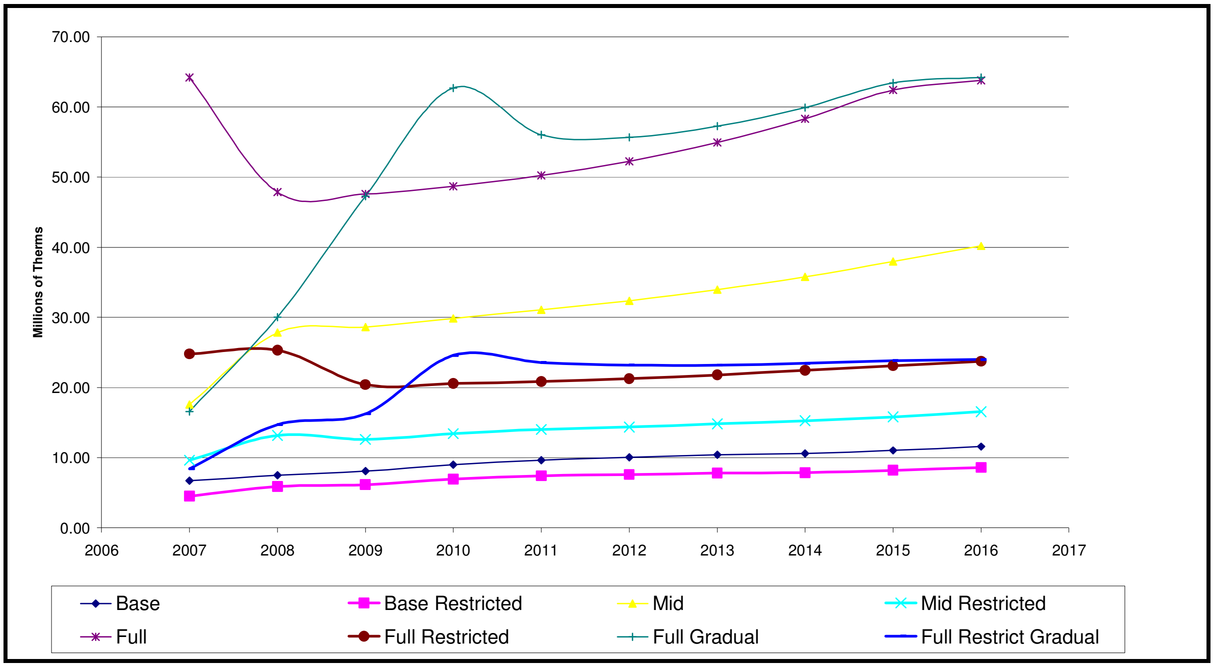
The Full Gradual scenario gradually increases incentives to reach a full incremental cost value in 2010. The Full Gradual scenario net program first year savings potential averaged about 51 million therms per year while the Full Restricted Gradual scenario net program first year savings potential averaged about 21 million therms per year.

Table 4-10: California IOU First-Year Net Program Natural Gas Efficiency Potential – 2007-2016 and 2026 (Million Therms)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	6.7	4.5	4.4	17.6	9.6	64.2	24.8	16.6	8.4
2008	7.5	5.9	5.4	27.8	13.2	47.9	25.3	30.0	14.7
2009	8.1	6.1	5.8	28.6	12.6	47.6	20.4	47.3	16.2
2010	9.0	6.9	5.9	29.9	13.4	48.7	20.6	62.7	24.6
2011	9.6	7.4	5.7	31.1	14.0	50.2	20.8	56.0	23.6
2012	10.0	7.6	5.9	32.4	14.4	52.2	21.3	55.7	23.2
2013	10.4	7.8	6.3	34.0	14.8	55.0	21.8	57.2	23.2
2014	10.6	7.9	6.7	35.8	15.3	58.3	22.5	59.9	23.4
2015	11.0	8.2	7.1	38.0	15.8	62.4	23.1	63.4	23.8
2016	11.6	8.6	7.5	40.2	16.6	63.8	23.8	64.2	24.0
2026	18.8	15.4	9.3	48.2	27.0	59.2	39.3	58.9	39.5

Refer to Table 4-1 for a description of the scenarios.

Figure 4-9: California IOU First-Year Net Program Natural Gas Efficiency Potential – 2007-2016 (Million Therms)



4.2.3 California IOU Costs and Benefits

Table 4-11 presents the estimates of costs and benefits associated with the different funding and TRC restriction scenarios. The costs and benefits presented in the table have been limited to the Base scenario and the three TRC Restricted scenarios. The substantial increase in costs with only very limited increases in savings associated with the higher non-restricted funding levels, limits the usefulness of the Mid and Full non-restricted scenarios.

If the utilities continue with their 2004-2005 energy efficiency programs, the estimated TRC is 1.23. Alternatively, if the utilities decided to limit their current list of high efficiency measures to those with a TRC > 0.85 while continuing with their current incentive levels, the estimated TRC is 2.02. The importance of the TRC restriction can be seen when comparing the PDV of Net Measure Costs between the Base and the Base Restricted scenarios. Continuing the current measure list and incentives implies a PDV of net measure costs of $6,021 million compared with the Base Restricted net measure costs of $2,705 million. The much smaller difference in the incentive differential, $3,316 million for the Base scenario and $2,155 million for the Base Restricted, indicates that the utilities are currently limiting their incentives for these high cost, low savings measures. If the utilities offer these non-cost effective measures in their portfolios with higher incentives (e.g., the Mid or Full incentive level), the adoption of these measures will significantly increase, increasing costs to the ratepayers with very limited benefits.

If the utilities increase their funding and restrict measures to those with a TRC > 0.85, the Mid Restricted scenario TRC is estimated to be 1.90 and the estimate of the Full Restricted scenario TRC is 1.74.

Table 4-11: Statewide Costs and Benefits – 2007-2026

	Base	Base Restrict	Mid Restrict	Full Restrict
PDV Gross Incentives	3,316,571	2,155,254	5,056,694	10,517,238
PDV Net Measure Costs*	6,021,551	2,705,105	5,429,971	8,740,474
PDV Gross Program Costs*	921,219	840,049	1,149,083	1,433,527
PDV Net Elec Avoided Cost Benefits	7,254,718	6,316,892	10,752,184	14,971,054
PDV Net Gas Avoided Cost Benefits	1,300,328	861,149	1,725,253	2,735,215
TRC	1.23	2.02	1.90	1.74

Refer to Table 4-1 for a description of the scenarios. Costs and Benefits are in $1000. A 5% discount rate has been used to discount future dollars.

4.3 Utility-Level Potential

This section aggregates the sector utility-level potential to the utility level to provide an estimate of the total utility-level potential. The estimates are presented at the total market level and the first-year program level for electric energy, coincident peak demand, and natural gas.

4.3.1 PG&E Electric Energy Potential

<u>PG&E Total Electric Potential</u>

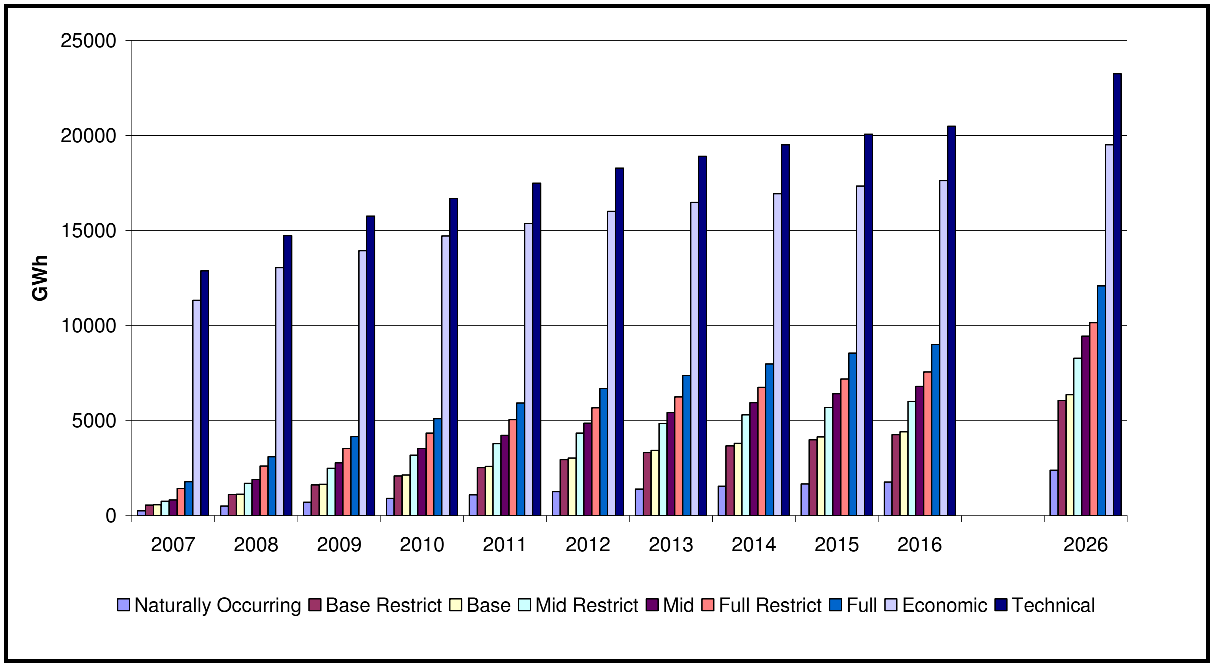
Table 4-12 and Figure 4-10 depict the total gross market and naturally occurring energy efficiency potential across all sectors for the PG&E service territory. Under the Base scenario, the gross energy efficiency potential for 2007-2016 is 4,418 GWh while the net potential is 2,647 GWh. Extending the forecast period to 2026 increases the gross potential to 6,350 GWh and the net potential to 3,964 GWh. The implied net-to-gross ratio is about 60%. Restricting measures to those with a TRC > 0.85 leads to only about a 4% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 6,800 GWh for 2007-2016 and 9,443 GWh for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 12%. The increase in incentives has encouraged more of PG&E's customers to purchase non-cost-effective measures. Further increasing incentives to the Full incremental cost level increases potential to 9,018 GWh for 2007-2016 and 12,093 GWh for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 16%.

Table 4-12: PG&E Total Gross Market and Naturally Occurring Energy Efficiency Potential – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	12845	11274	569	558	257	578	288	834	766	1785	1440	261
2008	14698	12996	1136	1112	496	1166	577	1896	1705	3103	2609	503
2009	15726	13885	1648	1611	708	1705	848	2773	2495	4162	3537	719
2010	16644	14653	2134	2081	904	2226	1114	3538	3173	5098	4337	918
2011	17458	15312	2595	2525	1086	2720	1369	4232	3785	5932	5037	1103
2012	18243	15944	3029	2939	1255	3181	1614	4861	4338	6687	5668	1274
2013	18879	16425	3429	3320	1407	3601	1840	5427	4834	7374	6228	1429
2014	19480	16877	3798	3671	1545	3979	2049	5949	5289	7988	6734	1570
2015	20026	17278	4139	3992	1670	4307	2239	6418	5688	8547	7182	1697
2016	20455	17561	4418	4254	1771	4569	2396	6800	6005	9018	7544	1800
2026	23217	19457	6350	6048	2386	6261	3330	9443	8269	12093	10138	2433

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-10: PG&E Total Gross Market and Naturally Occurring Energy Efficiency Potential – 2007-2016 and 2026 (GWh)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

<u>PG&E Sector Level Total Electric Potential</u>

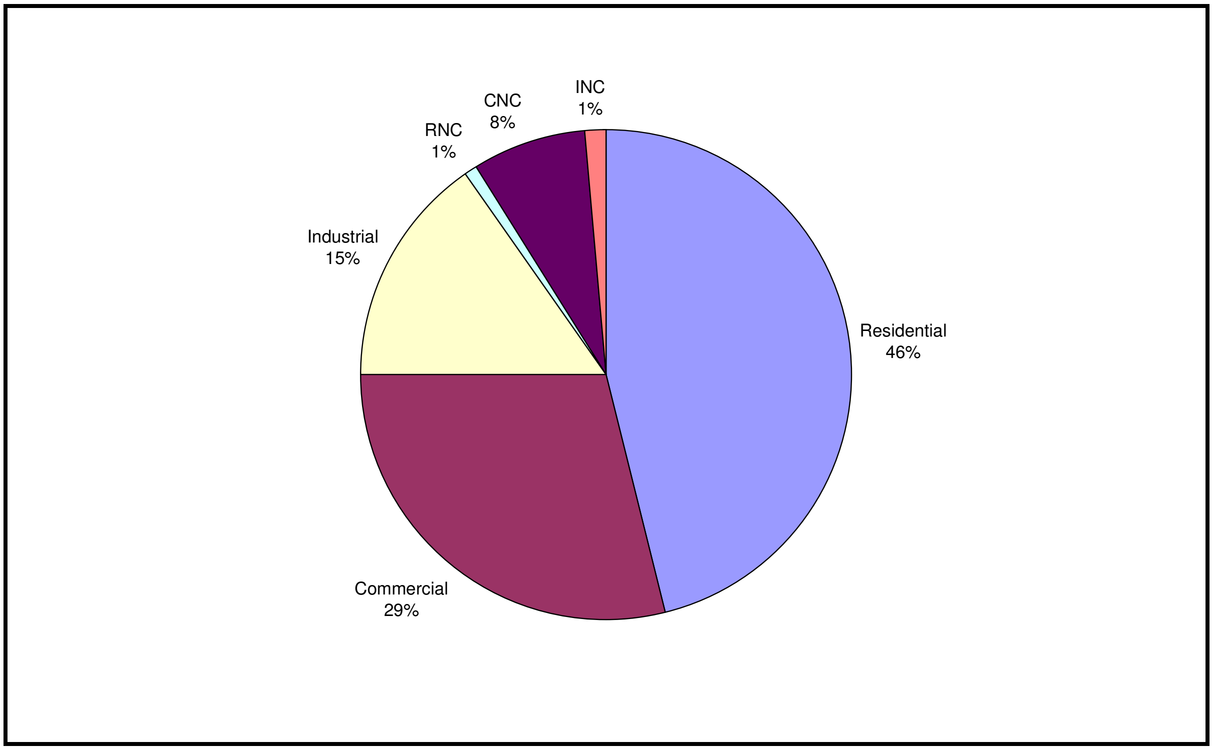
Table 4-13 and Figure 4-11 present the sector-level total market electric energy efficiency potential for the PG&E service territory for measures adopted from 2007 to 2016 that are still installed in 2016. Under the Full Restricted scenario, the existing residential sector accounts for 46% of PG&E energy efficiency potential, while the existing nonresidential sector contributes 44% and the new construction sector adds 10%.

Table 4-13: Sector-Level PG&E Total Gross Market and Naturally Occurring Energy Potential – 2007-2016 (GWh)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	10061	8082	2109	1983	750	2128	1030	3515	2904	4560	3477	770
Commercial	5905	5210	1194	1168	535	1292	795	1781	1655	2479	2183	545
Industrial	2605	2446	765	752	416	798	500	1005	946	1250	1155	416
RNC	147	97	27	27	0	27	0	42	42	63	63	0
CNC	1604	1593	240	240	0	240	0	367	367	570	570	0
INC	132	132	84	84	70	85	71	90	90	96	96	70
Total	20455	17561	4418	4254	1771	4569	2396	6800	6005	9018	7544	1800

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-11: PG&E Sector-Level Full Restricted Gross Market Energy Potential – 2007-2016 (GWh)



The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

PG&E First Year Electric Program Potential

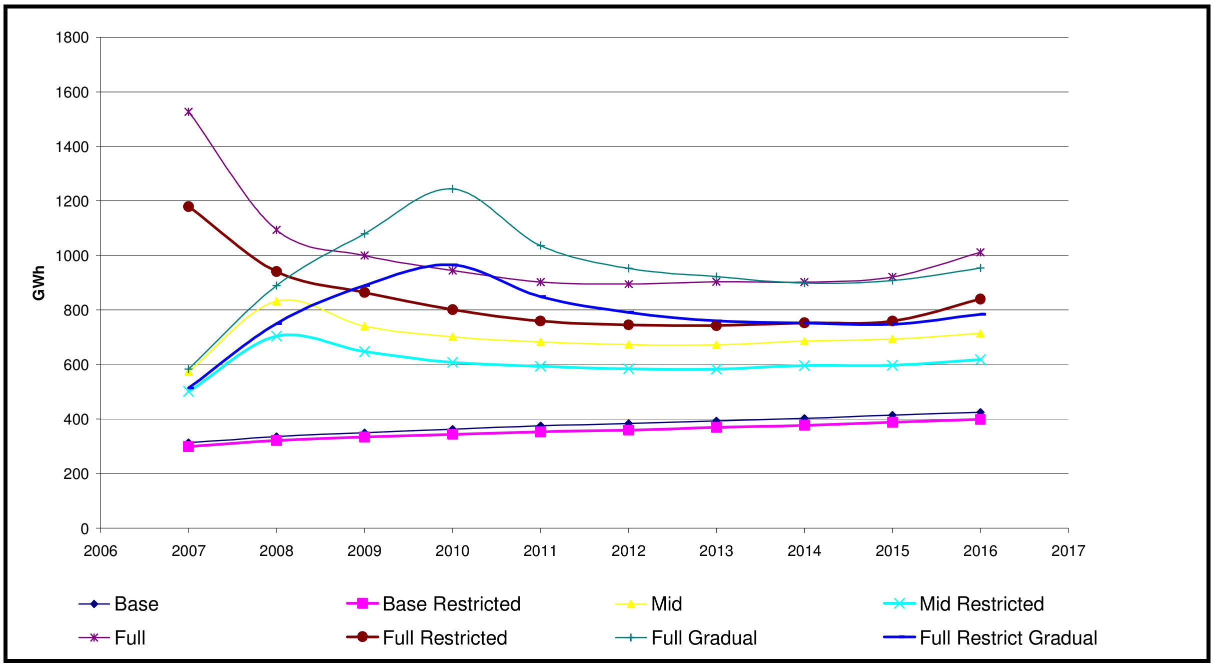
Table 4-14 and Figure 4-12 present the PG&E first-year net program energy efficiency potential for 2007-2016 and 2026. If PG&E were to continue with its current program, the model estimates that it would average 375 GWh of energy efficiency program savings per year. If PG&E increased its funding level to the Mid level, the average potential would be 697 GWh per year. Increasing funding to the Full Gradual level would increase savings potential to an average of 947 GWh per year.

Table 4-14: PG&E First-Year Net Program Electric Energy Efficiency Potential – 2007-2016 and 2026 (GWh)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	313	299	289	574	501	1527	1177	583	513
2008	335	321	305	832	702	1094	939	889	749
2009	350	334	314	740	646	1000	862	1080	889
2010	362	344	323	701	607	945	799	1245	963
2011	375	353	326	683	593	903	758	1036	847
2012	383	359	325	673	584	894	744	953	790
2013	393	369	327	672	583	903	742	922	759
2014	402	377	325	686	596	902	752	899	752
2015	414	388	320	693	597	921	758	908	747
2016	424	398	330	714	617	1012	839	954	783
2026	514	471	377	849	719	1128	927	1118	919

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-12: PG&E First-Year Net Program Electric Energy Efficiency Potential – 2007-2016 (GWh)

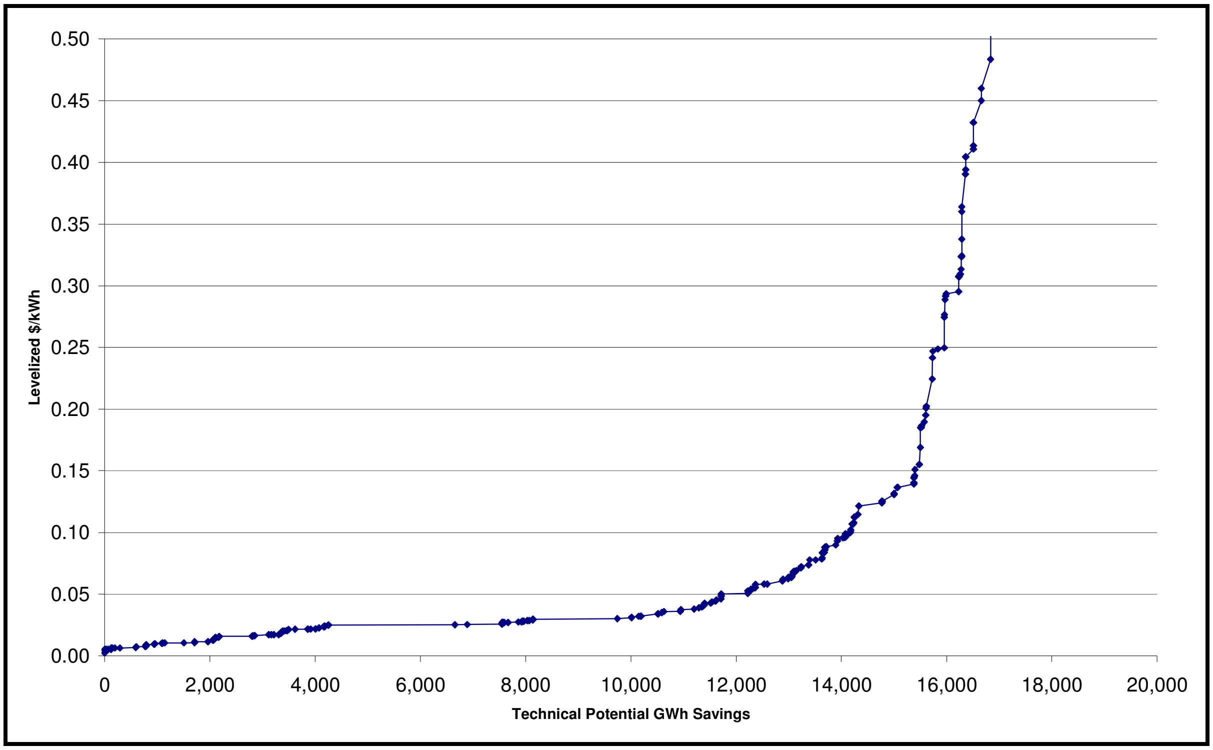


Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

PG&E Electric Supply Curve

Figure 4-13 illustrates the technical supply curve for PG&E for measures with a levelized cost per kWh saved of less than $0.50.[11] Measures with more than 200 GWh of technical potential by 2016 and a cost of less than $0.1/kWh are listed in Table 4-15.[12] The technical supply curve sorts the quantity and cost of technical potential such that those measures with the lowest cost are listed or added to the supply curve first. This ordering is equivalent to assuming that customers acquire all energy savings devices from least expensive to most expensive. The assumption of customer acquisition based upon cost is somewhat counter factual. Individual households, business, and industrial clients will purchase energy efficiency based upon their individual needs, desires, and concerns. These needs, desires, and concerns are market barriers that may limit the acquisition of some high efficiency measures with very low costs, while leading to the acquisition of other measures, which appear less desirable from a purely cost and benefit analysis.

Figure 4-13: PG&E Supply Curve Technical Energy Efficiency Potential – 2007-2016 (GWh)



11 A full listing of the potential and cost for all measures is available in the appendix.

12 The supply curve and the tabulation of data do not include the savings and cost data for refrigerator and freezer recycling. The adoption of these measures do not provide the customer with a similar service measures, these measures assume that the customer is willing to accept a lower service. The adoption of these measures is truly limited by the public's willingness to accept this reduction in services. Due to the differences in service level, this measure has been dropped from this presentation.

Table 4-15 includes 17 high efficiency measures with more than 200GWh of potential. These 17 high efficiency measures account for about 9,100 GWh of technical potential in 2016, or approximately 52% of PG&E's technical potential. Of the 17 high efficiency measures, 11 are lighting measures, with the residential CFLs 14-25 W having the largest technical savings potential of 2,400 GWh. The top potential measures on the supply curve reinforce the importance of lighting within the electric potential.

Table 4-15: PG&E Supply Curve Technical Energy Efficiency Potential for Measures with Technical Potential in Excess of 200 GWh – 2007-2016

Sector and Technology	Technical Potential Savings, 2016	Levelized $/kWh
Commercial CFL Over 24W	305	0.007
Commercial CLF Reflector	365	0.010
Commercial CFL 16-24W	205	0.011
Industrial Pump Control	249	0.011
Residential CFL Reflector	622	0.016
Commercial Computer 80+	264	0.017
Commercial Refrigeration Evap Fan ECM	238	0.022
Residential CFL 14-25W	2,400	0.025
Industrial Pump System Optimization	236	0.025
Residential CFL_25+W	661	0.026
CNC	1,604	0.030
Commercial PSMH Interior	267	0.031
Commercial T8 2Generation 4Ft	325	0.034
Industrial T8	310	0.036
Residential CFL Under14W	253	0.038
Residential CFL Torchiere	505	0.050
Commercial Oven	288	0.061

Measures were restricted to those with a cost of less than $ 0.10 per kWh.

4.3.2 SCE Electric Energy Potential

SCE Total Electric Potential

Table 4-16 and Figure 4-14 depict the total gross market and naturally occurring energy efficiency potential across all sectors for the SCE service territory. Under the Base scenario, the gross energy efficiency potential for 2007-2016 is 5,489 GWh while the net potential is 3,258 GWh. Extending the forecast period to 2026 increases the gross potential to 7,470 GWh and the net potential to 4,648 GWh. The implied net-to-gross ratio is about 60%. Restricting measures to those with a TRC > 0.85 leads to only about a 3.5% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 7,891

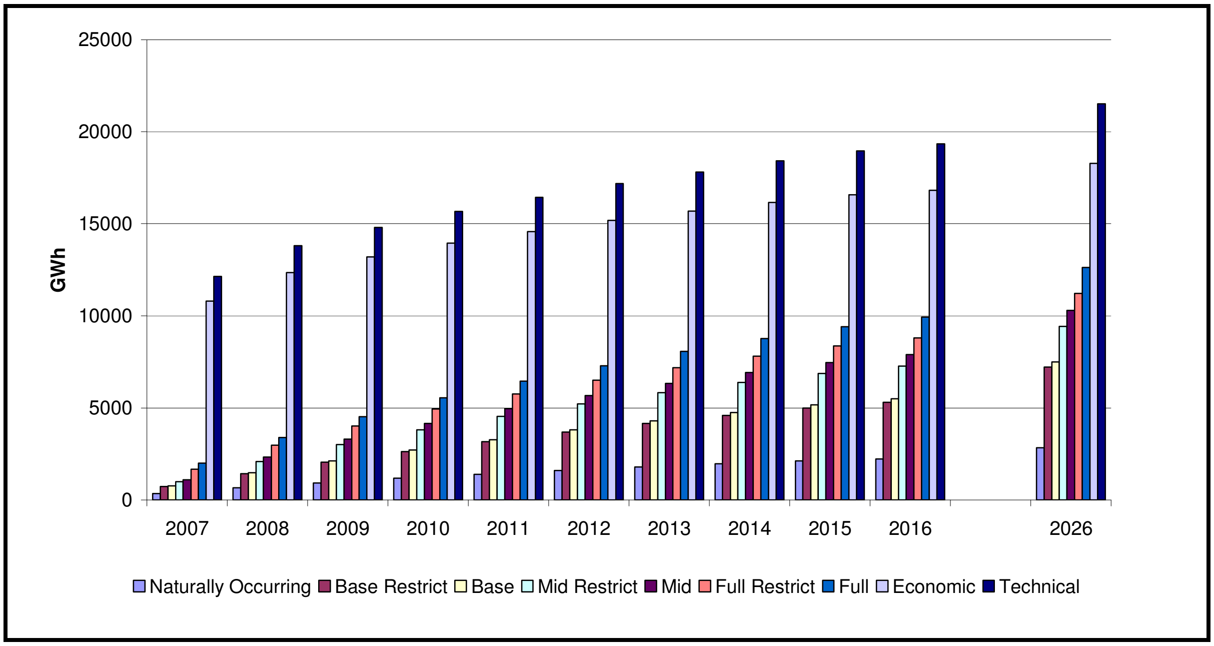
GWh for 2007-2016 and 10,293 GWh for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 8%. The increase in incentives has encouraged more of SCE's customers to purchase non-cost-effective measures. Further increasing incentives to the Full incremental cost level increases potential to 9,925 GWh for 2007-2016 and 12,629 GWh for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 11%.

Table 4-16: SCE Total Gross Market and Naturally Occurring Energy Efficiency Potential – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	12098	10726	764	735	341	759	382	1094	989	1993	1673	344
2008	13768	12274	1484	1433	655	1496	757	2324	2090	3389	2966	662
2009	14745	13126	2115	2043	926	2157	1102	3305	2999	4525	4001	937
2010	15620	13867	2708	2618	1172	2799	1438	4165	3802	5543	4918	1187
2011	16391	14504	3270	3162	1399	3418	1766	4947	4533	6456	5732	1418
2012	17133	15110	3799	3674	1610	4001	2084	5669	5203	7295	6480	1633
2013	17761	15605	4287	4146	1798	4537	2377	6317	5807	8070	7162	1825
2014	18361	16074	4739	4583	1967	5023	2649	6917	6365	8769	7784	1997
2015	18912	16499	5156	4982	2116	5448	2895	7460	6862	9410	8345	2150
2016	19285	16745	5489	5301	2231	5785	3095	7891	7250	9925	8779	2269
2026	21464	18191	7470	7188	2822	7484	4069	10293	9408	12629	11201	2873

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-14: SCE Total Gross Market and Naturally Occurring Energy Efficiency Potential – 2007-2016 and 2026 (GWh)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SCE Sector Level Total Electric Potential

Table 4-17 and Figure 4-15 present the sector-level total market electric energy efficiency potential for the SCE service territory for measures adopted from 2007 through 2016 and still installed in 2016. Under the Full Restricted scenario, the existing residential sector accounts for 39% of SCE energy efficiency potential, while the existing nonresidential sector contributes 50% and the new construction sector adds 11%.

The residential electric savings share for SCE is less than for PG&E and SDG&E due to the allocation of savings associated with dual fuel measures in the residential sector. Residential dual fuel measures include insulation and duct repair in homes with gas heat and central air conditioning, and high efficiency dishwashers in homes with gas water heating. These measures generate both electricity and gas savings. The potential associated with these measures was not estimated in the SCE residential sector. The electric and gas potential associated with these measures was assumed to be claimed by SCG.[13] The electric savings from these measures is included in the statewide totals but is not given the explicit IOU-level presentation of the other electric savings.

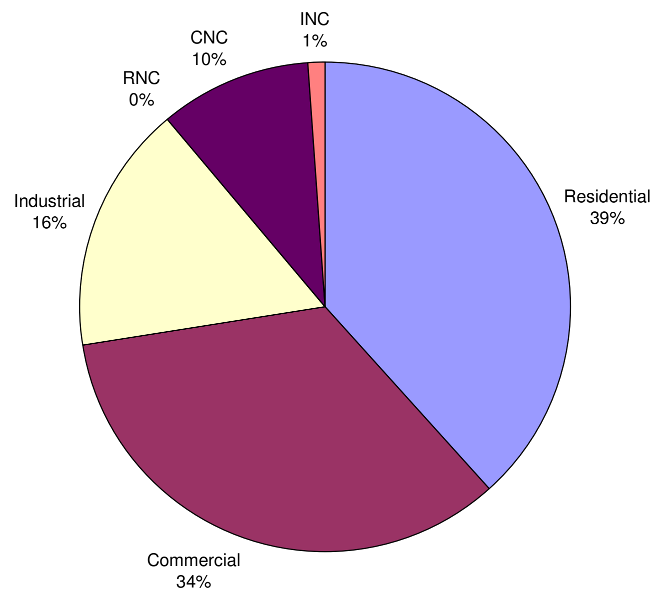
[13] To ensure that a measure's savings are not double counted, each measure's potential is only estimated for one utility. There is substantial overlap of SCE and SCG service territory. To ensure that the energy savings potential for dual fuel measures is counted, it is allocated to SCG, to ensure that it is not double counted, it is not counted for SCE. Dual fuel measures are only estimated for the residential sector. For all electric home, SCE was allocated the savings from insulation, duct repair, and dish washers.

Table 4-17: Sector-Level SCE Total Gross Market and Naturally Occurring Energy Potential – 2007-2016 (GWh)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	7558	6259	2327	2198	925	2405	1315	3341	2961	4039	3376	950
Commercial	6657	5922	1719	1712	741	1929	1112	2585	2446	3316	3004	754
Industrial	2930	2730	954	920	495	978	596	1262	1166	1552	1419	495
RNC	172	79	19	0	0	0	0	25	0	39	0	0
CNC	1814	1602	380	380	0	380	0	582	582	879	879	0
INC	153	153	91	91	70	94	72	96	96	101	101	70
Total	19285	16745	5489	5301	2231	5785	3095	7891	7250	9925	8779	2269

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-15: SCE Sector-Level Full Restricted Gross Market Energy Potential – 2007-2016 (GWh)



The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

SCE First Year Electric Potential

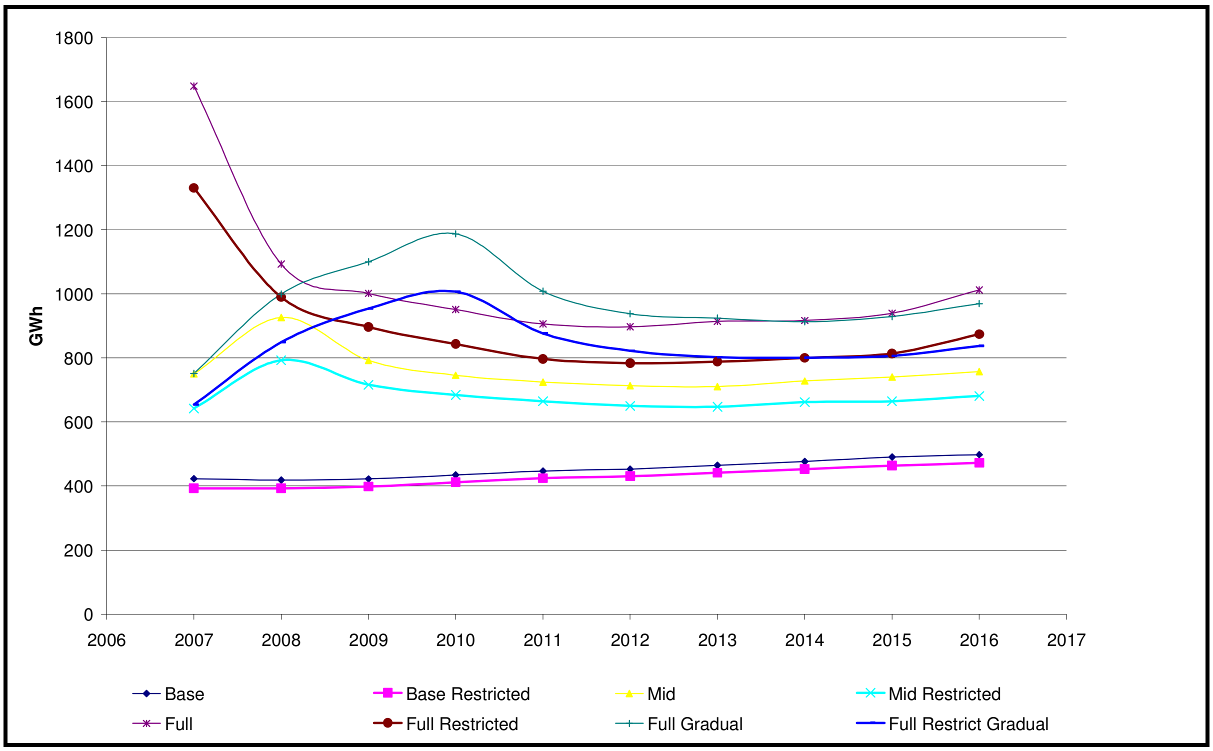
Table 4-18 and Figure 4-16 present the SCE first-year net program energy efficiency potential for 2007-2016 and 2026. If SCE were to continue with its current program, the model estimates that it would average 452 GWh of net energy efficiency program savings per year. If SCE increased its funding level to the Mid level, the net average savings would be 758 GWh per year. Increasing funding to the Full Gradual level would increase net savings potential to an average of 972 GWh per year.

Table 4-18: SCE First-Year Net Program Electric Energy Efficiency Potential – 2007-2016 and 2026 (GWh)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	423	392	375	750	640	1649	1326	751	652
2008	418	392	372	925	790	1093	986	999	846
2009	421	398	374	791	714	1001	893	1100	951
2010	434	411	387	745	682	950	840	1188	1002
2011	446	424	393	724	663	906	794	1008	873
2012	453	430	391	713	648	896	782	938	820
2013	464	440	393	710	646	913	786	924	800
2014	476	451	392	727	660	916	798	913	799
2015	490	463	385	740	664	939	812	929	805
2016	497	471	396	757	680	1012	873	969	836
2026	571	532	417	848	740	1076	912	1070	905

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-16: SCE First-Year Net Program Electric Energy Efficiency Potential – 2007-2016 (GWh)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SCE Electric Supply Curve

Figure 4-17 illustrates the technical supply curve for SCE. The individual measures with more than 200 GWh of technical potential by 2016 and with a levelized cost of less than $0.10/kWh are listed in Table 4-19.[14] The technical supply curve sorts the quantity and cost of technical potential such that those measures will the lowest cost are listed or added to the supply curve first.

Figure 4-17: SCE Supply Curve Technical Energy Efficiency Potential – 2007-2016 (GWh)

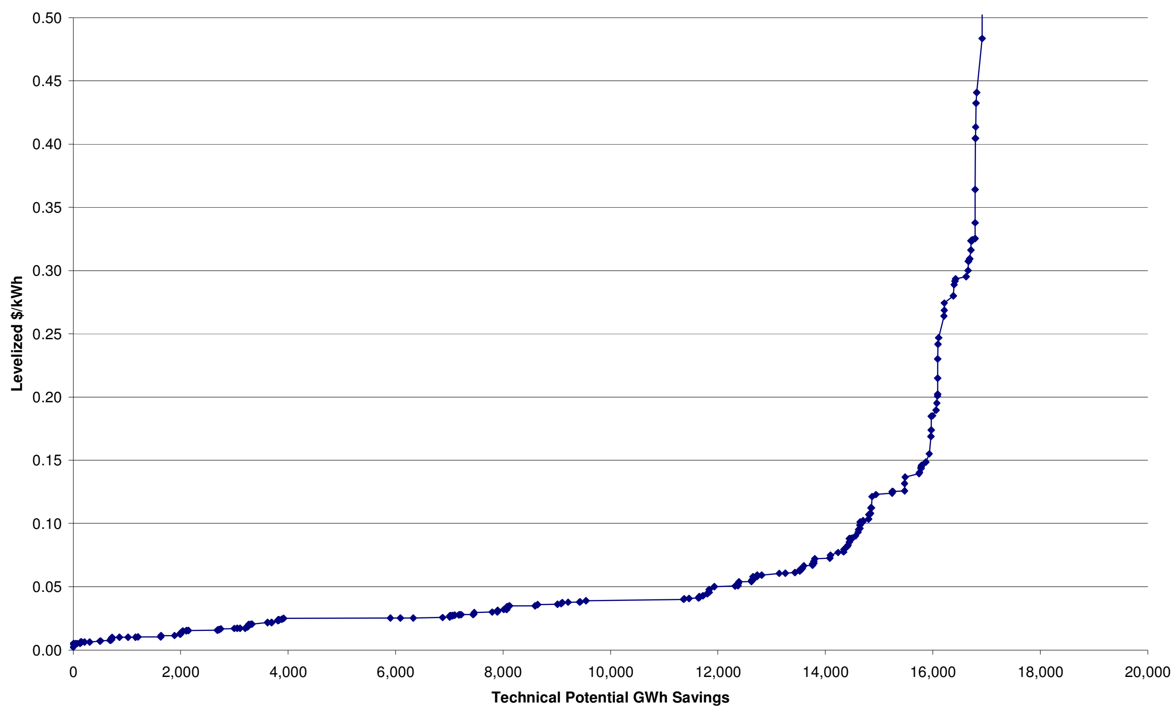


Table 4-19 includes 17 high efficiency measures with more than 200GWh of potential. These 17 high efficiency measures account for about 8,900 GWh of technical potential in 2016, or approximately 51% of SCE's technical potential. Of the 17 high efficiency measures, 10 are lighting measures, with the residential CFLs 14-25 W having the largest technical savings potential of 1,986 GWh. The top potential measures on the supply curve reinforce the importance of lighting within the electric potential.

[14] The supply curve and the tabulation of data do not include the savings and cost data for refrigerator and freezer recycling. The adoption of these measures do not provide the customer with a similar service measures, these measures assume that the customer is willing to accept a lower service. The adoption of these measures is truly limited by the public's willingness to accept this reduction in services. Due to the differences in service level, this measure has been dropped from this presentation.

Table 4-19: SCE. Supply Curve Technical Energy Efficiency Potential for Measures with Technical Potential in Excess of 200 GWh – 2007-2016

Sector and Technology	Technical Potential 2016	Levelized $/kWh
Commercial CFL Reflectors	424	0.010
Industrial Pump Controls	255	0.011
Residential CFL Reflectors	536	0.016
Commercial Computer 80+	254	0.017
Commercial Refrigeration Evap Fan ECM	289	0.022
Residential CFL 14 to 25 W	1,986	0.025
Industrial Pump Optimization	240	0.025
Residential CFL 25+ W	547	0.026
Commercial LED Exit	221	0.028
Commercial PSMH Interior	338	0.030
Commercial T8 2nd Gen 4Ft	478	0.035
Industrial T8	372	0.036
Residential CFL Under 14W	209	0.038
Commercial New Construction	1,814	0.040
Residential CFL Torchiere	389	0.050
Commercial Packaged Air Conditioner less than 65 KBTUH SEER 15	233	0.054
Commercial Packaged Air Conditioner greater than 65 KBTUH EER 12	324	0.061

4.3.3 SDG&E Electric Energy Potential

SDG&E Total Electric Potential

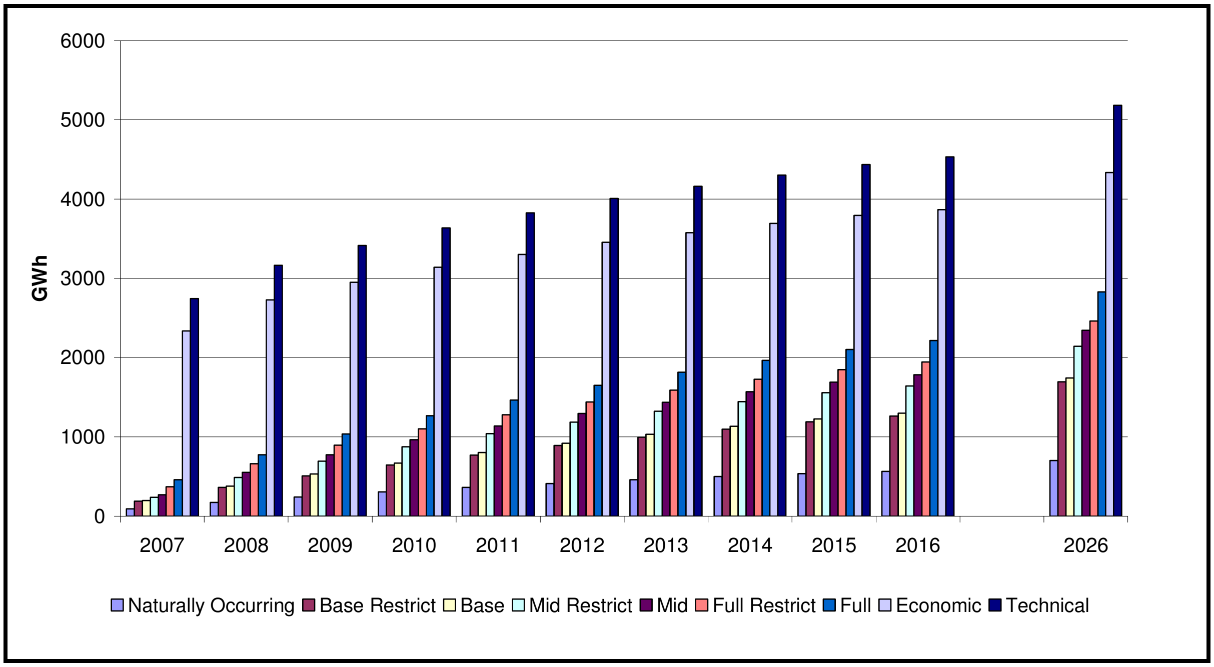
Table 4-16 and Figure 4-14 depict the total market gross and naturally occurring energy efficiency potential across all sectors for the SDG&E service territory. Under the Base scenario, the gross energy efficiency potential for 2007-2016 is 1,300 GWh while the net potential is 737 GWh. Extending the forecast period to 2026 increases the gross potential to 1,742 GWh and the net potential to 1,045 GWh. The implied net-to-gross ratio is about 58%. Restricting measures to those with a TRC > 0.85 leads to only about a 3% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 1,783 GWh for 2007-2016 and 2,345 GWh for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 8%. The increase in incentives has encouraged more of SDG&E's customers to purchase non-cost-effective measures. Further increasing incentives to the Full incremental cost level increases potential to 2,215 GWh for 2007-2016 and 2,828 GWh for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 12.5%.

Table 4-20: SDG&E Total Gross Market and Naturally Occurring Energy Efficiency Potential – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	2735	2324	199	187	91	194	103	269	236	460	368	93
2008	3157	2717	379	360	173	377	203	553	487	776	659	177
2009	3408	2938	531	507	242	538	295	773	693	1036	894	247
2010	3629	3129	670	643	304	692	384	965	875	1265	1099	311
2011	3821	3290	800	770	360	838	471	1138	1038	1466	1277	368
2012	4003	3443	920	889	411	973	554	1296	1186	1648	1440	421
2013	4154	3565	1031	997	457	1096	630	1436	1320	1815	1588	468
2014	4298	3681	1133	1098	499	1208	701	1569	1445	1967	1725	510
2015	4427	3783	1227	1189	535	1304	765	1688	1555	2104	1846	547
2016	4527	3855	1300	1262	563	1378	816	1783	1641	2215	1941	576
2026	5176	4323	1742	1691	697	1741	1052	2345	2142	2828	2455	716

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-18: SDG&E Total Gross Market and Naturally Occurring Energy Efficiency Potential – 2007-2016 and 2026 (GWh)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SDG&E Sector Level Total Electric Potential

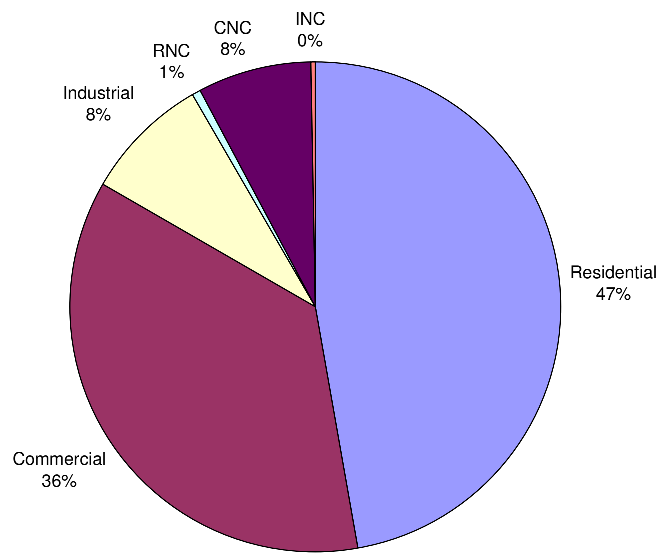
Table 4-21 and Figure 4-19 present the sector-level total market electric energy efficiency potential for the SDG&E service territory for measures adopted from 2007 to 2016 and still installed in 2016. Under the Full Restricted scenario, the existing residential sector accounts for 47% of SDG&E energy efficiency potential, while the existing nonresidential sector contributes 44% and the new construction sector adds 9%.

Table 4-21: SDG&E Sector-Level Total Gross Market and Naturally Occurring Energy Potential – 2007-2016 (GWh)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	2204	1720	647	615	283	677	414	914	806	1116	915	291
Commercial	1538	1382	443	441	210	488	317	595	574	758	703	215
Industrial	306	282	118	116	68	123	83	146	138	172	159	68
RNC	33	25	10	7	0	7	0	13	9	17	12	0
CNC	433	433	79	79	0	79	0	110	110	147	147	0
INC	13	13	4	4	2	4	2	4	4	5	5	2
Total	4527	3855	1300	1262	563	1378	816	1783	1641	2215	1941	576

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-19: SDG&E Sector-Level Full Restricted Gross Market Energy Potential – 2016 (GWh)



The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

SDG&E First Year Electric Potential

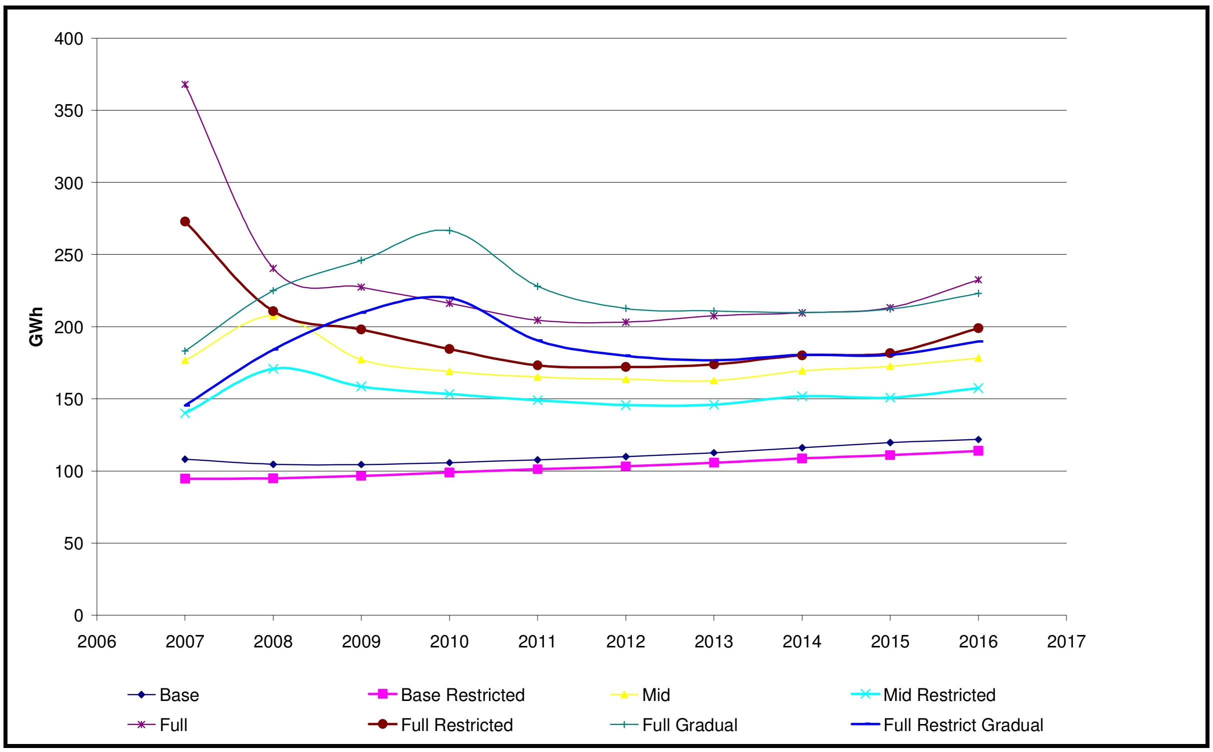
Table 4-18 and Figure 4-16 present the SDG&E first-year net program energy efficiency potential for 2007-2016 and 2026. If SDG&E were to continue with its current program, the model estimates that it would average 111 GWh of net energy efficiency program savings per year. If SDG&E increased its funding level to the Mid level, the net average savings would be 174 GWh per year. Increasing funding to the Full Gradual level would increase net savings potential to an average of 222 GWh per year.

Table 4-22: SDG&E First-Year Net Program Electric Energy Efficiency Potential – 2007-2016 and 2026 (GWh)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	108	95	90	177	140	368	273	183	145
2008	105	95	88	207	171	240	210	225	184
2009	104	96	89	177	158	227	198	246	210
2010	106	99	91	169	153	216	184	267	220
2011	108	101	90	165	149	204	173	228	190
2012	110	103	90	163	145	203	172	213	180
2013	113	106	90	163	146	207	174	211	177
2014	116	109	92	169	152	210	180	210	180
2015	120	111	91	173	151	213	182	212	180
2016	122	114	95	178	157	232	199	223	190
2026	146	134	101	205	174	252	205	251	204

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-20: SDG&E First-Year Net Program Electric Energy Efficiency Potential – 2007-2016 (GWh)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SDG&E Electric Supply Curve

Figure 4-21 illustrates the technical supply curve for SDG&E. The individual measures with more than 50 GWh of technical potential by 2016 and with a levelized cost of less than $0.10/kWh are listed in Table 4-23.[15] The technical supply curve sorts the quantity and cost of technical potential such that those measures will the lowest cost are listed or added to the supply curve first.

Figure 4-21: SDG&E Supply Curve Technical Energy Efficiency Potential – 2007-2016 (GWh)

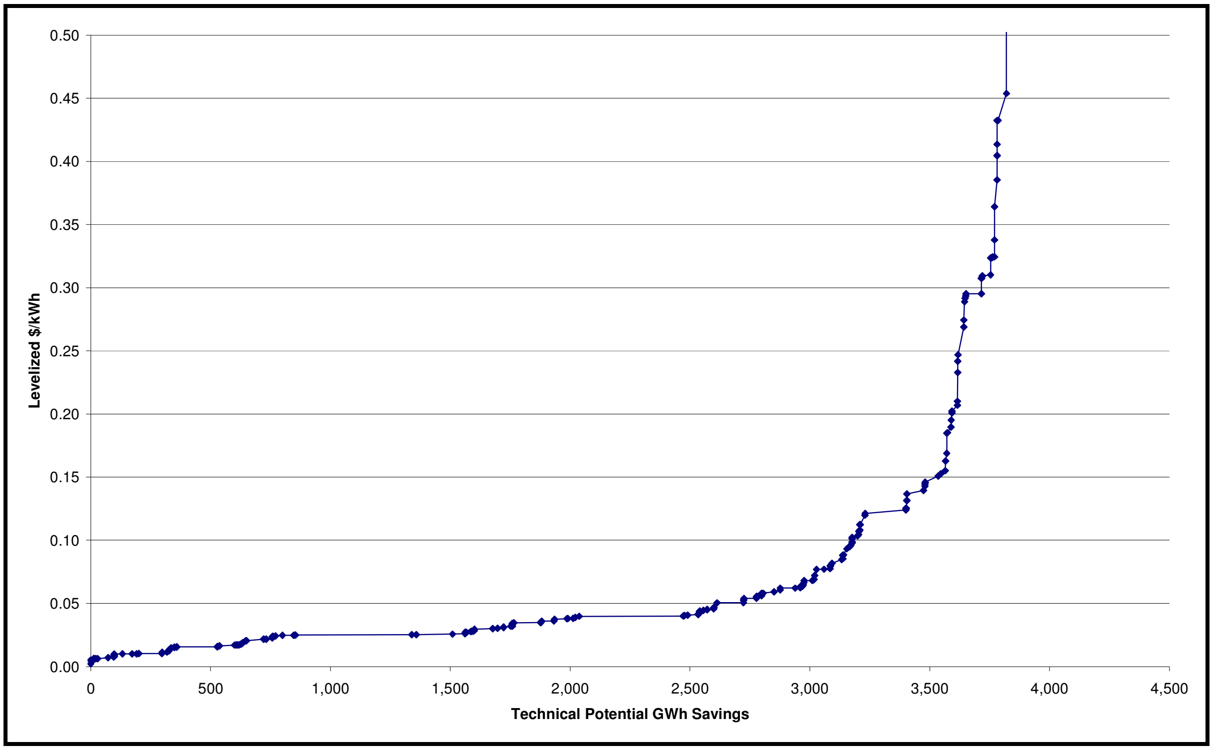


Table 4-23 includes 15 high efficiency measures with more than 50 GWh of potential. These 15 high efficiency measures account for about 2,000 GWh of technical potential in 2016, or approximately 52% of SDG&E's technical potential. Of the 15 high efficiency measures, 10 are lighting measures, with the residential CFLs 14-25 W having the largest technical savings potential of 486 GWh. The top potential measures on the supply curve reinforce the importance of lighting within the electric potential.

[15] The supply curve and the tabulation of data do not include the savings and cost data for refrigerator and freezer recycling. The adoption of these measures do not provide the customer with a similar service measures, these measures assume that the customer is willing to accept a lower service. The adoption of these measures is truly limited by the public's willingness to accept this reduction in services. Due to the differences in service level, this measure has been dropped from this presentation.

Table 4-23: SDG&E Supply Curve Technical Energy Efficiency Potential for Measures with Technical Potential in Excess of 50 GWh – 2007-2016

Sector and Technology	Technical Potential 2016	Levelized Cost $/kWh
Commercial CFL Reflector	96	0.010
Residential CFL Reflector	168	0.016
Commercial Computer 80+	63	0.017
Commercial Refrigeration Evap Fan ECM	71	0.022
Residential CFL 14-25 W	486	0.025
Residential CFL 25+ W	151	0.026
Commercial LED Exit	52	0.026
Commercial PSMH Interior	77	0.030
Commercial T8 2nd Gen 4Ft	111	0.035
Industrial T8	51	0.036
Residential CLF Under 14 W	51	0.038
Commercial New Construction	433	0.040
Commercial CFL Torchiere	110	0.050
Commercial Packaged Air Conditioner less than 65 KBTUH SEER 15	52	0.054
Commercial Packaged Air Conditioner greater than 65 KBTUH EER 12	62	0.062

4.3.4 PG&E Coincident Peak Demand Potential

PG&E Total Coincident Peak Demand Potential

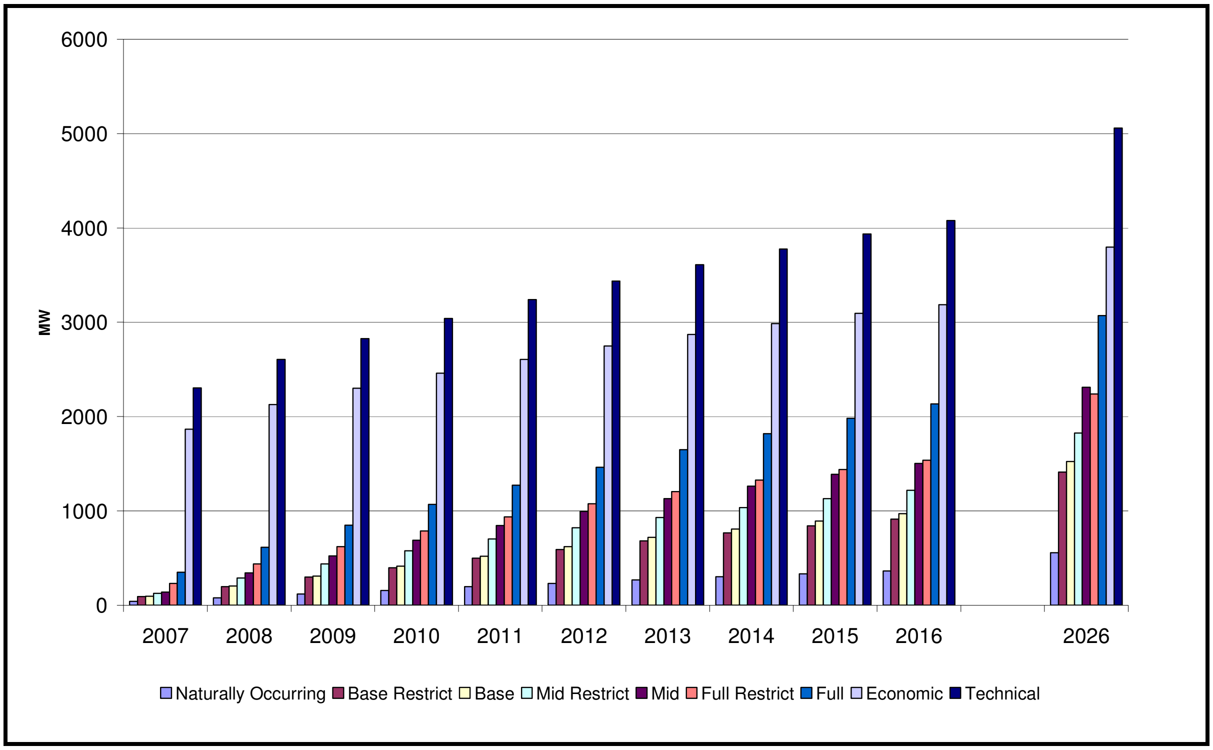
Table 4-24 and Figure 4-22 depict the total market gross and naturally occurring coincident peak demand potential across all sectors for the PG&E service territory. Under the Base scenario, the gross demand potential for 2007-2016 is 968 MW while the net potential is 606 MW. Extending the forecast period to 2026 increases the gross potential to 1,520 MW and the net potential to 964 MW. The implied net-to-gross ratio is about 63%. Restricting measures to those with a TRC > 0.85 leads to only about a 6% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 1,500 MW for 2007-2016 and 2,309 MW for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 19%. The increase in incentives has encouraged more of PG&E's customers to purchase non-cost-effective measures. The percentage fall due to cost-effectiveness is higher for the coincident peak demand potential than the energy potential because of non-cost-effectiveness of residential air conditioning. Further increasing incentives to the Full incremental cost level increases potential to 2,132 MW for 2007-2016 and 3,070 MW for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 27%.

Table 4-24: PG&E Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	2295	1856	95	92	41	98	48	138	124	349	229	41
2008	2598	2114	202	195	80	211	101	341	288	615	438	81
2009	2820	2289	307	296	118	325	156	522	438	849	620	120
2010	3031	2449	413	398	157	437	213	688	574	1067	784	158
2011	3232	2595	520	497	195	542	269	846	702	1271	934	197
2012	3427	2737	622	591	232	640	323	993	819	1463	1073	234
2013	3601	2859	718	681	267	733	374	1131	929	1647	1203	270
2014	3768	2976	808	763	301	820	422	1262	1033	1818	1324	304
2015	3927	3083	892	841	333	900	468	1387	1129	1981	1435	336
2016	4069	3175	968	911	362	972	509	1500	1215	2132	1535	365
2026	5051	3785	1520	1409	556	1460	772	2309	1823	3070	2235	562

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-22: PG&E Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

PG&E Sector Level Total Coincident Peak Demand Potential

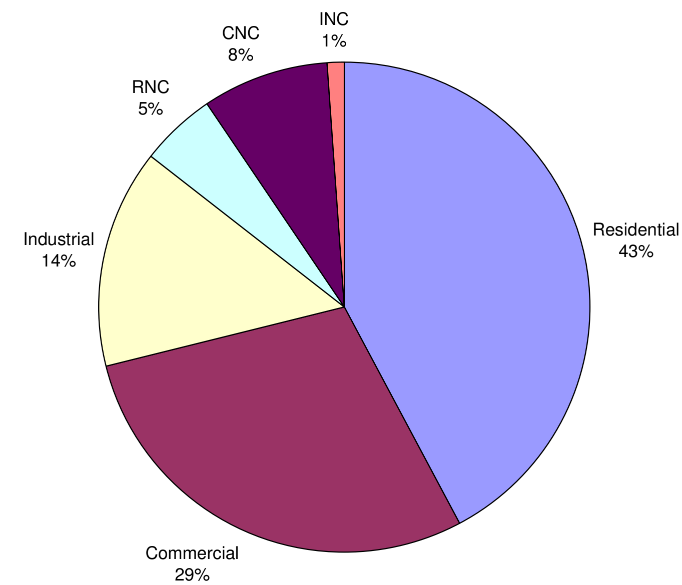
Table 4-21 and Figure 4-19 present the sector-level total market coincident peak demand potential for the PG&E service territory for measures adopted from 2007 to 2016 that are still installed in 2016. Under the Full Restricted scenario, the existing residential sector accounts for 43% of PG&E coincident peak demand potential, while the existing nonresidential sector contributes 43% and the new construction sector adds 14%. The share of peak demand potential associated with the new construction sector is higher than its share of energy efficiency potential due to the composition of the high efficiency new construction packages. The residential new construction packages consist of HVAC, shell, and water heating measures.

Table 4-25: PG&E Sector-Level Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 (MW)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	2016	1324	493	440	174	468	259	809	561	1179	648	176
Commercial	1035	912	231	228	101	252	148	354	327	497	447	102
Industrial	486	457	145	143	76	152	91	190	179	235	218	76
RNC	165	118	32	32	0	32	0	51	51	77	77	0
CNC	345	343	53	53	0	53	0	82	82	129	129	0
INC	22	22	14	14	12	14	12	15	15	16	16	12
Total	4069	3175	968	911	362	972	509	1500	1215	2132	1535	365

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-23: PG&E Sector-Level Full Restricted Gross Market Coincident Peak Demand Potential – 2007-2016 (MW)



The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

PG&E First Year Program Coincident Peak Demand Potential

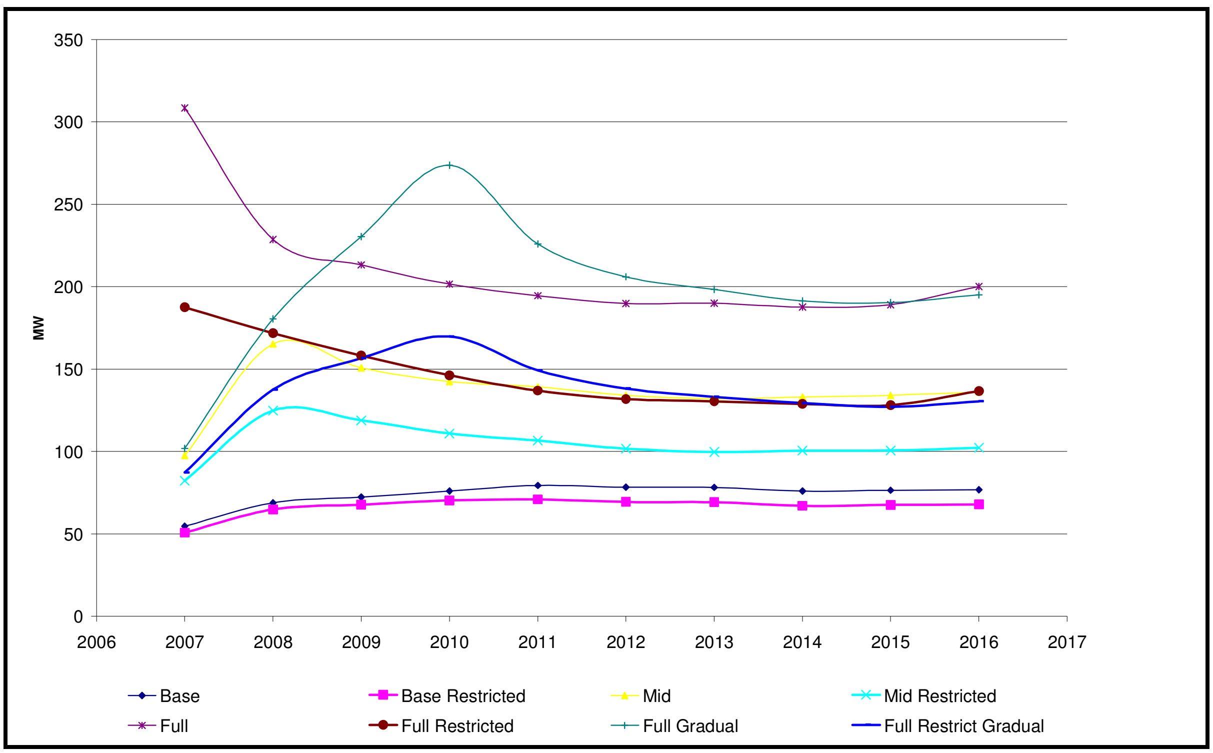
Table 4-26 and Figure 4-24 present the PG&E first-year net program coincident peak demand potential for 2007-2016 and 2026. If PG&E were to continue with its current program, the model estimates that it would average 74 MW of energy efficiency program savings per year. If PG&E increased its funding level to the Mid level, the average savings would be 136 MW per year. Increasing funding to the Full Gradual level would increase savings potential to an average of 200 MW per year.

Table 4-26: PG&E First-Year Net Program Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	55	51	50	97	82	309	187	102	87
2008	69	65	61	165	125	229	171	180	137
2009	72	68	64	151	119	213	158	230	156
2010	76	70	63	142	111	201	146	274	169
2011	79	71	58	139	106	194	137	226	149
2012	78	69	56	134	101	190	132	206	138
2013	78	69	57	132	100	190	130	198	133
2014	76	67	57	133	100	187	129	191	129
2015	76	67	56	134	100	189	128	190	127
2016	77	68	58	136	102	200	136	195	130
2026	95	80	67	149	115	196	150	195	149

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-24: PG&E First-Year Net Program Coincident Peak Demand Potential – 2007-2016 (MW)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

4.3.5 SCE Coincident Peak Demand Potential

SCE Total Coincident Peak Demand Potential

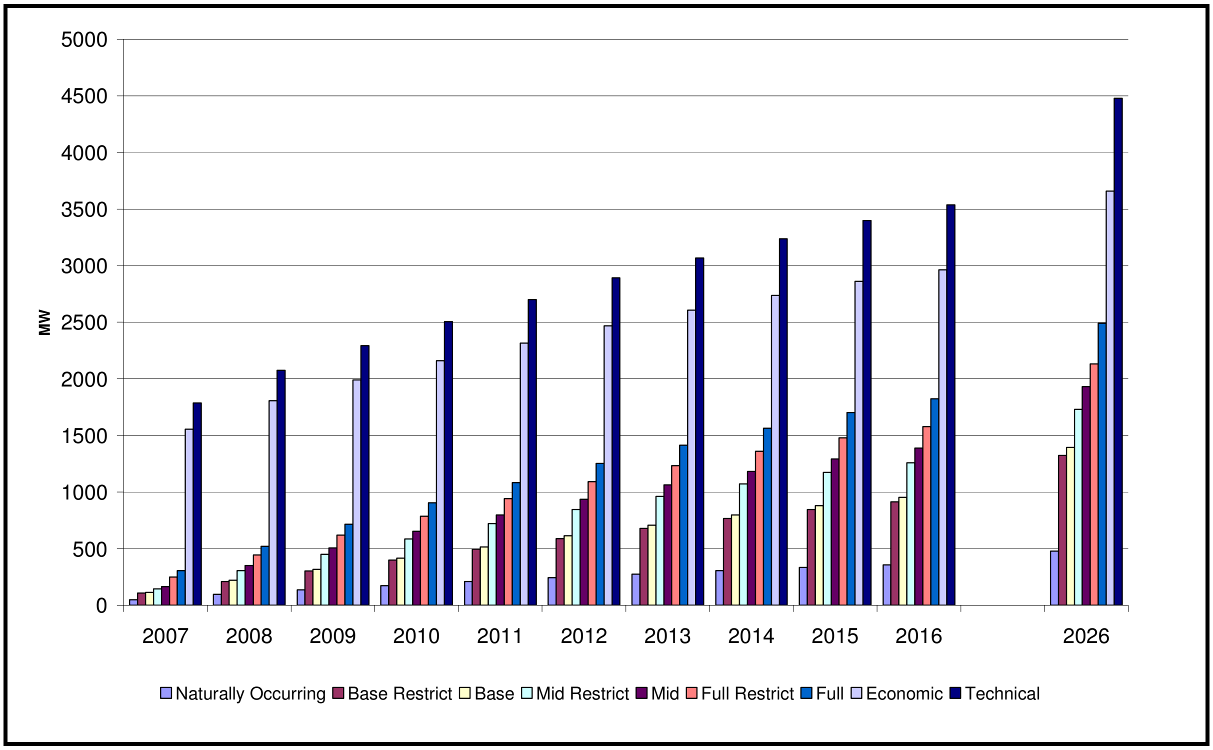
Table 4-27 and Figure 4-25 depict the total market gross and naturally occurring coincident peak demand potential across all sectors for the SCE service territory. Under the Base scenario, the gross demand potential for measures adopted from 2007 to 2016 that are still installed in 2016 is 951 MW while the net potential is 596 MW. Extending the forecast period to 2026 increases the gross potential to 1,390 MW and the net potential to 912 MW. The implied net-to-gross ratio is about 63%. Restricting measures to those with a TRC > 0.85 leads to only about a 4.5% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 1,388 MW for 2007-2016 and 1,930 MW for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 10%. The increase in incentives has encouraged more of SCE's customers to purchase non-cost-effective measures. The percentage fall due to cost-effectiveness is higher for the coincident peak demand potential than the energy potential because of non-cost-effectiveness of residential air conditioning. Further increasing incentives to the Full incremental cost level increases potential to 1,822 MW for 2007-2016 and 2,489 MW for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 14%.

Table 4-27: SCE Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	1778	1540	113	107	49	111	56	165	143	305	249	50
2008	2064	1791	219	209	95	219	111	349	304	520	442	96
2009	2285	1975	317	303	135	322	164	505	448	715	616	137
2010	2495	2145	415	397	173	430	217	653	584	904	783	175
2011	2691	2302	515	493	208	540	270	796	717	1082	939	210
2012	2882	2453	613	587	242	647	324	933	843	1251	1087	245
2013	3057	2590	706	677	274	748	374	1060	960	1413	1227	278
2014	3227	2721	795	762	304	843	423	1180	1069	1562	1355	308
2015	3389	2847	878	842	332	929	468	1291	1170	1701	1473	336
2016	3525	2946	951	910	355	1003	507	1388	1256	1822	1572	360
2026	4467	3641	1390	1320	478	1374	702	1930	1725	2489	2124	484

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-25: SCE Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SCE Sector Level Total Coincident Peak Demand Potential

Table 4-28 and Figure 4-26 present the sector-level total market coincident peak demand potential for the SCE service territory for measures adopted from 2007 to 2016 that are still installed in 2016. Under the Full Restricted scenario, the existing residential sector accounts for 27% of SCE coincident peak demand potential, while the existing nonresidential sector contributes 56% and the new construction sector adds 17%.

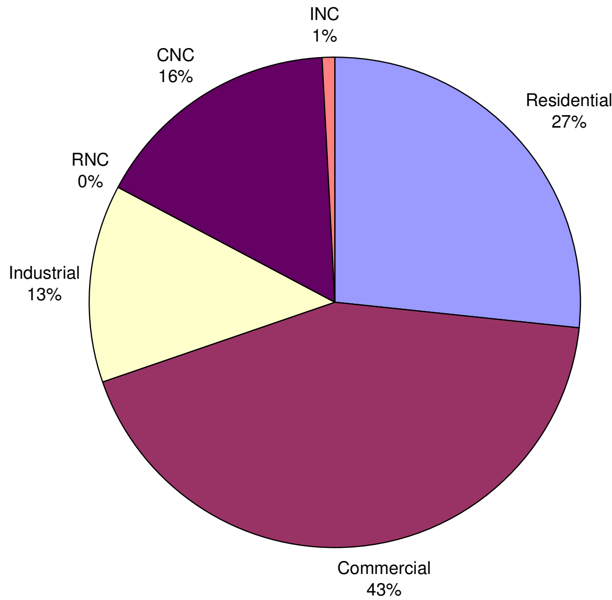
SCE residential coincident peak demand potential does not include the savings associated with insulation and duct repair in homes with gas heat and central air conditioning. These savings are assumed to be allocated to SCG's residential program. Allocating the savings from these measures to SCG reduces the residential share of coincident peak demand for SCE relative to the other two electric utilities.

Table 4-28: SCE Sector-Level Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 (MW)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	1129	813	291	271	112	307	166	434	360	582	422	114
Commercial	1317	1210	393	393	164	442	246	577	555	714	677	166
Industrial	413	379	133	128	69	136	84	180	164	224	201	69
RNC	122	52	15	0	0	0	0	20	0	30	0	0
CNC	523	472	105	105	0	105	0	163	163	257	257	0
INC	21	21	14	14	11	14	11	14	14	15	15	11
Total	3525	2946	951	910	355	1003	507	1388	1256	1822	1572	360

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-26: SCE Sector-Level Full Restricted Gross Market Coincident Peak Demand Potential – 2007-2016 (MW)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

SCE First Year Program Coincident Peak Demand Potential

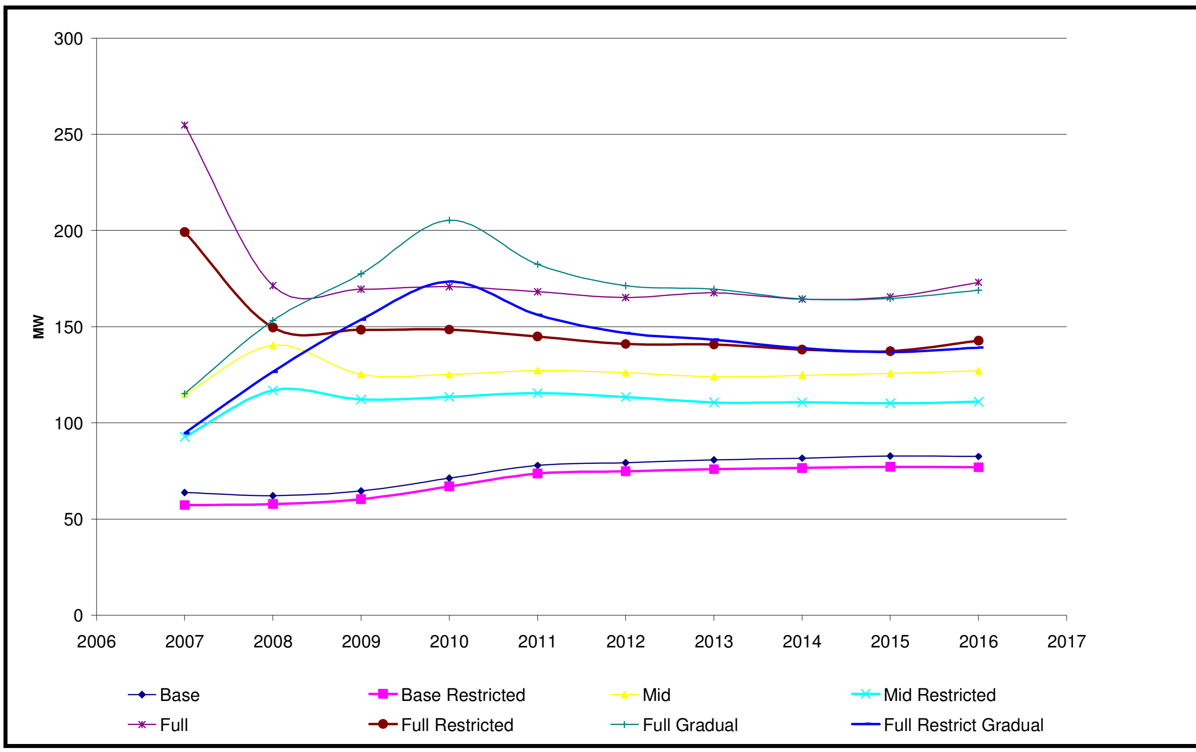
Table 4-29 and Figure 4-27 present the SCE first-year net program coincident peak demand potential for 2007-2016 and 2026. If SCE were to continue with its current program, the model estimates that it would average 75 MW of energy efficiency program savings per year. If SCE increased its funding level to the Mid level, the average savings would be 126 MW per year. Increasing funding to the Full Gradual level would increase savings potential to an average of 167 MW per year.

Table 4-29: SCE First-Year Net Program Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	62	58	54	140	117	171	149	153	126
2008	65	60	58	125	112	170	148	178	153
2009	71	67	64	125	113	171	148	206	173
2010	78	73	68	127	115	168	144	182	156
2011	79	75	68	126	113	165	141	171	146
2012	81	76	69	124	110	167	140	170	143
2013	82	76	69	125	110	164	138	164	138
2014	83	77	65	126	110	165	137	165	137
2015	82	77	66	127	111	173	142	169	139
2016									
	93	84	68	136	115	179	146	178	146
2026	62	58	54	140	117	171	149	153	126

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-27: SCE First-Year Net Program Coincident Peak Demand Potential – 2007-2016 (MW)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

4.3.6 SDG&E Coincident Peak Demand Potential

SDG&E Total Coincident Peak Demand Potential

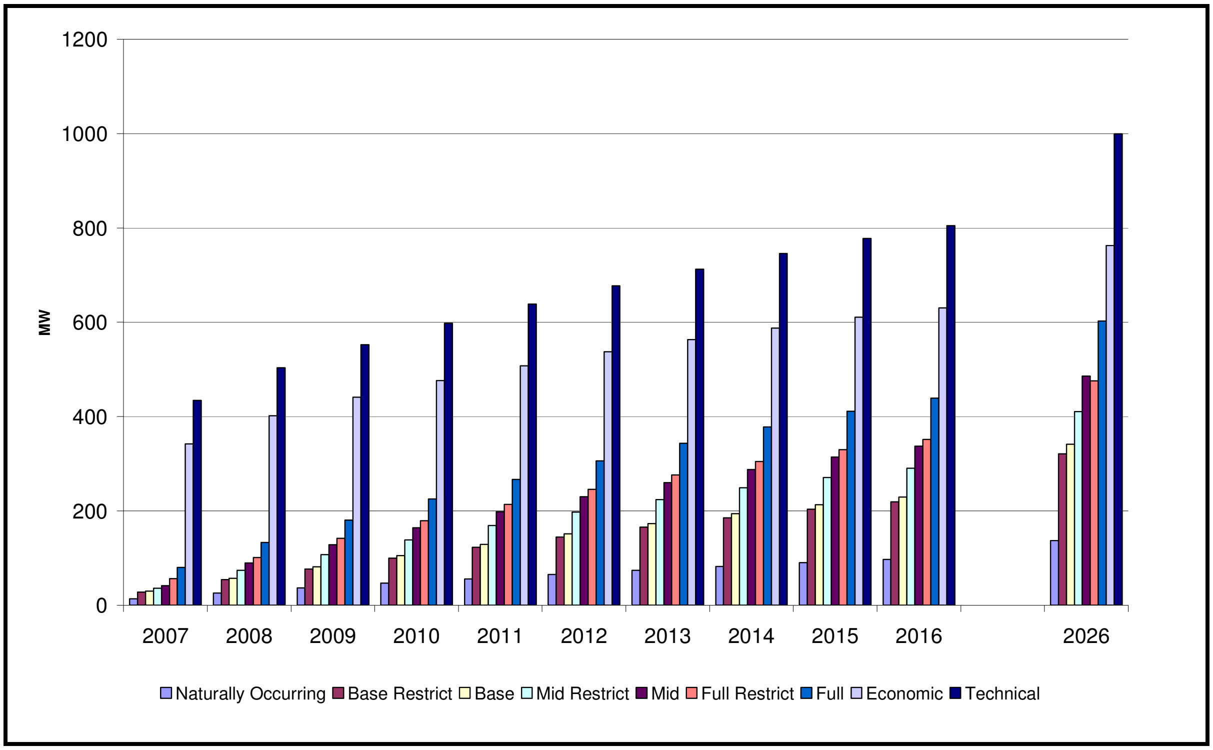
Table 4-30 and Figure 4-28 depict the total market gross and naturally occurring coincident peak demand potential across all sectors for the SDG&E service territory. Under the Base scenario, the gross demand potential for measures adopted from 2007 to 2016 that are still installed in 2016 is 229 MW while the net potential is 132 MW. Extending the forecast period to 2026 increases the gross potential to 341 MW and the net potential to 205 MW. The implied net-to-gross ratio is about 58%. Restricting measures to those with a TRC > 0.85 leads to only about a 5% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 337 MW for 2007-2016 and 485 MW for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 14%. The increase in incentives has encouraged more of SDG&E's customers to purchase non-cost-effective measures. The percentage fall due to cost-effectiveness is higher for the coincident peak demand potential than the energy potential because of non-cost-effectiveness of residential air conditioning. Further increasing incentives to the Full incremental cost level increases potential to 439 MW for 2007-2016 and 602 MW for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 20%.

Table 4-30: SDG&E Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	433	340	30	28	14	29	16	42	35	80	56	14
2008	502	399	57	54	26	56	31	89	74	133	101	27
2009	551	438	81	77	37	82	45	128	107	181	142	37
2010	596	473	105	100	47	108	60	164	139	225	179	47
2011	637	505	129	122	56	134	75	198	169	267	213	57
2012	676	535	151	144	65	159	90	230	197	306	245	66
2013	711	560	173	165	74	183	105	259	223	343	276	75
2014	744	585	193	185	82	205	119	288	248	378	304	83
2015	776	608	213	203	90	224	132	314	271	411	329	91
2016	803	627	229	218	97	241	144	337	290	439	350	98
2026	998	760	341	321	136	331	206	485	410	602	475	139

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-28: SDG&E Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SDG&E Sector Level Total Coincident Peak Demand Potential

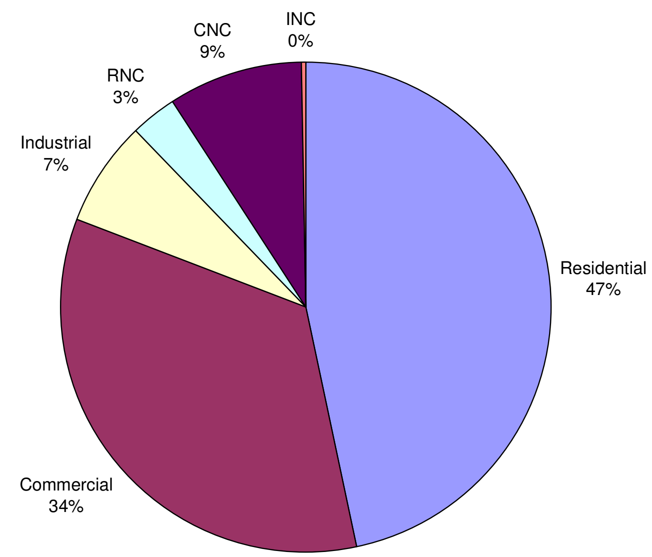
Table 4-31 and Figure 4-29 present the sector-level total market coincident peak demand potential for the SDG&E service territory for measures adopted from 2007 to 2016 that are still installed in 2016. Under the Full Restricted scenario, the existing residential sector accounts for 47% of SDG&E coincident peak demand potential, while the existing nonresidential sector contributes 41% and the new construction sector adds 12%.

Table 4-31: SDG&E Sector-Level Total Gross Market and Naturally Occurring Coincident Peak Demand Potential – 2007-2016 (MW)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	394	253	109	101	49	115	76	178	138	238	164	50
Commercial	245	224	76	76	37	84	55	101	98	127	120	38
Industrial	46	42	18	17	10	18	13	22	21	26	24	10
RNC	28	18	9	6	0	6	0	12	8	15	10	0
CNC	90	89	17	17	0	17	0	24	24	32	32	0
INC	2	2	1	1	0	1	0	1	1	1	1	0
Total	803	627	229	218	97	241	144	337	290	439	350	98

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-29: SDG&E Sector-Level Full Restricted Gross Market Coincident Peak Demand Potential – 2007-2016 (MW)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

SDG&E First Year Program Coincident Peak Demand Potential

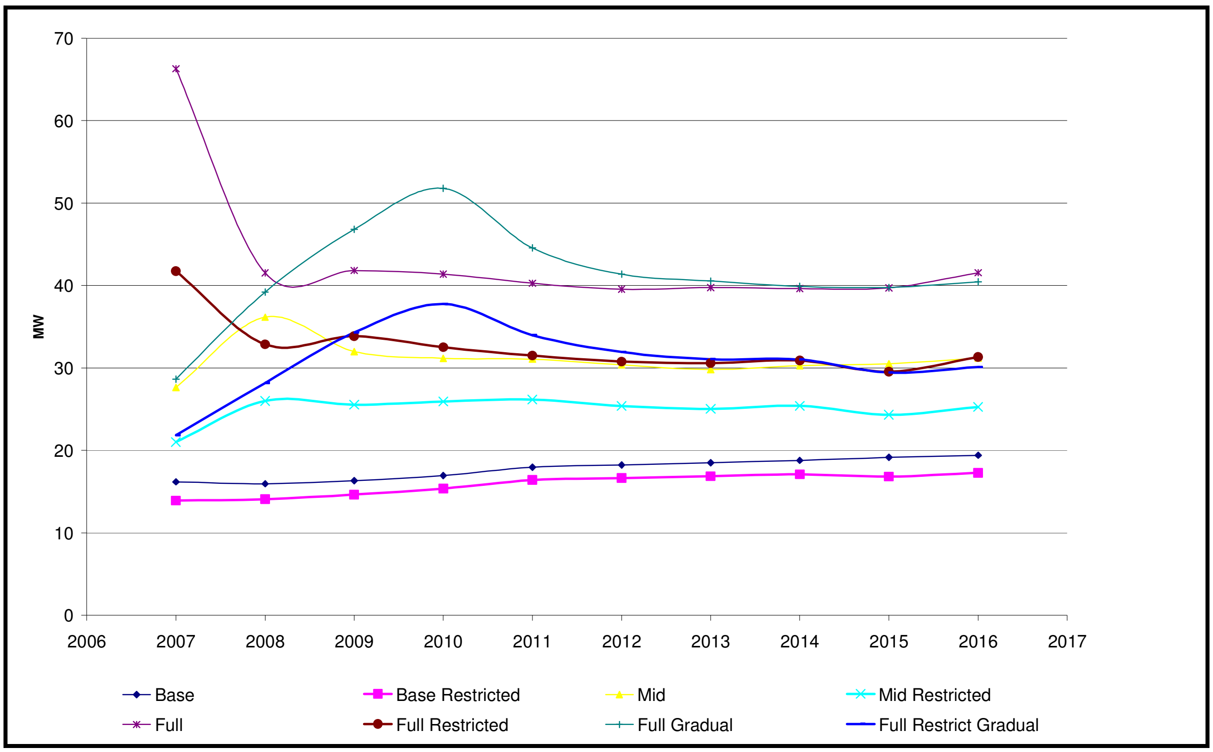
Table 4-29 and Figure 4-27present the SDG&E first-year net program coincident peak demand potential for 2007-2016 and 2026. If SDG&E were to continue with its current program, the model estimates that it would average 18 MW of energy efficiency program savings per year. If SDG&E increased its funding level to the Mid level, the average savings would be 31 MW per year. Increasing funding to the Full Gradual level would increase savings potential to an average of 41 MW per year.

Table 4-32: SDG&E First-Year Net Program Coincident Peak Demand Potential – 2007-2016 and 2026 (MW)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	16	14	13	28	21	66	42	29	22
2008	16	14	13	36	26	42	33	39	28
2009	16	15	14	32	26	42	34	47	34
2010	17	15	14	31	26	41	32	52	38
2011	18	16	15	31	26	40	31	45	34
2012	18	17	15	30	25	40	31	41	32
2013	18	17	15	30	25	40	31	41	31
2014	19	17	15	30	25	40	31	40	31
2015	19	17	14	31	24	40	30	40	29
2016	19	17	15	31	25	42	31	40	30
2026	23	20	15	33	27	42	32	41	32

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-30: SDG&E First-Year Net Program Coincident Peak Demand Potential – 2007-2016 (MW)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

4.3.7 PG&E Natural Gas Potential

PG&E Total Natural Gas Potential

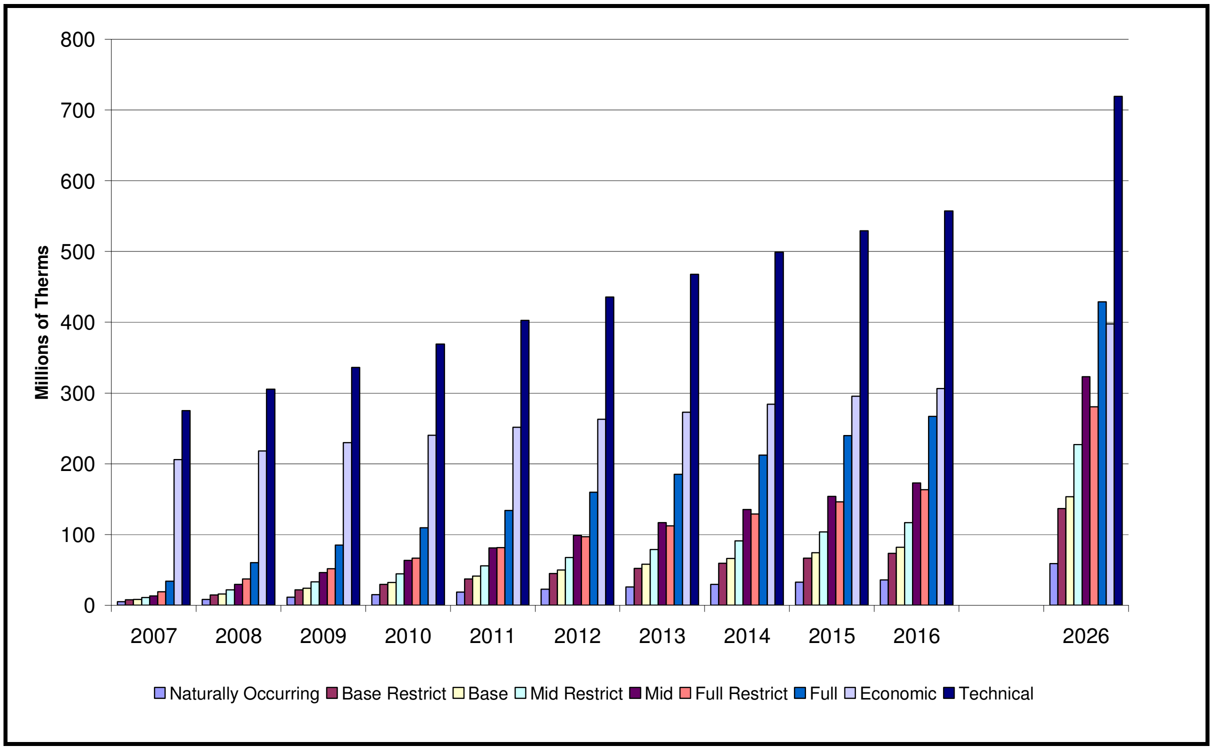
Table 4-33 and Figure 4-31 depict the total market gross and naturally occurring natural gas potential across all sectors for the PG&E service territory. Under the Base scenario, the gross energy efficiency potential for 2007-2016 is 82 million therms while the net potential is 46 million therms. Extending the forecast period to 2026 increases the gross potential to 153 million therms and the net potential to 95 million therms. The implied net-to-gross ratio is about 56% for 2007-2016 and 61% for 2007-2026. Restricting measures to those with a TRC > 0.85 leads to about a 10.5% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 173 million therms for 2007-2016 and 323 million therms for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 30%. The increase in incentives has encouraged more of PG&E's customers to purchase non-cost-effective measures. Further increasing incentives to the Full incremental cost level increases potential to 267 million therms for 2007-2016 and 429 million therms for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 36%.

Table 4-33: PG&E Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	275	206	8	8	5	8	5	13	11	34	19	5
2008	305	218	16	14	8	15	9	29	22	60	37	8
2009	336	229	24	22	11	23	14	46	33	85	52	12
2010	369	240	32	29	15	31	18	63	44	109	67	16
2011	402	251	41	37	19	39	23	81	55	134	81	20
2012	436	263	50	45	22	47	28	99	67	159	97	24
2013	468	273	58	52	26	55	33	117	79	185	112	28
2014	499	284	66	59	29	63	38	135	91	212	129	32
2015	529	295	74	66	33	72	43	154	104	240	146	35
2016	557	306	82	73	36	80	48	173	117	267	163	39
2026	719	397	153	137	59	150	89	323	227	429	280	63

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-31: PG&E Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

PG&E Sector Level Total Natural Gas Potential

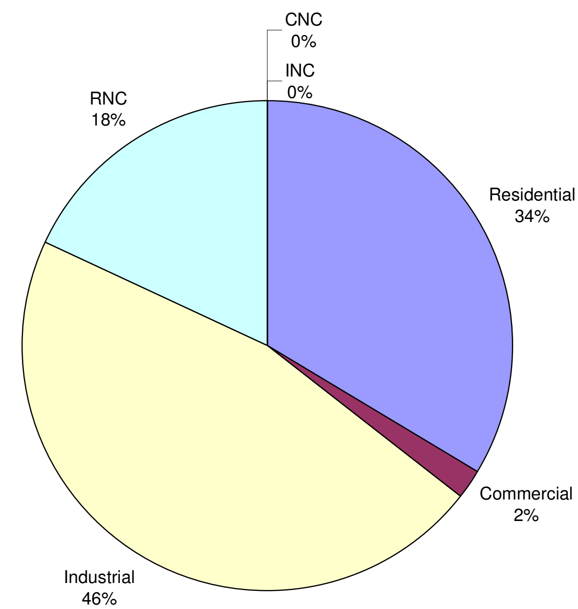
Table 4-34 and Figure 4-32 present the sector-level total market natural gas potential for the PG&E service territory for measures adopted from 2007 to 2016 that are still installed in 2016. Under the Full Restricted scenario, the existing residential sector accounts for 34% of PG&E natural gas potential, while the existing industrial sector contributes 46% and the residential new construction sector adds 18%.

Table 4-34: PG&E Sector-Level Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 (Millions of Therms)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	275.3	55.2	37.2	28.7	17.7	30.7	24.0	97.9	43.9	152.5	54.7	20.5
Commercial	24.7	16.2	1.7	1.7	1.0	1.9	1.3	4.6	2.7	8.9	3.5	1.1
Industrial	169.8	169.8	29.4	29.4	17.1	34.0	22.4	49.0	49.0	75.8	75.8	17.1
RNC	66.7	44.1	11.4	11.4	0.0	11.4	0.0	19.1	19.1	29.2	29.2	0.0
CNC	20.7	20.6	2.1	2.1	0.0	2.1	0.0	1.9	1.9	0.2	0.2	0.0
INC												
Total	557.2	306.0	81.8	73.2	35.9	80.1	47.7	172.6	116.6	266.6	163.4	38.8

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-32: PG&E Sector-Level Full Restricted Gross Market Natural Gas Potential – 2007-2016 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

PG&E First Year Natural Gas Potential

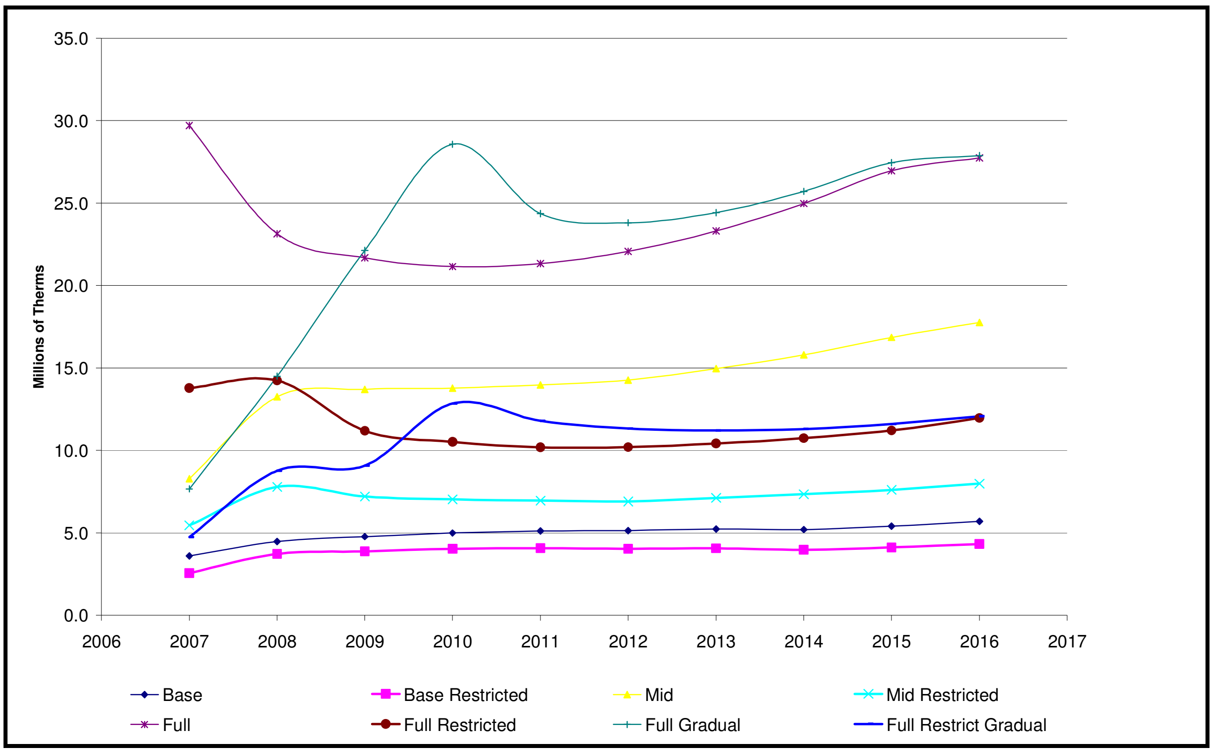
Table 4-35 and Figure 4-33 present the PG&E first-year net program natural gas potential for 2007-2016 and 2026. If PG&E were to continue with its current program, the model estimates that it would average 5 million therms of energy efficiency program savings per year. If PG&E increased its funding level to the Mid level, the average savings would be 14 million therms per year. Increasing funding to the Full Gradual level would increase savings potential to an average of 23 million therms per year.

Table 4-35: PG&E First-Year Net Program Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	3.6	2.6	2.6	8.3	5.5	29.7	13.8	7.7	4.7
2008	4.5	3.7	3.5	13.2	7.8	23.1	14.2	14.5	8.8
2009	4.8	3.9	3.6	13.7	7.2	21.7	11.2	22.1	9.1
2010	5.0	4.0	3.5	13.8	7.0	21.1	10.5	28.6	12.8
2011	5.1	4.1	3.1	14.0	7.0	21.3	10.2	24.4	11.8
2012	5.1	4.0	3.1	14.3	6.9	22.1	10.2	23.8	11.3
2013	5.2	4.1	3.2	15.0	7.1	23.3	10.4	24.4	11.2
2014	5.2	4.0	3.5	15.8	7.3	25.0	10.7	25.7	11.3
2015	5.4	4.1	3.7	16.8	7.6	26.9	11.2	27.4	11.6
2016	5.7	4.3	4.0	17.7	8.0	27.7	12.0	27.9	12.1
2026	9.7	7.7	5.0	21.8	11.8	27.1	15.3	26.9	15.1

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-33: PG&E First-Year Net Program Natural Gas Potential – 2007-2016 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

PG&E Natural Gas Supply Curve

Figure 4-34 illustrates the natural gas technical supply curve for PG&E. The individual measures with more than 15 million therms of technical potential by 2016 and with a levelized cost of less than $2.5/therm are listed in Table 4-36.[16] The technical supply curve sorts the quantity and cost of technical potential such that those measures will the lowest cost are listed or added to the supply curve first.

Figure 4-34: PG&E Supply Curve Technical Natural Gas Potential – 2007-2016 Millions of Therms

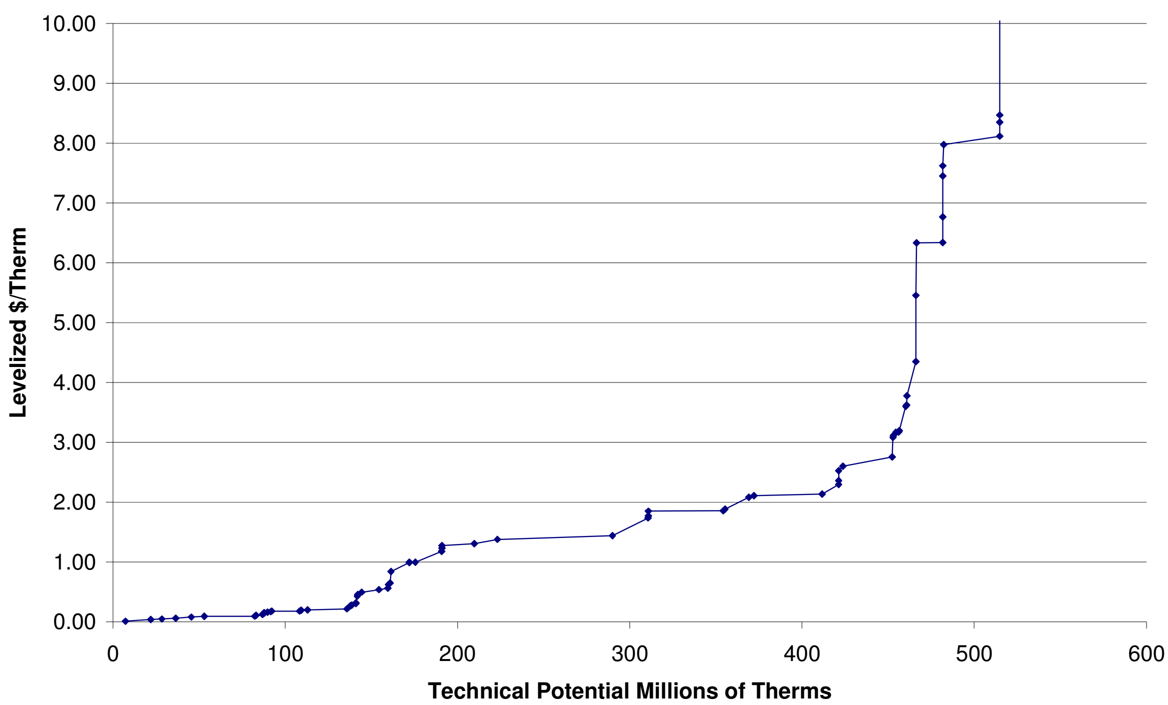


Table 4-36 includes nine high efficiency measures with more than 15 million therms of potential.[17] These nine high efficiency measures account for 233 million therms of technical potential in 2016, or approximately 42% of PG&E's technical potential. Of the nine high efficiency measures, the first three are industrial measures and five measures are residential applications.

[16] The supply curve illustration is limited to measures with a levelized cost per therm of less than $10. The Appendix lists all measures analyzed in the study. .

[17] Measures included in Table 4-36 were restricted to those with at least 15 million therms of technical potential and a levelized cost per therm of less than $2.50.

Table 4-36: PG&E Supply Curve Technical Natural Gas Potential for Measures with Technical Potential in Excess of 15 Million Therms – 2007-2016

Sector and Technology	Technical Potential 2016	Levelized $/Therm
Industrial Boiler Insulation	29	0.09
Industrial Process Controls and Management	16	0.18
Industrial Steam Trap Maintenance	23	0.22
Residential Faucet Aerator	15	1.18
Residential Shower Head	19	1.30
Residential New Construction	67	1.44
Commercial New Construction	21	1.74
Residential Wall Insulation	43	1.86
Residential Furnace	40	2.13

4.3.8 SCG Natural Gas Potential

SCG Total Natural Gas Potential

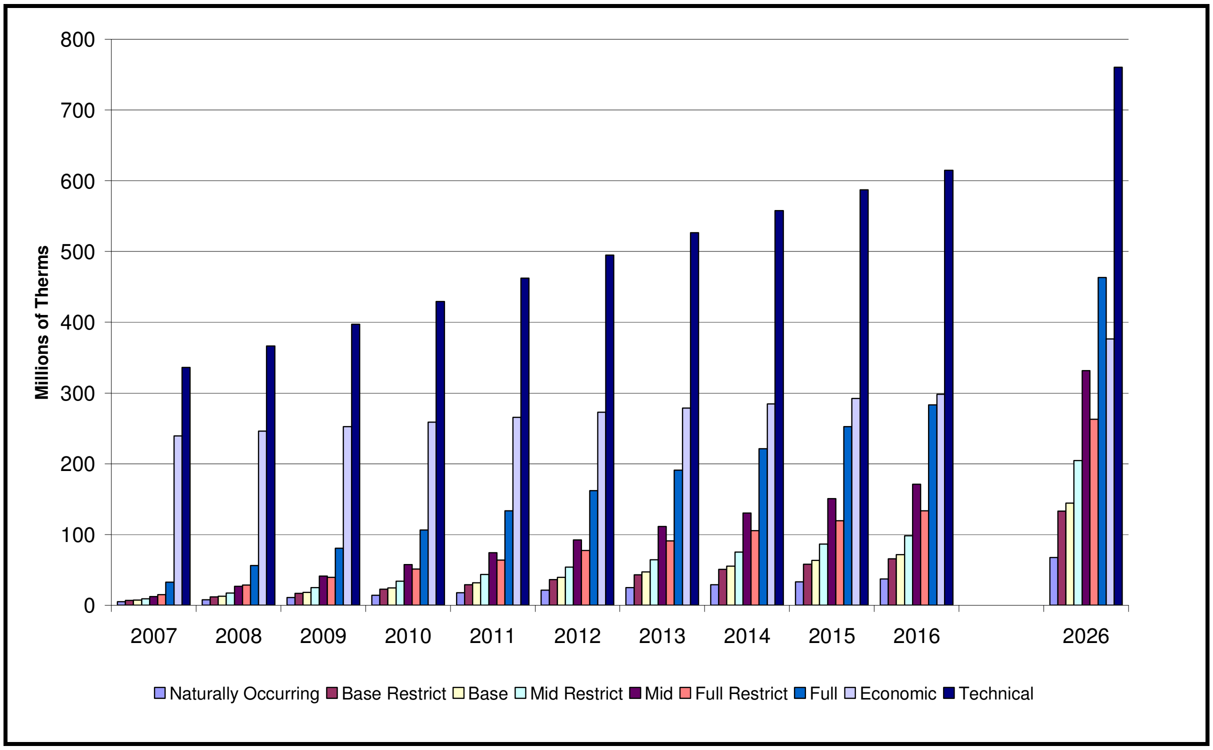
Table 4-37 and Figure 4-35 depict the total market gross and naturally occurring natural gas potential across all sectors for the SCG service territory. Under the Base scenario, the gross energy efficiency potential for 2007-2016 is 72 million therms while the net potential is 35 million therms. Extending the forecast period to 2026 increases the gross potential to 144 million therms and the net potential to 77 million therms. The implied net-to-gross ratio is about 48% in 2016 and 53% in 2026. Restricting measures to those with a TRC > 0.85 leads to about an 8% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 171 million therms for 2007-2016 and 332 million therms for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 40%. The increase in incentives has encouraged more of SCG's customers to purchase non-cost-effective measures. Further increasing incentives to the Full incremental cost level increases potential to 283 million therms for 2007-2016 and 463 million therms for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 53% for 2007-2016 and 43% for 2007-2026.

Table 4-37: SCG Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	336	239	7	7	5	7	5	12	9	33	15	5
2008	366	246	13	12	8	12	9	27	17	56	28	8
2009	397	252	18	17	11	18	12	41	25	81	39	12
2010	429	259	25	23	14	24	17	57	34	106	51	15
2011	462	265	32	29	17	31	21	74	43	133	64	18
2012	495	273	39	36	21	39	27	92	54	162	77	22
2013	527	279	47	43	25	48	33	111	64	191	91	26
2014	558	284	55	51	29	56	39	130	75	221	105	30
2015	587	292	63	58	33	65	45	150	87	252	119	34
2016	615	298	72	66	37	75	51	171	98	283	134	38
2026	760	376	144	133	68	145	102	332	205	463	263	70

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-35: SCG Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SCG Sector Level Total Natural Gas Potential

Table 4-38 and Figure 4-36 present the sector-level total market natural gas potential for the SCG service territory for measures adopted from 2007 to 2016 that are still installed in 2007. Under the Full Restrict scenario, the existing residential sector accounts for 35% of SCG natural gas potential, while the existing industrial sector contributes 43% and the commercial new construction sector adds 12%.

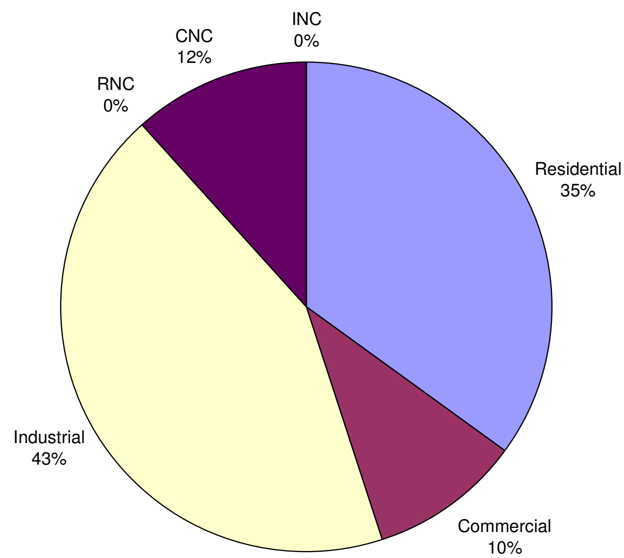
The residential and commercial new construction natural gas savings potential for SCG is assumed to be associated with packages of measures installed under a joint program with SCE. Under the assumed program, SCE and SCG cooperate such that SCE claims the electricity potential and SCG claims the natural gas savings. The existing residential savings incorporate natural gas savings associated with dual fuel measures such as insulation, duct repair, and dishwashers. These measures contribute both electricity and natural gas savings. SCG is assumed to claim both the electricity and natural gas savings associated with these measures.

Table 4-38: SCG Sector-Level Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 (Millions of Therms)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	324	61	28	25	16	30	25	97	36	180	47	17
Commercial	37	24	11	10	8	11	9	21	12	24	13	8
Industrial	195	195	22	22	13	25	17	36	36	58	58	13
RNC	28	6	2	0	0	0	0	3	0	6	0	0
CNC	31	12	9	9	0	9	0	15	15	15	15	0
INC												
Total	**615**	**298**	**72**	**66**	**37**	**75**	**51**	**171**	**98**	**283**	**134**	**38**

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-36: SCG Sector-Level Full Restricted Gross Market Natural Gas Potential – 2007-2016 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

SCG First Year Natural Gas Potential

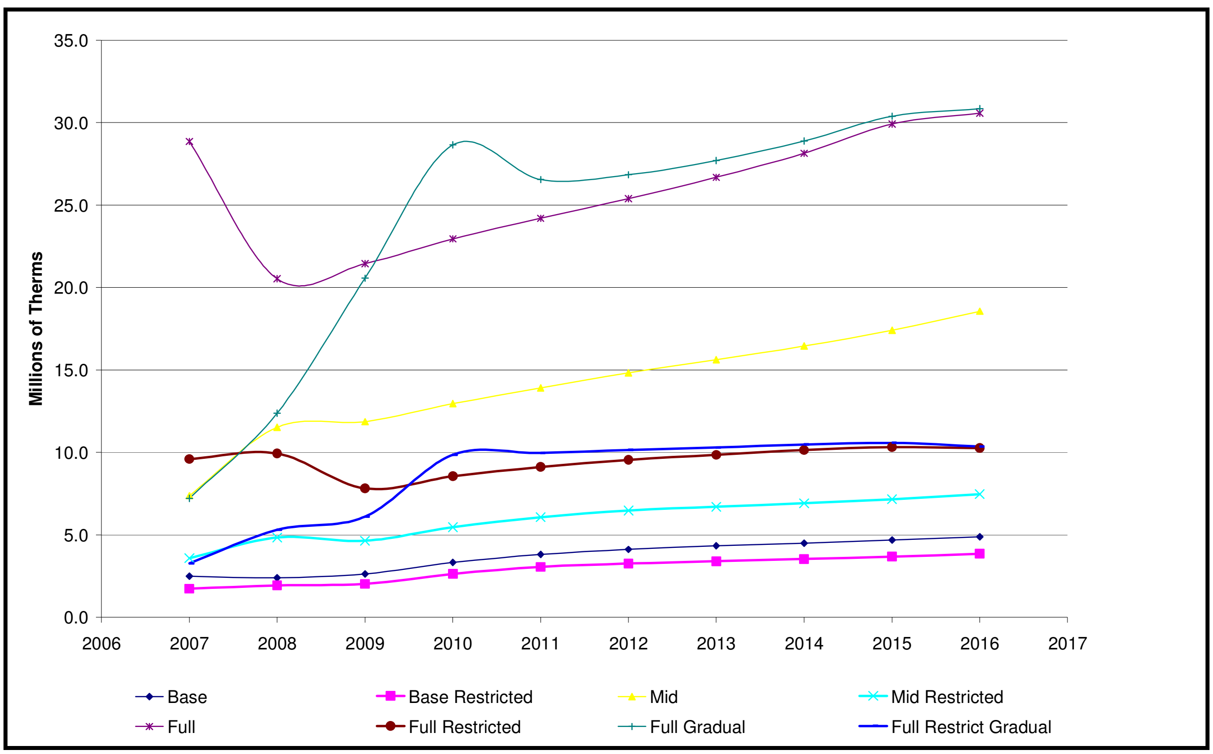
Table 4-39 and Figure 4-37 present the SCG first-year net program natural gas potential for 2007-2016 and 2026. If SCG were to continue with its current program, the model estimates that it would average 3.7 million therms of energy efficiency program savings per year. If SCG increased its funding level to the Mid level, the average savings would be 14 million therms per year. Increasing funding to the Full Gradual level would increase savings potential to an average of 24 million therms per year.

Table 4-39: SCG First-Year Net Program Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)

Year	Base	Base	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restricted Gradual
2007	2.5	1.7	1.6	7.4	3.6	28.9	9.6	7.2	3.3
2008	2.4	1.9	1.8	11.5	4.8	20.5	9.9	12.4	5.3
2009	2.6	2.0	2.0	11.9	4.6	21.4	7.8	20.6	6.1
2010	3.3	2.6	2.2	12.9	5.5	22.9	8.6	28.6	9.9
2011	3.8	3.0	2.3	13.9	6.1	24.2	9.1	26.5	10.0
2012	4.1	3.3	2.5	14.8	6.5	25.4	9.5	26.8	10.2
2013	4.3	3.4	2.7	15.6	6.7	26.7	9.8	27.7	10.3
2014	4.5	3.5	2.9	16.4	6.9	28.1	10.1	28.9	10.5
2015	4.7	3.7	3.0	17.4	7.2	29.9	10.3	30.4	10.6
2016	4.9	3.8	3.1	18.6	7.5	30.6	10.3	30.8	10.3
2026	7.5	6.7	3.8	21.8	13.6	26.8	22.2	26.7	22.5

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-37: SCG First-Year Net Program Natural Gas Potential – 2007-2016 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SCG Natural Gas Supply Curve

Figure 4-38 illustrates the natural gas technical supply curve for SCG. The individual measures with more than 15 million therms of technical potential by 2016 and with a levelized cost of less than $2.5/therm are listed in Table 4-40.[18] The technical supply curve sorts the quantity and cost of technical potential such that those measures will the lowest cost are listed or added to the supply curve first.

Figure 4-38: SCG Supply Curve Technical Natural Gas Potential – 2007-2016 (Millions of Therms)

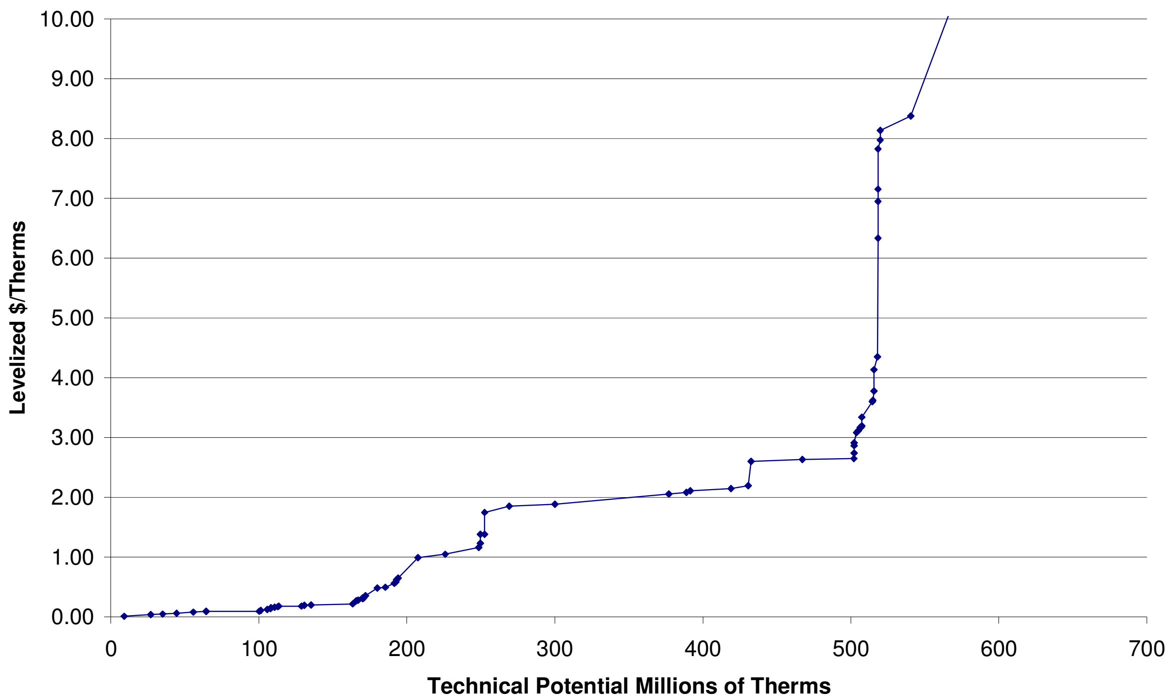


Table 4-40 includes ten high efficiency measures with more than 15 million therms of potential.[19] These 10 high efficiency measures account for about 290 million therms of technical potential in 2016, or approximately 47% of SCG's technical potential. Of the 10 high efficiency measures, the first four are industrial measures and five measures are residential applications.

18 The supply curve illustration is limited to measures with a levelized cost per therm of less than $10. The Appendix lists all measures analyzed in the study. .

19 Measures included in Table 4-40 were restricted to those with at least 15 million therms of technical potential and a levelized cost per therm of less than $2.50.

Table 4-40: SCG Supply Curve Technical Natural Gas Potential for Measures with Technical Potential in Excess of 15 Millions Therms – 2007-2016

Sector and Technology	Technical Potential	Levelized $/Therm
Industrial Boiler Load Control	18	0.041
Industrial Boiler Insulation	36	0.095
Industrial Process Controls and Management	15	0.181
Industrial Steam Trap Maintenance	28	0.218
Residential Faucet Aerators	18	1.047
Residential Shower Heads	23	1.160
Residential Duct Repair	17	1.852
Commercial New Construction	31	1.882
Residential Wall Insulation	77	2.054
Residential New Construction	28	2.145

4.3.9 SDG&E Natural Gas Potential

SDG&E Total Natural Gas Potential

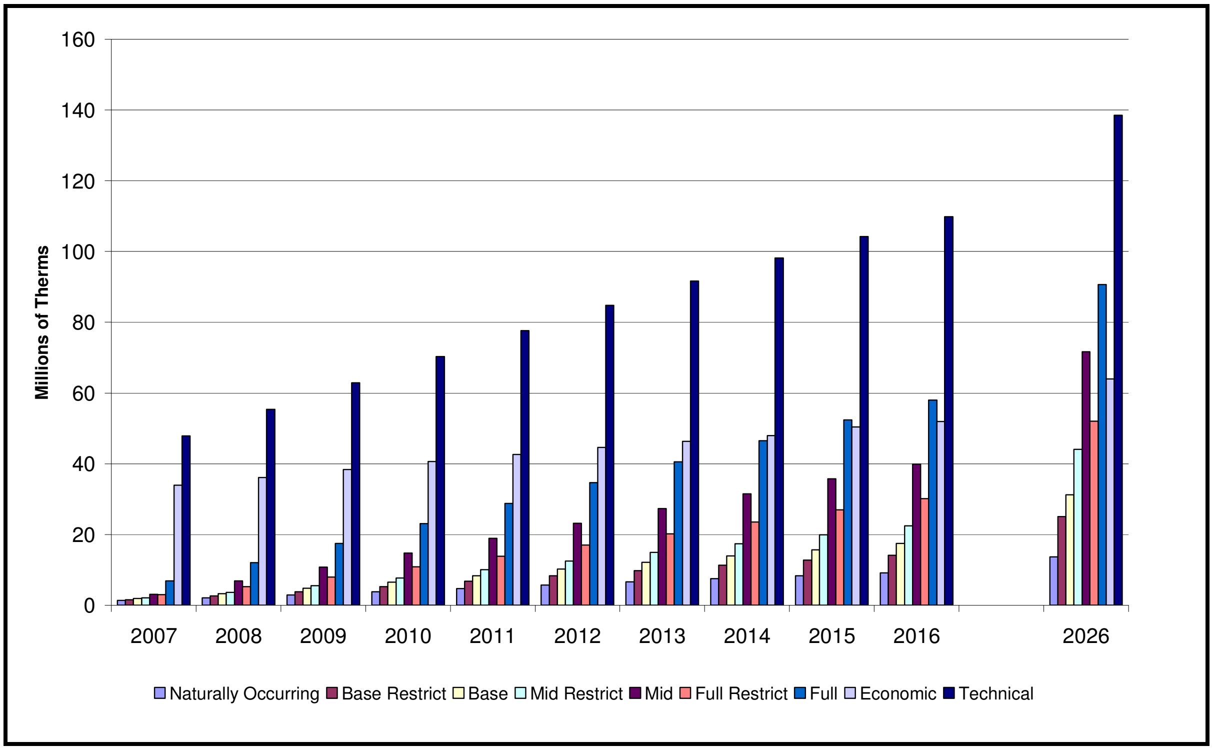
Table 4-41 and Figure 4-39 depict the total market gross and naturally occurring natural gas potential across all sectors for the SDG&E service territory. Under the Base scenario, the gross energy efficiency potential for 2007-2016 is 17 million therms while the net potential is 8 million therms. Extending the forecast period to 2026 increases the gross potential to 31 million therms and the net potential to 17 million therms. The implied net-to-gross ratio is about 47% for 2007-2016 and 56% for 2007-2026. Restricting measures to those with a TRC > 0.85 leads to about a 19% fall in total Base-level potential. Increasing incentives to the Mid level increases gross potential to 40 million therms for 2007-2016 and 71 million therms for 2007-2026. Restricting measures to those that have a TRC > 0.85 reduces the Mid forecast by about 41%. The increase in incentives has encouraged more of SDG&E's customers to purchase non-cost-effective measures. Further increasing incentives to the Full incremental cost level increases potential to 58 million therms for 2007-2016 and 91 million therms for 2007-2026. Restricting the measures to those with a TRC > 0.85 reduces the full potential by 48% in 2016 and 43% for 2007-2026.

Table 4-41: SDG&E Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
2007	48	34	2	2	1	2	1	3	2	7	3	1
2008	55	36	3	3	2	3	2	7	4	12	5	2
2009	63	38	5	4	3	4	3	11	6	17	8	3
2010	70	41	6	5	4	6	4	15	8	23	11	4
2011	78	43	8	7	5	7	6	19	10	29	14	5
2012	85	45	10	8	6	9	7	23	12	35	17	6
2013	92	46	12	10	7	11	9	27	15	41	20	7
2014	98	48	14	11	8	13	10	32	17	46	24	8
2015	104	50	16	13	8	15	11	36	20	52	27	9
2016	110	52	17	14	9	16	13	40	22	58	30	10
2026	138	64	31	25	14	28	21	72	44	91	52	16

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-39: SDG&E Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SDG&E Sector Level Total Natural Gas Potential

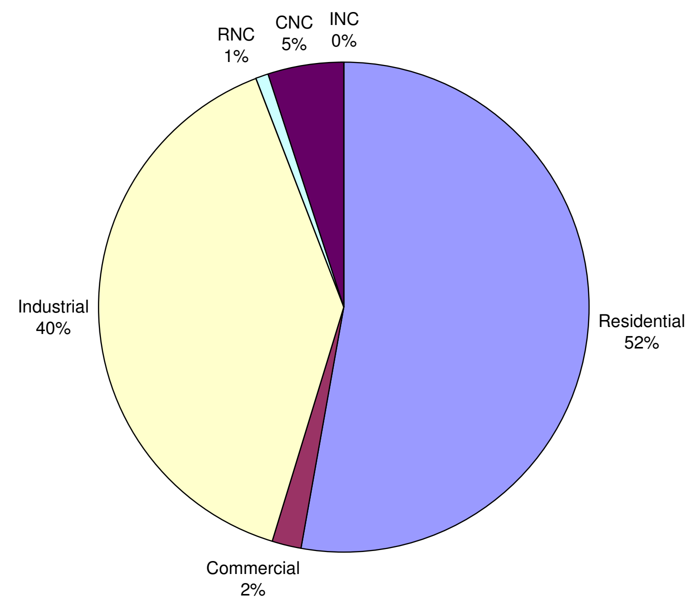
Table 4-34 and Figure 4-32 present the sector-level total market natural gas potential for the SDG&E service territory for measures adopted from 2007 to 2016 that are still installed in 2016. Under the Full Restrict scenario, the existing residential sector accounts for 52% of SDG&E natural gas potential, while the existing industrial sector contributes 40% and the new construction sector adds 6%.

Table 4-42: SDG&E Sector-Level Total Gross Market and Naturally Occurring Natural Gas Potential – 2007-2016 (Millions of Therms)

	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Mid and Full Naturally Occurring
Residential	64.5	14.1	10.7	8.3	6.1	9.7	8.6	27.6	13.1	38.6	15.9	7.2
Commercial	8.8	5.3	0.4	0.4	0.3	0.4	0.4	1.7	0.5	3.2	0.5	0.3
Industrial	26.2	26.2	4.7	4.7	2.8	5.5	3.6	7.8	7.8	11.9	11.9	2.8
RNC	5.2	1.2	1.0	0.1	0.0	0.1	0.0	1.8	0.1	2.6	0.2	0.0
CNC	5.1	5.1	0.5	0.5	0.0	0.5	0.0	1.0	1.0	1.5	1.5	0.0
INC												
Total	109.8	51.9	17.4	14.1	9.1	16.3	12.5	39.9	22.5	57.9	30.2	10.3

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

Figure 4-40: SDG&E Sector-Level Full Restricted Gross Market Natural Gas Potential – 2007-2016 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level and reflect the savings from measures adopted from 2007-2016 that are still installed in 2016.

SDG&E First Year Program Natural Gas Potential

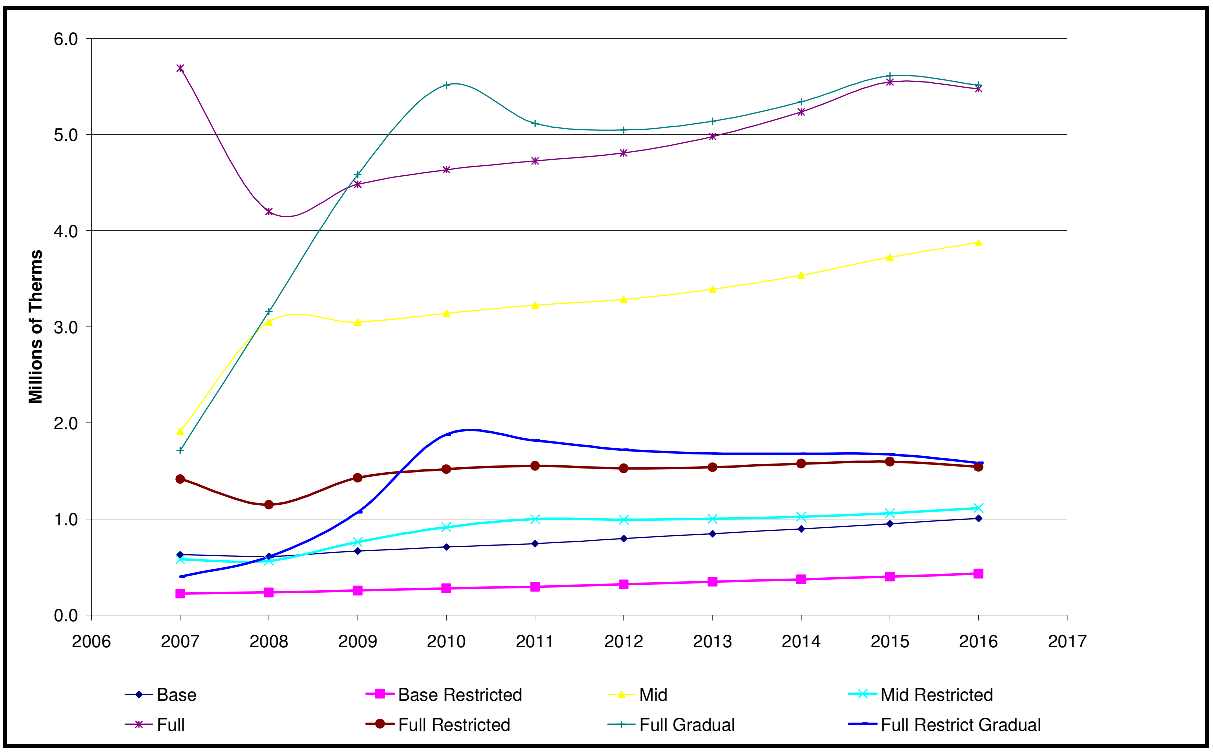
Table 4-43 and Figure 4-41 present the SDG&E first-year net program natural gas potential for 2007-2016 and 2026. If SDG&E were to continue with its current program, the model estimates that it would average 0.8 million therms of energy efficiency program savings per year. If SDG&E increased its funding level to the Mid level, the average savings would be 3.2 million therms per year. Increasing funding to the Full Gradual level would increase savings potential to an average of 4.7 million therms per year.

Table 4-43: SDG&E First-Year Net Program Natural Gas Potential – 2007-2016 and 2026 (Millions of Therms)

Year	Base	Base Restrict	Base Restrict Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual
2007	0.6	0.2	0.2	1.9	0.6	5.7	1.4	1.7	0.4
2008	0.6	0.2	0.2	3.0	0.6	4.2	1.1	3.2	0.6
2009	0.7	0.3	0.2	3.0	0.8	4.5	1.4	4.6	1.1
2010	0.7	0.3	0.3	3.1	0.9	4.6	1.5	5.5	1.9
2011	0.7	0.3	0.3	3.2	1.0	4.7	1.6	5.1	1.8
2012	0.8	0.3	0.3	3.3	1.0	4.8	1.5	5.0	1.7
2013	0.8	0.3	0.3	3.4	1.0	5.0	1.5	5.1	1.7
2014	0.9	0.4	0.3	3.5	1.0	5.2	1.6	5.3	1.7
2015	0.9	0.4	0.4	3.7	1.1	5.5	1.6	5.6	1.7
2016	1.0	0.4	0.4	3.9	1.1	5.5	1.5	5.5	1.6
2026	1.7	0.9	0.5	4.5	1.5	5.3	1.8	5.3	1.8

Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

Figure 4-41: SDG&E First-Year Net Program Natural Gas Potential – 2007-2016 (Millions of Therms)



Refer to Table 4-1 for a description of the scenarios. The energy savings potential are at the generation level.

SDG&E Natural Gas Supply Curve

Figure 4-42 illustrates the natural gas technical supply curve for SDG&E. The individual measures with more than 2.5 million therms of technical potential by 2016 and with a levelized cost of less than $2.5/therm are listed in Table 4-44.[20] The technical supply curve sorts the quantity and cost of technical potential such that those measures will the lowest cost are listed or added to the supply curve first.

Figure 4-42: SDG&E Supply Curve Technical Natural Gas Potential – 2007-2016 (Millions of Therms)

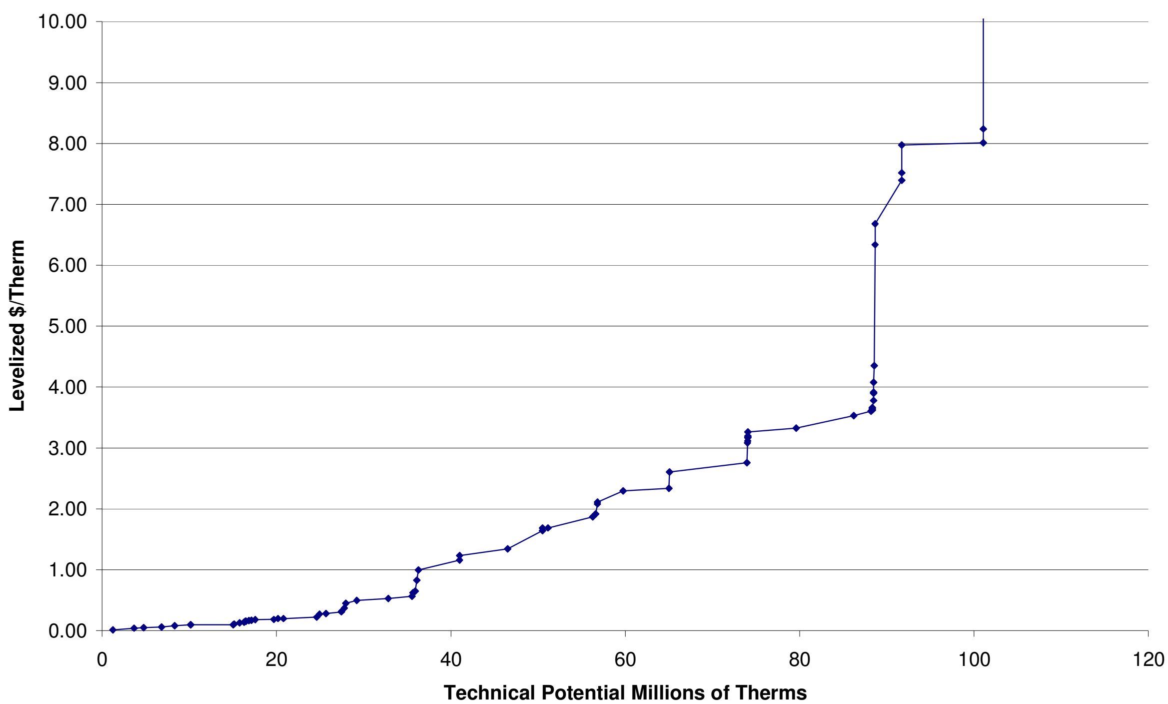


Table 4-44 includes ten high efficiency measures with more than 2.5 million therms of potential.[21] These 10 high efficiency measures account for about 43 million therms of technical potential in 2016, or approximately 39% of SDG&E's technical potential. Of the 10 high efficiency measures, the three are industrial measures and six measures are residential applications.

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20 The supply curve illustration is limited to measures with a levelized cost per therm of less than $10. The Appendix lists all measures analyzed in the study.

21 Measures included in Table 4-44were restricted to those with at least 15 million therms of technical potential and a levelized cost per therm of less than $2.50.

Table 4-44: SDG&E Supply Curve Technical Natural Gas Potential for Measures with Technical Potential in Excess of 2.5 Million Therms – 2007-2016

Sector and Technology	Technical Potential	Levelized $/Therm
Industrial Boiler Insulation	4.89	0.095
Industrial Steam Trap Maintenance	3.82	0.218
Residential Pipe Wrap	3.61	0.524
Industrial Process Heat Recovery	2.74	0.563
Residential Faucet Aerator	4.72	1.158
Residential Shower Head	5.52	1.340
Residential Duct Repair	4.01	1.639
Commercial New Construction	5.13	1.869
Residential Water Heater	2.96	2.293
Residential New Construction	5.24	2.336

4.3.10 Utility Level Costs and Benefits

Table 4-45 through Table 4-48 present IOU level estimates of costs and benefits associated with the different funding and TRC restriction scenarios. The costs and benefits presented in these tables have been limited to the Base scenario and the three TRC Restricted scenarios. The substantial increase in costs with only very limited increases in savings associated with the higher non-restricted funding levels, limits the usefulness of the Mid and Full non-restricted scenarios.

If PG&E continues with their 2004-2005 energy efficiency programs, the estimated TRC is 1.17. If PG&E limits their current energy efficiency offerings to measures with a TRC > 0.85, while continuing with their 2006 incentive level, the estimated TRC is 1.87. The TRC restriction eliminates a few relatively high cost measures whose benefits do not exceed their costs. The cost impacts of the TRC restriction is clearly reflected in the PDV of Net Measure Costs listed in Table 4-45. The measure costs for the unrestricted Base scenario is $2,633 million, while the measure costs for the Base Restricted scenario is $1,194 million and $2,271 million for the Mid Restricted scenario.

If PG&E increases their funding and restricts measures to those with a TRC > 0.85, the Mid Restricted scenario TRC is estimated to be 1.86 and the estimate for the Full Restricted scenario is 1.77.

Table 4-45: PG&E Costs and Benefits – 2007-2026

	Base	Base Restrict	Mid Restrict	Full Restrict
PDV Gross Incentives*	1,686	1,081	2,197	4,299
PDV Net Measure Costs*	2,633	1,194	2,271	3,575
PDV Gross Program Costs*	417	387	545	700
PDV Net Elec Avoided Cost Benefits*	2,822	2,441	4,259	6,082
PDV Net Gas Avoided Cost Benefits*	759	521	975	1,476
TRC	1.17	1.87	1.86	1.77

* In Millions of dollars.

Table 4-46 lists SCE's estimated costs and benefits by funding scenario. The summation of cost and benefits at the utility level for SCE and SCG necessitated that the costs and benefits from the residential new construction program be allocated to one utility.[22] For this presentation, these costs and benefits have been allocated to SCE.

SCE's Base scenario TRC is estimated to be 1.43. Restricting their current portfolio of measures to those with a TRC > 0.85 would increase their estimated TRC to 2.18. Restricting measures to those that are at least nearly cost effective reduce the present discounted value of the required incentives from $1,166 million to $839 million, a 28% reduction in incentives.

If SCE increases incentives to the Mid level while restricting measures to those with a TRC > 0.85, their estimated TRC is 1.98. Further increasing their incentive to the Full Restricted scenario reduces their estimated TRC to 1.78.

Table 4-46: SCE Costs and Benefits – 2007-2026

	Base	Base Restrict	Mid Restrict	Full Restrict
PDV Gross Incentives*	1,166	839	2,015	4,145
PDV Net Measure Costs*	2,080	1,084	2,177	3,455
PDV Gross Program Costs*	353	328	433	517
PDV Net Elec Avoided Cost Benefits*	3,464	3,076	5,156	7,038
PDV Net Gas Avoided Cost Benefits*	8	5	15	16
TRC	1.43	2.18	1.98	1.78

* In Millions of dollars. The natural gas avoided costs are attributable to the residential new construction potential estimates. SCE and SCG are assumed to run a joint RNC program.

[22] The residential new construction potential analysis analyzed least cost packages that included both gas and electric measures. The costs and savings from these packages can not easily be disaggregated into cost associated with gas measures and costs associated with electric measures. In addition, these packages assumed that both gas and electric measures were installed, requiring the cooperation of SCE and SCG.

Table 4-47 lists SDG&E's estimated costs and benefits by funding scenario. The Base scenario estimated TRC is 1.17. Restricting their current portfolio to measures with a TRC > 0.85 significantly reduces both the present discounted value of their incentives and the incremental measure costs. These reductions indicate there are a limited number of measures currently included in SDG&E's portfolio that are not cost effective. The Base Restricted scenario estimated TRC is 2.23. Increasing incentives to the Mid level, while restricting measures to those with a TRC > 0.85, reduces the estimated TRC to 1.97. Further increasing incentives to the Full Restricted level, results in an estimated TRC of 1.85.

Table 4-47: SDG&E Costs and Benefits – 2007-2026

	Base	Base Restrict	Mid Restrict	Full Restrict
PDV Gross Incentives*	345	197	513	1,026
PDV Net Measure Costs*	736	251	546	811
PDV Gross Program Costs*	94	83	107	126
PDV Net Elec Avoided Cost Benefits*	837	705	1,163	1,552
PDV Net Gas Avoided Cost Benefits*	137	40	121	182
TRC	1.17	2.23	1.97	1.85

* In Millions of dollars.

Table 4-48 lists SCG's estimated costs and benefits by scenario. The summation of cost and benefits at the utility level for SCE and SCG necessitated that the costs and benefits from the residential new construction program be allocated to one utility. For this presentation, these costs and benefits have been allocated to SCE. In the existing residential analysis, the potential from dual fuel measures (insulation, duct repair, and dishwashers) for gas heated and gas water heated homes has been assigned to SCG. The electric potential benefits listed in Table 4-48 are from these dual fuel measures.

The Base TRC for SCG is 0.84. Restricting measures to those with a TRC > 0.85 increases the estimated TRC to 1.78. Increasing incentives to the Mid Restricted forecast results in an estimated TRC of 1.58. Further increasing incentives to Full Restricted reduces the estimated TRC to 1.38.

Table 4-48: SCG Costs and Benefits – 2007-2026

	Base	Base Restrict	Mid Restrict	Full Restrict
PDV Gross Incentives*	119	38	331	1,047
PDV Net Measure Costs*	573	176	436	899
PDV Gross Program Costs*	57	42	64	90
PDV Net Elec Avoided Cost Benefits*	132	95	174	300
PDV Net Gas Avoided Cost Benefits*	397	294	614	1,061
TRC	0.84	1.78	1.58	1.38

* In Millions of dollars. The electric avoided costs are attributable to the dual fuel measures in the existing residential estimates. SCG was assumed to install these measures in homes with gas heat.

5

Energy Efficiency Potential in Existing Residential Buildings

This section presents the estimates of residential energy efficiency potential in existing homes. Estimates of potential are presented for the period 2007 through 2016, and for 2007 through 2026. Market potential was estimated for 10 scenarios. The scenarios assume alternative levels of measure incentives, cost-effectiveness tests, measure awareness, and the availability of incandescent lighting.[1] All market results are presented as both gross and net total savings associated with cumulative adoptions over the estimation period.[2] Estimates of residential consumption, technical potential, and economic potential are presented for comparison purposes.

5.1 Overview

Sixty-six residential energy efficiency measures were included in the analysis. These measures can be broken down into 44 electric, 16 gas, and 6 dual fuel high efficiency measures.[3] The measures are all commercially available. The report does not provide an estimate of the potential from emerging measures in the residential sector. In the presentation of results below, measures are aggregated into four electric end uses and two gas end uses. Table 5-1 lists the individual measures that correspond to each end use and fuel type in the analysis. All the measures listed in Table 5-1 were analyzed in the Full incremental cost market and the Mid market forecasts. A few of the measures listed in the table were not included in the current market forecast which is dependent on measure savings

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1 The Huffman Bill passed by the California legislature requires that residential lighting UECs decline by 50%. To achieve this level of lighting reduction, we assume that CFLs will need to become the base lighting assumption and re-calculate the nine scenarios without CFL lighting potential.

2 The energy savings potential presented in the Itron 2006 forecast were gross savings. The 2006 study did not contain a baseline or naturally occurring estimate. The KEMA 2002/2003 forecasts were reported as net savings with an estimate of naturally occurring savings.

3 The dual fuel measures include two insulation measures, duct sealing, and three dishwashers. The insulation and duct sealing measures are assumed to be installed in homes with central AC and gas heat. The high efficiency dishwashers are assumed to be installed in homes with gas water heating. These six measures all have electric counter parts within the 44 electric measures.

from the IOU-specific energy efficiency programs.[4] Measures are organized around base case technologies.[5] For measures modeled as replace-on-burnout, the base case is the minimum energy efficiency standard. For measures modeled as retrofit, the base case is the existing technologies found in California homes.

Table 5-1: Residential Measure Descriptions

End Use	Measure Description	Fuel Type
HVAC	CAC 13 SEER (w/Duct, 2007+)	Electric
HVAC	CAC 15 SEER (w/Duct, 2007+)	Electric
HVAC	AC Heat Pump 13 SEER (w/Duct, 2007+)	Electric
HVAC	AC Heat Pump 15 SEER (12.70 EER)/8.8 HSPF (3.74 COP) (w/Duct, 2007+)	Electric
HVAC	Room A/C SEER=10.3	Electric
HVAC	Whole House Fan	Electric
HVAC	AC Diagnostic and Tune-up	Electric
HVAC	Night Economizer, Current Emerging Technology	Electric
HVAC	Central Gas Furnace AFUE = 90	Gas
HVAC	Central Gas Furnace AFUE = 92	Gas
HVAC	Central Gas Furnace AFUE = 96	Gas
HVAC	U-0.25 (tint) Window	Electric
HVAC	Wall Blow-In R-0 to R-13 Insulation - Electric Space Heat, CAC	Electric
HVAC	Wall Blow-In R-0 to R-13 Insulation - Gas Space Heat, CAC	Both
HVAC	Ceiling Insulation R19 to R30 - Electric Space Heat, CAC	Electric
HVAC	Ceiling Insulation R19 to R30 - Gas Space Heat, CAC	Both
HVAC	Duct Repair – Electric Space Heat, CAC	Electric
HVAC	Duct Repair – GAS Space Heat, CAC	Both
HVAC	Cool Roof, Current Emerging Technology	Electric

[4] Residential programmable thermostats were not included in the residential analysis even though there are reported program accomplishments for 2006. Due to uncertain measure savings, this measure was eliminated from the residential energy efficiency program in 2006. This measure was not modeled in this study or in the Itron 2006 study.

[5] A full listing of residential measures with their base technologies is available in Appendix A.

Table 5-1 (cont'd.): Residential Measure Descriptions

End Use	Measure Description	Fuel Type
Lighting	Under 14 Watt - screw-in CFL	Electric
Lighting	14 to 25 Watt - screw-in CFL	Electric
Lighting	Over 25 Watt - screw-in	Electric
Lighting	Modular CFL (Fixture)	Electric
Lighting	CFL Reflector - R30, R40	Electric
Lighting	LED Reflector, Current Emerging Tech	Electric
Lighting	CFL Torchiere	Electric
Lighting	LED Exit Sign	Electric
Lighting	LED Christmas Lights, Current Emerging Tech	Electric
Lighting	Occupancy Sensor - Ceiling or Wall Box	Electric
Lighting	Photocell, Time Clock	Electric
Lighting	Premium T8 El Ballast	Electric
Lighting	CFL Table Lamp	Electric
Lighting	R30 CFL R30 Reflector	Electric
Lighting	R40 CFL R40 Reflector	Electric
Miscellaneous	Refrigerator Recycling	Electric
Miscellaneous	Freezer Recycling	Electric
Miscellaneous	Refrigerator – ENERGY STAR	Electric
Miscellaneous	Efficient Single-Speed Pool Pump, 1 hp	Electric
Miscellaneous	Efficient Two-Speed Pool Pump	Electric
Water Heating	Clothes Washer - Elec Water Heat MEF=1.26, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Electric
Water Heating	Clothes Washer - Elec Water Heat MEF=1.60, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Electric
Water Heating	Clothes Washer - Elec Water Heat MEF=1.80, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Electric
Water Heating	Clothes Washer - Elec Water Heat MEF=2.0, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Electric
Water Heating	Clothes Washer - Elec Water Heat MEF=2.2, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Electric
Water Heating	Dishwasher - Elec Water Heat, EF=0.58	Electric
Water Heating	Dishwasher - Elec Water Heat, EF=0.62	Electric
Water Heating	Dishwasher - Elec Water Heat, EF=0.68	Electric

Table 5-1 (cont'd.): Residential Measure Descriptions

End Use	Measure Description	Fuel Type
Water Heating	High Efficiency Water Heater - Electric, EF=0.93	Electric
Water Heating	Solar Water Heater - Retrofit	Electric
Water Heating	Faucet Aerators, Elec Water Heat	Electric
Water Heating	Pipe Wrap, Elec Water Heat	Electric
Water Heating	Low Flow Showerhead, Elec Water Heat	Electric
Water Heating	Clothes Washer - Gas Water Heater & Dry, MEF=1.26, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Gas
Water Heating	Clothes Washer - Gas Water Heater & Dry, MEF=1.60, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Gas
Water Heating	Clothes Washer - Gas Water Heater & Dry, MEF=1.80, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Gas
Water Heating	Clothes Washer - Gas Water Heater & Dry, MEF=2.0, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Gas
Water Heating	Clothes Washer - Gas Water Heater & Dry, MEF=2.2, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily	Gas
Water Heating	Dishwasher - Gas Water Heater, EF=0.58	Both
Water Heating	Dishwasher - Gas Water Heater, EF=0.62	Both
Water Heating	Dishwasher - Gas Water Heater, EF=0.68	Both
Water Heating	High Efficiency Water Heater - Gas, EF = 0.63	Gas
Water Heating	Point of Use Water Heater - Gas	Gas
Water Heating	Solar Water Heater - Retrofit	Gas
Water Heating	High Efficiency Small Multifamily Boiler – AFUE 82%	Gas
Water Heating	Circulation Pump Time Clock, Multifamily Boiler Controller	Gas
Water Heating	Faucet Aerator, Gas Water Heat	Gas
Water Heating	Pipe Wrap, Gas Water Heat	Gas
Water Heating	Low Flow Showerhead, Gas Water Heat	Gas

The analysis was conducted for three housing types (single family, multifamily and mobile homes), 21 electric climate zones, and 23 natural gas climate zones (16 CEC Title 24 zones further divided into unique utility service areas). In addition, the analysis of market potential considered 10 scenarios. The scenarios names and a short description are in Table 5-2.

Table 5-2: Scenario Descriptions

Scenario Name	Scenario Description
Base Incentive	Includes measures incentivized in the 2004-2005 program year with incentives that were available in 2006.
Mid Incentive	Includes all measures analyzed in the study with incentives half way between those that were available in 2006 and full incremental costs.
Full Incentive	Includes all measures analyzed with incentives set to full incremental costs.
Base Incentive TRC Restricted	Current incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85. The TRC is calculated using the ratio of avoided costs to measure costs.[6]
Mid Incentive TRC Restricted	Mid incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85. The TRC is calculated using the ratio of avoided costs to measure costs.
Full Incentive TRC Restricted	Full incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85. The TRC is calculated using the ratio of avoided costs to measure costs.
Full Gradual	Includes all measures analyzed with incentives increasing from 2006 levels to full incremental costs in 2010.
Full Gradual TRC Restricted	Full gradual scenario with measures restricted to those with a TRC greater than or equal to 0.85. The TRC is calculated using the ratio of avoided costs to measure costs.
Base TRC Restricted Higher Awareness	The current incentive TRC restricted scenario with a higher level of awareness for both the program and the naturally occurring analysis.
CFLs as Base Lighting	A re-calculation of the previous 9 scenarios assuming that CFL are the base lighting technology.

For the Mid and the Full Restricted and Non-restricted market scenarios and the Economic and Technical theoretical analyses, there were a limited number of measures added to the IOU measures included in the 2004/2005 program accomplishments (measures analyzed in the Base and Base Restricted scenarios). The added measures include measures that were added to the 2006-2008 programs and measures the IOUs are interested in adding to their programs in the near future. Table 5-3 lists the measures added to all scenarios other than the Base and Base Restricted scenarios.

[6] The restricted model TRC calculations do not include the program costs in the denominator. These costs are not included in the restriction because at this point in the model calculations these costs have not been determined. The program costs are incorporated in the calculations of the TRC that are used to determine program cost-effectiveness.

Table 5-3: High Efficiency Measures Added to the Mid, Full, Economic, and Technical Scenarios

EndUse	Measure Description	Fuel Type
Lights	CFL Reflector - R30, R40	Elec
Lights	LED Reflector, Current Emerging Tech	Elec
Lights	LED Christmas Lights, Current Emerging Tech	Elec
Lights	Premium T8 El Ballast	Elec
Lights	CFL Table Lamp	Elec
Water Heaters	Solar Water Heater – Retrofit	Elec
Water Heaters	Faucet Aerators, Elec Water Heat	Elec
Water Heaters	Pipe Wrap, Elec Water Heat	Elec
Water Heaters	Low Flow Showerhead, Elec Water Heat	Elec
Water Heaters	Point of Use Water Heater – Gas	Gas
Water Heaters	Solar Water Heater – Retrofit	Gas
Water Heaters	Faucet Aerator, Gas Water Heat	Gas
Water Heaters	Pipe Wrap, Gas Water Heat	Gas
Water Heaters	Low Flow Showerhead, Gas Water Heat	Gas
HVAC	Night Economizer, Current Emerging Technology	Elec
HVAC	Cool Roof, Current Emerging Technology	Elec

5.2 Electric Efficiency Potential in Existing Residential Buildings

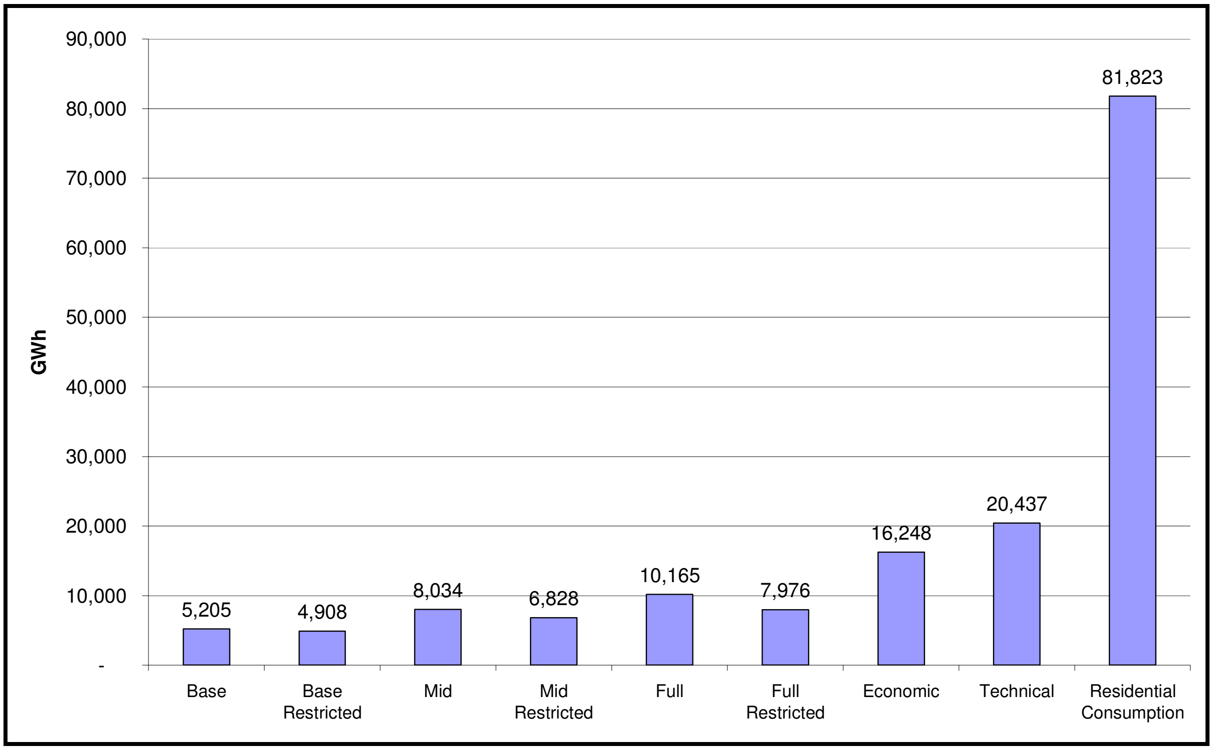
5.2.1 Residential Market Potential for Energy Efficiency

In this subsection, the results of the analysis of the potential for residential existing homes are presented under the alternative market scenarios. Figure 5-1 and Figure 5-2 present the total estimated market, technical, and economic electric energy and demand savings potential resulting from the analysis for the four state investor-owned utilities: PG&E, SCE, SCG, and SDG&E.[7] Also shown in these figures is the forecasted electricity use and demand for these utilities, as estimated by the CEC.[8] The values are provided for 2016, the last year of the short run analysis.

7 Limited electric potential savings are included for SCG. These savings are derived from the six dual fuel measures and are very limited in quantity. These results will be included in the statewide IOU totals but will not receive the complete presentation provided to the electric utilities.

8 California Energy Commission. *California Energy Demand 2008-2018: Staff Energy Demand Forecast.* June 2005.

Figure 5-1: Forecasted California IOU Residential Electricity Usage in 2016 and Gross Market, Economic, and Technical Potential for Existing Residential Buildings – 2007-2016 (GWh)



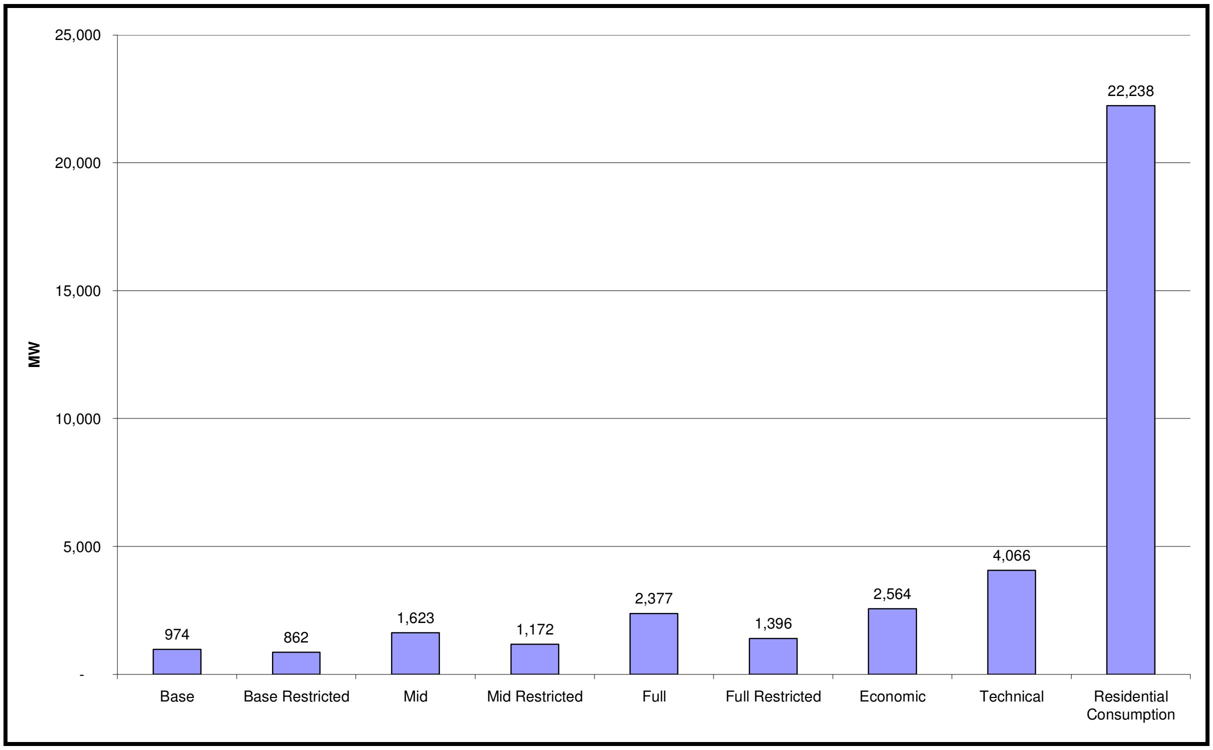
The forecast of residential consumption uses data from the *California Energy Demand 2008-2018 Staff Revised Forecast* (November 2007). The residential consumption numbers are derived from a combination of data from Form 1.1b and Form 1.1c. The 2016 residential consumption numbers are multiplied by the ratio of IOU-specific consumption relative to the total statewide consumption (ratio = .75546). Refer to Table 5-2 for a description of the scenarios.

As shown in Figure 5-1, the total CEC estimated residential electric consumption for 2016 is 81,823 GWh. The estimated technical energy savings potential for measures adopted from 2007 to 2016, that are still installed in 2016, is 20,473 GWh, total estimated economic potential is 16,248 GWh, total gross Full incentive potential is 10,165 GWh, and current incentive or the Base forecast is 5,205 GWh.[9] The technical potential is about 25% of expected consumption, the economic potential is about 20%, while the Full incentive potential estimate is approximately 12.5% of expected electric energy consumption. Figure 5-2 shows total estimated residential coincident peak demand of 22,238 MW in 2016. The estimated coincident peak demand technical potential for measures adopted from 2007 to 2016, that are still installed in 2016 is 4,066 MW, economic potential is 2,564 MW and total gross coincident peak demand potential under the Full scenario of 2,377 MW. The technical potential is about 18% of the expected coincident peak demand in 2016. Economic potential

[9] The energy savings potential presented in this report is at the generation level.

is about 13% and Full incentive potential is approximately 11% of coincident peak demand in 2016.

Figure 5-2: Forecasted California IOU Residential Electricity Coincident Peak Demand in 2016 and Gross Market, Economic, and Technical Coincident Peak Demand Potential for Existing Residential Buildings – 2007-2016 (MW)



The forecast of residential consumption uses data from the *California Energy Demand 2008-2018 Staff Revised Forecast* (November 2007). The residential coincident peak demand numbers are derived from a combination of data from Form 1.3 and Form 1.4b. The 2016 residential coincident peak demand numbers are multiplied by the ratio of IOU-specific coincident peak demand relative to the total statewide coincident peak demand (ratio = .74993). Refer to Table 5-2 for a description of the scenarios.

The total existing residential market electric potential by scenario, across all four California IOUs, is listed in Table 5-4. Potential estimates are provided for the intermediate forecast period (2007-2016) and through the end of the forecast period (2007-2026). Total IOU market potential under the Base scenario is 5,205 GWh of gross energy savings from 2007 through 2016 and 6,625 GWh from 2007 through 2026. The Base net energy savings potential is 3,181 GWh from 2007 through 2016 and 4,272 GWh from 2007 through 2026. These savings are the estimated energy savings potential if the IOUs continue the 2006 incentive levels and limit their program offerings to those measures with program accomplishments during the 2004-2005 program cycle. Increasing incentives to full incremental costs and expanding the measure list to include a limited number of additional technologies increases the total gross market potential estimates to 10,165 GWh from 2007 through 2016 and 12,777 GWh from 2007 through 2026. The Full scenario net potential energy estimates are 8,088 GWh from 2007 through 2016 and 10,334 GWh from 2007 through 2026. If program incentives were set halfway between current incentives and full incremental costs (the Mid scenario), estimate gross energy savings potential is 8,034 GWh from 2007 through 2016 and 10,426 GWh from 2007 through 2026.

Looking at the potential estimate through 2016 and limiting measures to those that are cost-effective makes only a modest reduction in savings in the Base scenario (297 GWh or 6%), but leads to a larger reduction in the Mid (1,206 GWh, 15%) and Full (2,189 GWh or 22%) scenarios. The design of the current programs, as reflected by the Base scenario, is largely restricted to measures that are cost-effective or nearly cost-effective. For those measures in the current IOU energy efficiency programs that are not cost-effective, the current rebate levels and program designs usually result in the non-cost-effective measures having very limited adoptions.[10] If the IOUs significantly increase the incentives on measures that are not cost-effective, in a manner similar to the Mid and Full incentive level scenarios, the model estimates that a significant number of customers would adopt these non-cost-effective measures.[11]

Total IOU market coincident peak demand potential is presented in Table 5-4. The total IOU gross existing residential market coincident peak demand potential under the Base scenario is 974 MW from 2007 through 2016 and 1,478 MW from 2007 through 2026. The Base net coincident peak demand potential is 605 MW from 2007 through2016 and 905 MW from 2007 through 2026. Increasing incentives to the halfway point between current and full incremental cost incentives increases the estimate of gross coincident peak demand potential to 1,632 MW from 2007 through 2016 and 2,485 MW from 2007 through 2026. The Mid net estimate of demand potential is 1,248 MW from 2007 through 2016 and 1,905 MW inform 2007 through 2026. Further increasing incentives to full incremental measure cost increases gross residential coincident peak demand potential to 2,377 MW through the first 10 years and 3,320 MW for the 20-year forecast period. The Full net demand potential estimate is 2,002 MW from 2007 through 2016 and 2,736 MW inform 2007 through 2026. Restricting incentivized measures to those that are cost-effective reduces net Base coincident demand potential to 493 MW from 2007 through2016, the Mid incentive net coincident demand potential to 797 MW from 2007 through 2016, and the Full incentive net coincident demand potential to 1,021 MW from 2007 through 2016.

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[10] The Mid and the Full incentive scenarios include measures that were not in the 2004-2005 programs and are not included in the Base scenario. Examination of the measure level results, however, indicate that the large difference between the mid and full restricted and non-restricted forecasts is due to measures in the base forecast that are not cost-effective.

[11] Incentivizing non-cost-effective measures may lead to substantially higher levels of savings, but it may not be in the utility's or society's best interest to spend resources on these measures.

Table 5-4: Estimated California IOU Total Market Potential by Scenario for Existing Residential Buildings – 2007-2016 and 2007-2026 (GWh and MW)

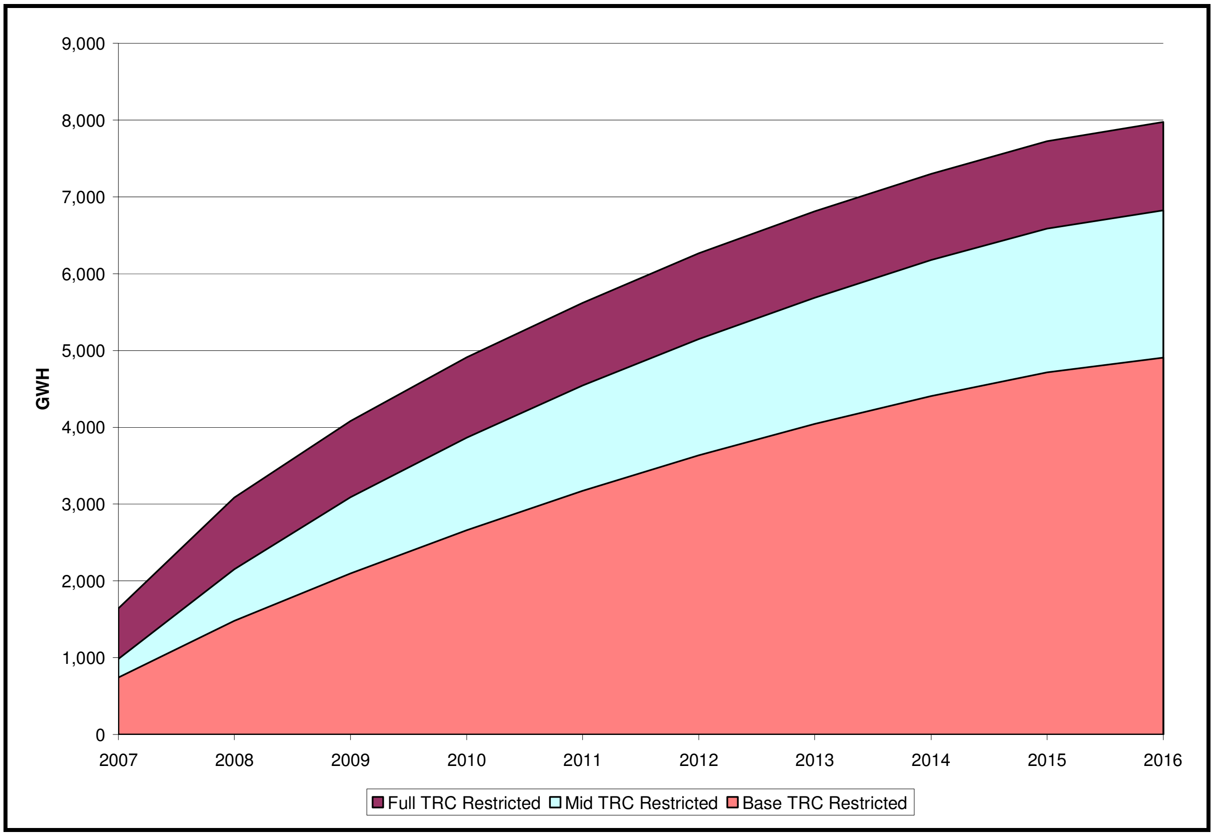
Scenario	Gross Market Energy (GWh, 2016)	Naturally Occurring Energy (GWh, 2016)	Coincident Peak Demand (MW, 2016)	Naturally Occurring Coincident Peak Demand (MW, 2016)	Gross Market Energy (GWh, 2026)	Naturally Occurring Energy (GWh, 2026)	Coincident Peak Demand (MW, 2026)	Naturally Occurring Coincident Peak Demand (MW, 2026)
Base	5,205	2,024	974	369	6,625	2,353	1,478	573
Base Restricted	4,908	2,024	862	369	6,144	2,353	1,264	573
Mid	8,034	2,077	1,623	375	10,426	2,443	2,485	584
Mid Restricted	6,828	2,077	1,172	375	8,601	2,443	1,702	584
Full	10,165	2,077	2,377	375	12,777	2,443	3,320	584
Full Restricted	7,976	2,077	1,396	375	10,008	2,443	2,009	584
Full Gradual	10,114	2,077	2,332	375	12,742	2,443	3,296	584
Full Gradual Restricted	7,952	2,077	1,357	375	9,977	2,443	1,979	584

Refer to Table 5-2 for a description of the scenarios. The naturally occurring potential is higher for the Mid and the Full scenarios than the Base sceario because additional measures have been added to the Mid and Full scenario that were not analyzed in the Base scenario.

Table 5-4 also presents potential estimates for a scenario in which the incentives levels were gradually increased from current incentive levels (in 2006) to full incentive levels (by 2010). The results from this scenario indicate that the slower ramp-up of incentives, when compared to the instantaneous jump from current incentives in 2006 to full incentives in 2007, leads to only a minor loss in potential relative to the Full scenario.

The results for the TRC restricted gross market scenarios are illustrated in Figure 5-3 and Figure 5-4. These graphs illustrate the yearly estimate of TRC restricted market potential from cumulative adoptions from 2007 to 2016.[12]

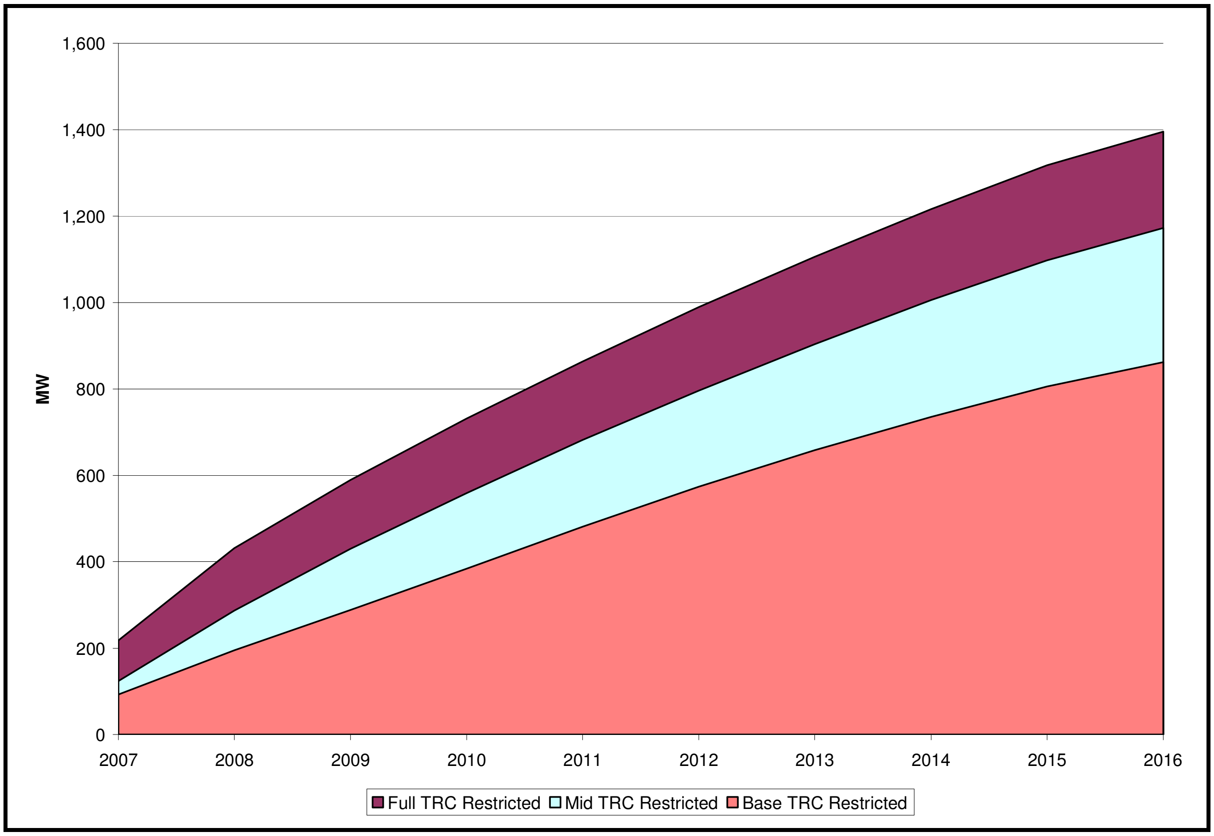
Figure 5-3: Estimated California IOU Gross Total Energy Market Potential by TRC Restricted Funding Levels for Existing Residential Buildings – 2007-2016 (GWh)



Refer to Table 5-2 for a description of the scenarios.

12 The results presented in these figures are gross program savings estimates. The savings estimates have not been reduced by the naturally occurring estimate of savings.

Figure 5-4: Estimated California IOU Gross Total Coincident Peak Demand Market Potential by TRC Restricted Funding Levels for Existing Residential Buildings – 2007-2016 (MW)



Refer to Table 5-2 for a description of the scenarios.

<u>Market and Naturally Occurring Potential with Higher Awareness</u>

Voluntary energy efficiency programs have encouraged Californians to adopt efficiency technologies for approximately three decades. During this period, their basic knowledge of energy efficiency measures and their willingness to install these measures has grown. The ongoing emphasis on expanding energy efficiency savings, and the growing public concern about global warming, may lead to a faster future growth in the awareness and willingness of consumers to adopt energy efficiency devices. In particular, it may lead to an increase in the awareness of efficiency measures and willingness of customers to adopt these measures without receiving rebates. To model this possibility, the Base TRC Restricted Higher Awareness scenario assumes a faster growth rate for the awareness than in the Base TRC Restricted scenario. In addition, this scenario assumes that the awareness and willingness of the naturally occurring estimate grows at a rate set equal to 75% of the growth rate of the program analysis.[13]

Table 5-5 lists the estimated electric savings for the Base TRC Restricted with Higher Awareness scenario. Comparing the 2007-2016 market energy efficiency potential with the Base TRC Restricted estimates presented in Table 5-4, the gross market energy savings with higher awareness increases by 443 GWh or 9% from 2007 through 2016 while the naturally occurring energy savings increase by 852 GWh or 42% through the same period. The large increase in the naturally occurring estimate leads to a reduction in the net-to-gross ratio. The net-to-gross ratio for the Base TRC Restricted scenario (from Table 5-4) is about 59% in 2016 and 62% in 2026. The net-to-gross for the Base TRC Restricted Higher Awareness scenario is approximately 46% in 2016 and 43% in 2026.

Table 5-5: Estimated California IOU Total Market Potential for the Base TRC Restricted with Higher Awareness for Existing Residential Buildings – 2007-2016 and 2007-2026 (GWh and MW)

	Gross Base TRC Restricted Higher Awareness 2016	Naturally Occurring Base TRC Restricted Higher Awareness 2016	Gross Base TRC Restricted Higher Awareness 2026	Naturally Occurring Base TRC Restricted Higher Awareness 2026
GWh	5,351	2,876	6,376	3,627
MW	987	579	1,375	900

Refer to Table 5-2 for a description of the scenarios.

Market Potential by End Use for Existing Residential Buildings

Table 5-6 and Table 5-7 summarize the energy market potential estimates by funding level and end use from 2007 through 2016 and 2026, respectively. Table 5-8 and **Error! Reference source not found.** present similar results for coincident peak demand reduction. Increasing funding for HVAC, lighting, miscellaneous, and water heater measures from current funding levels to full incremental cost increases gross energy savings for 2007-2016 by 174%, 91%, 46%, and 184%, respectively. Limiting the measure list to those with a TRC ≥ 0.85 reduces the impact of an increase in funding from Current incentive to Full incentive, increasing gross energy savings for 2007-2016 for HVAC measures by 66%, 68% for lighting, 39% for miscellaneous, and 16% for water heating measures and appliances.

[13] In all other scenarios, the awareness and willingness of the naturally occurring estimate is held fixed; it does not grow. For the base TRC restrict higher awareness scenario, the growing awareness and willingness for the naturally occurring analysis is intended to reflect the possible influence of market effects and growing awareness of global warming on the probability of adoption outside the program. The awareness and willingness of the naturally occurring estimate is never allowed to exceed 95%. The awareness and willingness of the program estimate commonly reaches 100% prior to the end of the forecast period.

Table 5-6: Estimated California IOU Total Gross Market Energy Potential by Funding Level and End Use for Existing Residential Buildings – 2007-2016 (GWh)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	485	400	182	843	538	1,327	664	183
Lighting	3,925	3,725	1,340	6,129	5,370	7,508	6,272	1,387
Miscellaneous	675	655	398	842	800	987	912	399
Water Heating	121	110	103	220	120	344	128	108
Total	**5,205**	**4,890**	**2,024**	**8,034**	**6,828**	**10,165**	**7,976**	**2,077**

Refer to Table 5-2 for a description of the scenarios. The miscellaneous end use includes pool pumps, high efficiency refrigerators, and refrigerator and freezer recycling.

Table 5-7: Estimated California IOU Total Gross Market Energy Potential by Funding Level and End Use for Existing Residential Buildings – 2007-2026 (GWh)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	910	737	388	1,528	969	2,086	1,171	390
Lighting	4,914	4,615	1,577	7,663	6,703	9,200	7,857	1,657
Miscellaneous	630	590	256	837	755	930	795	257
Water Heating	172	154	132	397	174	561	184	139
Total	**6,625**	**6,097**	**2,353**	**10,426**	**8,601**	**12,777**	**10,008**	**2,443**

Refer to Table 5-2 for a description of the scenarios. The miscellaneous end use includes pool pumps, high efficiency refrigerators, and refrigerator and freezer recycling.

The distribution of energy savings potential by end use indicates that the majority of the existing residential sector's remaining energy efficiency potential is in the lighting end use. Approximately 75% of the Base scenario's energy savings potential is lighting for 2007-2016 and 2007-2026. Restricting IOU portfolios to those measures with a TRC $\geq$ 0.85 does not significantly change the lighting share under the Current programs (the Base TRC Restricted lighting share is 76%). If incentives increase to Full incremental costs, lighting's share is 74% in 2016 and 72% in 2026. Restricting the Full scenario to measures with a TRC > 0.85 increases lightings share to 79% for 2007-2016 and 2007-2026. Lighting's share of the economic energy potential for the existing residential sector is about 60% in 2016 and 67% in 2026, helping to explain the high lighting market share.

Comparing the market and naturally occurring potentials listed in Table 5-6 indicates that the net water heating potential is very low.[14] This finding is due, at least in part, to the high market share achieved by high efficiency clothes washers with relatively low MEFs (1.6 and 1.8). The California RMST Appliance report (2005) found that about 50% of clothes washers sold in 2005 were ENERGY STAR clothes washers (MEF 1.4 or greater).[15] Four high efficiency clothes washers were analyzed for this report, including MEF 1.26, MEF 1.6, MEF 2, and MEF 2.2. In addition, the study incorporated the code change increasing the base efficiency from MEF 1.04 to 1.26 in 2007. Given the existing high market share for clothes washers, the model estimates a high naturally occurring market share for clothes washers with an MEF of 1.26 and 1.6. The IOU high efficiency clothes washer programs work to encourage adoptions for higher efficiency clothes washers (MEF 2 and 2.2), but the marginal efficiency gains are small, leading to a small net impact.

Table 5-8: Estimated California IOU Total Gross Market Coincident Peak Demand Potential by Funding Level and End Use for Existing Residential Buildings – 2007-2016 (MW)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	474	411	166	866	518	1,444	637	166
Lighting	395	375	135	612	535	750	625	140
Miscellaneous	81	79	48	101	96	119	110	48
Water Heating	24	22	21	44	23	64	24	21
Total	**974**	**886**	**369**	**1,623**	**1,172**	**2,377**	**1,396**	**375**

Refer to Table 5-2 for a description of the scenarios. The miscellaneous end use includes pool pumps, high efficiency refrigerators, and refrigerator and freezer recycling.

14 Net potential is calculated by subtracting the naturally occurring potential from the gross market scenario potential.

15 Data are from the California Residential Efficiency Market Share Tracking Report: Appliances 2005, October 2006, Table 3.3. In 2002, clothes washers with an MEF of 1.26 or higher captured about 32% of the market.

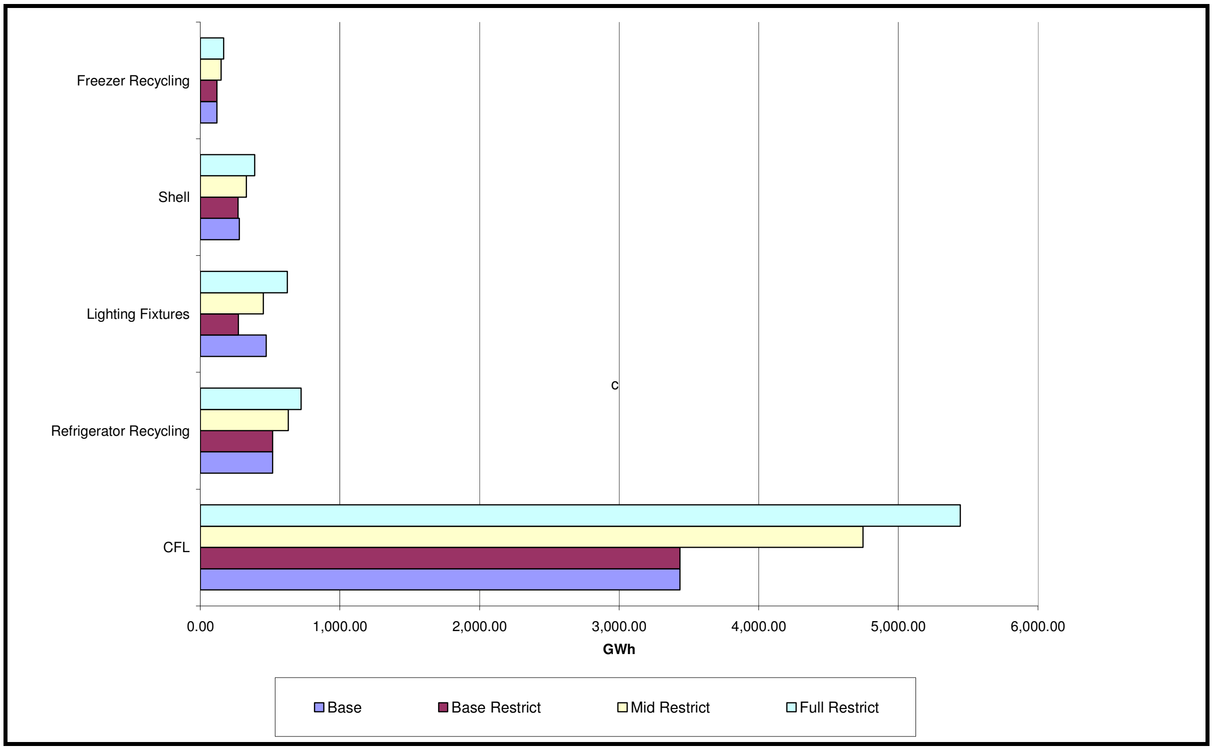
Table 5-9: Estimated California IOU Total Gross Market Coincident Peak Demand Potential by Funding Level and End Use for Existing Residential Buildings – 2007-2026 (MW)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	873	750	357	1,555	918	2,201	1,107	358
Lighting	495	465	159	756	659	908	772	167
Miscellaneous	76	71	31	101	91	112	96	31
Water Heating	34	30	26	74	33	99	34	27
Total	**1,478**	**1,317**	**573**	**2,485**	**1,702**	**3,320**	**2,009**	**584**

Refer to Table 5-2 for a description of the scenarios. The miscellaneous end use includes pool pumps, high efficiency refrigerators, and refrigerator and freezer recycling.

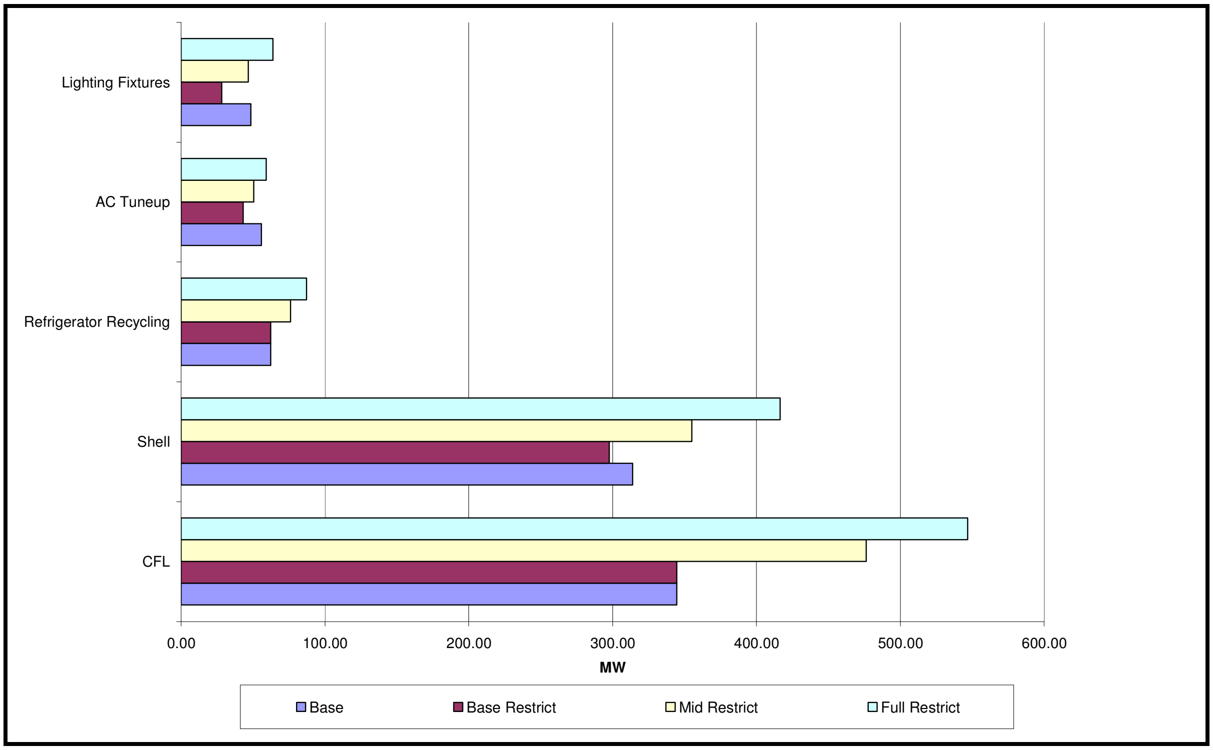
Figure 5-5 and Figure 5-6 present estimates of total market gross potential at the grouped measure level for the top five saving measures ordered by their Mid TRC Restricted market scenario. As shown in these figures, grouping all screw-in CFLs into one measure group results in CFLs contributing significantly more savings potential than any other measure grouping. After screw-in CFLs, refrigerator recycling, lighting fixtures, shell measures (insulation, windows and ducts), and freezer recycling round out the top five energy savings measures while the remaining top demand savings measures are shell measures, refrigerator recycling, AC tune-ups, lighting fixtures, and refrigerator recycling.

Figure 5-5: California IOU Residential Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 5-2 for a description of the scenarios.

Figure 5-6: California IOU Residential Total Market Gross Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 5-2 for a description of the scenarios.

5.2.2 Existing Residential Potential if CFL Lighting becomes Base Technology

The California legislature recently passed Assembly Bill 1109 (the Huffman Bill). The Huffman Bill requires a 50% reduction in the statewide unit energy consumption for indoor residential lighting between 2007 and 2018. In an attempt to provide the IOUs with a very quick estimate of the impact of this legislation on their energy efficiency lighting potential, each of the above scenarios was re-calculated without the CFL lighting potential.

Table 5-10 and Table 5-11 list existing residential energy and coincident peak demand savings potential for lighting by scenario, with screw-in incandescent as base technology (the assumption of the rest of the study) and screw-in CFLs as base technologies (a possible future with the Huffman Bill). Eliminating screw-in CFLs from the residential voluntary energy efficiency program will reduce lighting technical potential by 8,069 GWh from 11,535 GWh to 3,466 GWh in 2016. Continuing the forecast period through 2026 leads to a 8,847 GWh reduction in residential lighting technical potential from 13,140 GWh to 4,293 GWh. The Base TRC Restricted gross lighting energy potential will fall from 3,725 GWh to 279 GWh in 2016 and from 4,615 to 612 GWh in 2026. The Full TRC Restricted gross potential will fall from 6,272 GWh to 782 GWh in 2016 and 7,857 GWh to 1,796 GWh in 2026.

Table 5-10: California IOU Estimated Total Technical, Economic, and Gross Market Energy Potential for Residential Lighting by Scenario, with Incandescent and CFL Base – 2007-2016 and 2007-2026(GWh)

	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid Restrict	Full Restrict	Mid and Full Naturally Occurring
Lighting, 2016	11,535	9,650	3,925	3,725	1,340	5,370	6,272	1,387
Lighting CFL Base, 2016	3,466	1,581	479	279	159	590	782	200
Lighting, 2026	13,140	10,963	4,914	4,615	1,577	6,703	7,857	1,657
Lighting CFL Base, 2026	4,293	2,116	910	612	272	1,425	1,796	344

Refer to Table 5-2 for a description of the scenarios.

Table 5-11: California IOU Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential for Existing Residential Lighting by Scenario, with Incandescent and CFL Base – 2007-2016 and 2007-2026 (MW)

	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid Restrict	Full Restrict	Mid and Full Naturally Occurring
Lighting, 2016	1,136	944	395	375	135	535	625	140
Lighting CFL Base, 2016	323	132	49	29	17	56	74	21
Lighting, 2026	1,290	1,068	495	465	159	659	772	167
Lighting CFL Base, 2026	398	177	93	63	28	129	163	35

Refer to Table 5-2 for a description of the scenarios.

5.2.3 Electric Cost and Benefit Results for Existing Residential Buildings

Table 5-12 presents a summary of the present discounted value of costs and benefits and the benefit-to-cost ratios for four of the market potential funding and TRC restricted scenarios. The table does not include the cost and benefit information for the Mid and Full scenario.[16] Increasing incentives without restricting the non-cost effective measures dramatically increases costs while only leading to a small increase in benefits. These scenarios were not included in this analysis due to their very low TRC values and the subsequently low likelihood that the utilities would undertake a non-restricted high incentive program design.

[16] The electric cost and benefit analysis does not include the benefits or the costs associated with the installation of dual fuel measures in SCG's territory. These measures were assigned to the gas cost and benefit analysis because they require the existence of gas heat or gas water heat.

Table 5-12: Summary of the California IOU Electric Market Costs and Benefits by Scenario for Existing Residential Buildings – 2007-2026

(Costs and benefits are in $1,000,000)	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	1,379	737	1,569	2,588
PDV Net Measure Costs	2,515	925	1,587	2,036
PDV Gross Program Costs	300	281	393	472
PDV Net Elec Avoided Cost Benefits	3,411	2,748	4,575	5,840
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	1.21	2.28	2.31	2.33

Refer to Table 5-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

The results show that the Base funding level results in a residential program that is cost-effective based on the TRC test. The TRC ratio for the Base scenario is 1.21. If the Base scenario is restricted to measures that are cost effective, the TRC increases to 2.28. Restricting measures to those that are cost effective leads to an estimated 20% reduction in avoided cost benefits and a 63% reduction in measure cost expenditures. Restricting the current portfolio to measures that are cost effective eliminates a couple of high cost, low savings measures. Increasing funding to the Mid Restricted scenario leads to a TRC of 2.31 in 2026 and the Full Restricted TRC is 2.33

5.2.4 Residential Utility-Level Potential, Benefits, and Costs

In this subsection, market, technical and economic potential are presented at the utility level. The utility-specific costs, savings, and TRC test results are also listed below. Figure 5-7 through Figure 5-18 illustrate and Table 5-13 through Table 5-18 list the estimates of potential electric energy and demand savings for the various market scenarios for PG&E, SCE, and SDG&E, respectively.

The yearly illustration of technical and economic potential needs to be analyzed carefully. For retrofit and conversion models, the technical potential assumes an instantaneous installation of energy efficiency measures wherever applicable and feasible. For replace-on-burnout models, the technical potential is phased in as the previous measures burn out. Economic potential is similar to technical, with the further consideration of costs. Both the technical and economic potential should be viewed as theoretical constructions that do not reflect the market barriers that must be overcome to achieve voluntary market adoptions. Given the definitions of economic and technical potential, the technical potential illustrated for each utility in 2007 demonstrates what the utility could achieve if it could force all households that could adopt the measure to adopt the measure. Increases in technical potential over time are due to population growth and the burnout of existing measures.

PG&E Potential Energy Savings Forecasts for Existing Residential Buildings

The results in Table 5-13 list the energy savings potential from existing homes in PG&E's service territory, while Figure 5-7 illustrates the savings estimates. Estimated gross market savings potential under current incentives is 2,109 GWh for 2007 through 2016 and 2,811 GWh for 2007 through 2026, with nearly three-fourths of these savings derived from the residential lighting program. Increasing incentives to the average between current incentives and full incremental measure costs (Mid incentives scenario) increases the estimate of savings to 3,515 GWh for 2007-2016 and 4735 GWh for 2007-2026. Increasing incentives to full incremental measure cost increases potential savings to 4,560 GWh for 2007-2016 and 5,940 GWh for 2007-2026.

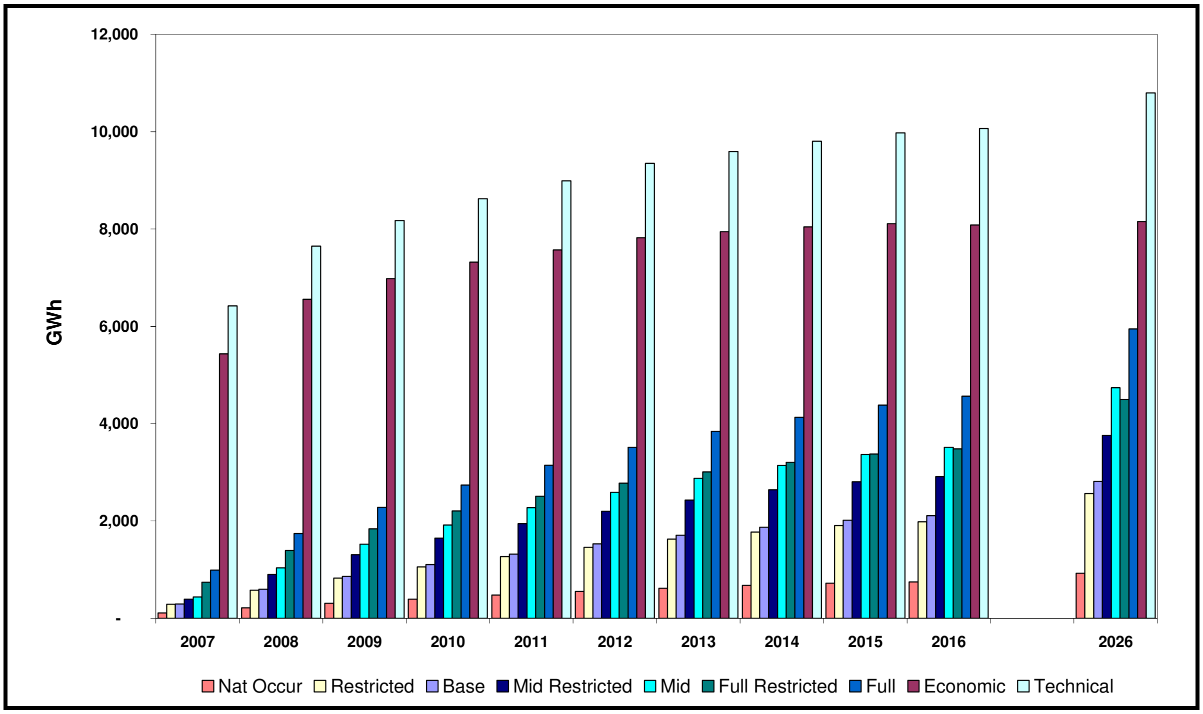
Figure 5-8 illustrates the energy savings potential from the top five energy savings measure groups. Grouping all CFLs into one measure group clearly illustrates the importance of this measure in PG&E's residential energy efficiency program. Following CFLs, the measure groups with the highest energy savings potential include shell measures, refrigerator recycling, lighting fixtures, and reflectors. The presence of three lighting technology groups in the top five measures is consistent with the finding that lighting potential accounts for more than three-fourths of PG&E existing residential potential.

Table 5-13: PG&E Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	6,417	5,433	293	283	109	294	122	438	390	988	737	453	404	112
2008	7,640	6,553	595	575	214	601	248	1,038	895	1,737	1,390	1,076	926	219
2009	8,170	6,978	857	827	307	868	365	1,520	1,308	2,276	1,839	1,751	1,459	314
2010	8,618	7,313	1,098	1,057	394	1,117	480	1,919	1,647	2,738	2,205	2,454	1,977	403
2011	8,985	7,565	1,322	1,268	475	1,348	592	2,272	1,941	3,145	2,511	2,984	2,381	486
2012	9,347	7,814	1,527	1,458	550	1,563	700	2,589	2,199	3,514	2,781	3,413	2,702	563
2013	9,588	7,939	1,709	1,625	616	1,755	801	2,875	2,428	3,841	3,005	3,776	2,956	631
2014	9,802	8,040	1,871	1,773	674	1,917	894	3,137	2,635	4,126	3,203	4,083	3,171	690
2015	9,972	8,101	2,013	1,901	721	2,050	973	3,360	2,804	4,378	3,374	4,348	3,354	740
2016	10,061	8,082	2,109	1,983	750	2,128	1,030	3,515	2,904	4,560	3,477	4,550	3,477	770
2026	10,793	8,147	2,811	2,557	925	2,637	1,358	4,735	3,754	5,940	4,489	5,927	4,479	961

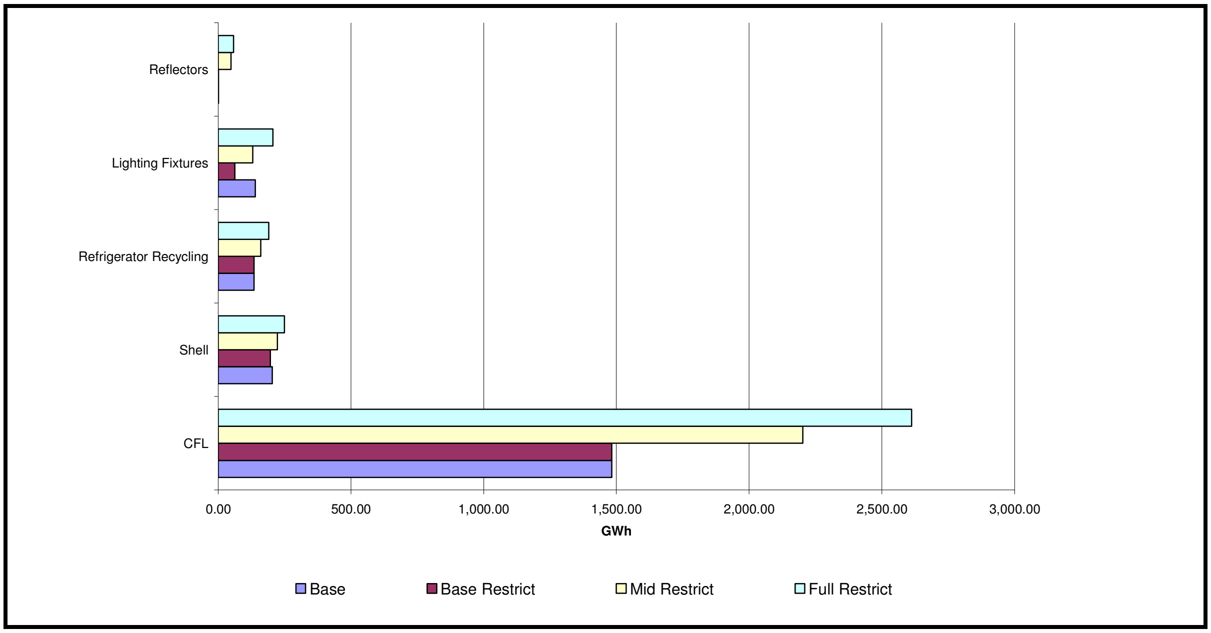
Refer to Table 5-2 for a description of the scenarios.

Figure 5-7: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Energy Potential for Existing Residential Buildings – 2007-2016 and 2026 (GWh)



Refer to Table 5-2 for a description of the scenarios.

Figure 5-8: PG&E Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 5-2 for a description of the scenarios.

SCE Potential Energy Savings Forecasts for Existing Residential Buildings

The results in Table 5-14 list the energy savings potential from existing homes in SCE's service territory, while Figure 5-9 illustrates the savings estimates. Estimated gross market savings potential under current incentives is 2,322 GWh for 2007 through 2016 and 2,733 GWh for 2007 through 2026, with slightly more than three-fourths of these savings derived from the residential lighting program. Increasing incentives to the average between current incentives and full incremental measure costs (Mid incentives scenario), increases the estimate of savings to 3,341 GWh for 2007-2016 and 4039 GWh for 2007-2026. Increasing incentives to full incremental measure cost increases potential savings to 4,039 GWh 2007-2016 and 4,788 GWh for 2007-2026.

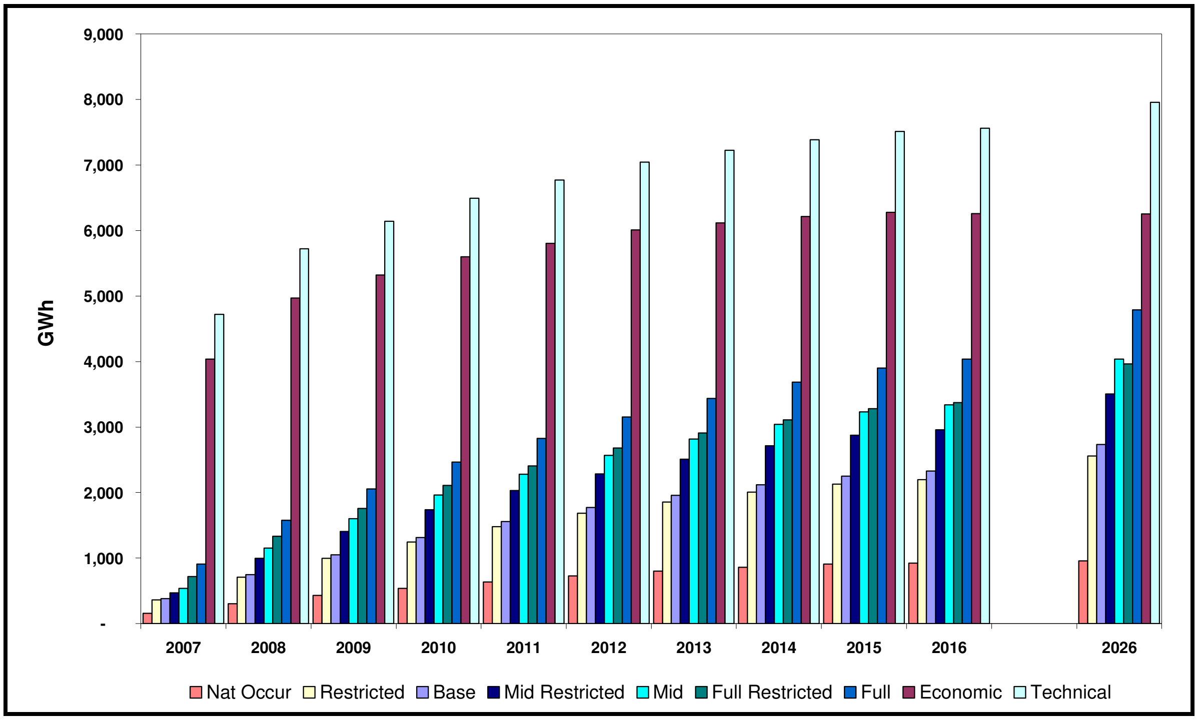
Figure 5-10 illustrates the top five energy saving measure groups in the SCE service territory. CFLs are the top energy savings measure group, followed distantly by refrigerator recycling, lighting fixtures, freezer recycling, and AC tune-ups.

Table 5-14: SCE Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (GWh)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Naturally Occurring	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restric t	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	4,722	4,038	383	360	157	370	174	536	468	910	720	552	481	159
2008	5,722	4,969	750	709	305	735	346	1,150	997	1,578	1,336	1,190	1,026	310
2009	6,144	5,322	1,050	995	429	1,036	500	1,600	1,407	2,055	1,758	1,758	1,522	437
2010	6,494	5,600	1,316	1,248	539	1,314	647	1,963	1,740	2,465	2,109	2,296	1,975	550
2011	6,773	5,807	1,557	1,478	638	1,574	790	2,281	2,030	2,826	2,410	2,727	2,337	651
2012	7,044	6,009	1,772	1,682	728	1,815	928	2,567	2,287	3,154	2,682	3,088	2,638	743
2013	7,223	6,120	1,956	1,855	802	2,024	1,054	2,816	2,511	3,440	2,908	3,392	2,881	820
2014	7,386	6,216	2,116	2,005	862	2,197	1,165	3,043	2,713	3,687	3,109	3,651	3,091	882
2015	7,514	6,279	2,252	2,131	907	2,335	1,257	3,232	2,875	3,902	3,281	3,873	3,270	929
2016	7,558	6,259	2,327	2,198	925	2,405	1,315	3,341	2,961	4,039	3,376	4,020	3,375	950
2026	7,957	6,254	2,733	2,559	955	2,669	1,512	4,039	3,503	4,788	3,961	4,774	3,955	996

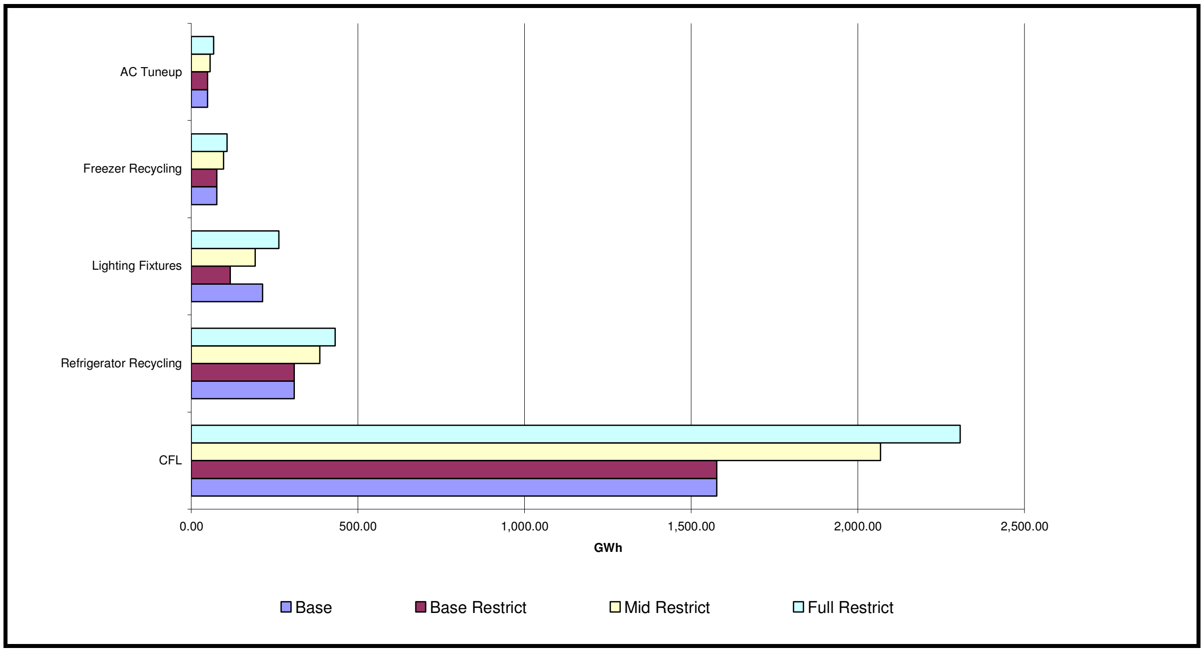
Refer to Table 5-2 for a description of the scenarios.

Figure 5-9: SCE Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Energy Potential for Existing Residential Buildings – 2007-2016 and 2026 (GWh)



Refer to Table 5-2 for a description of the scenarios.

Figure 5-10: SCE Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 5-2 for a description of the scenarios.

SDG&E Potential Energy Savings Forecasts for Existing Residential Buildings

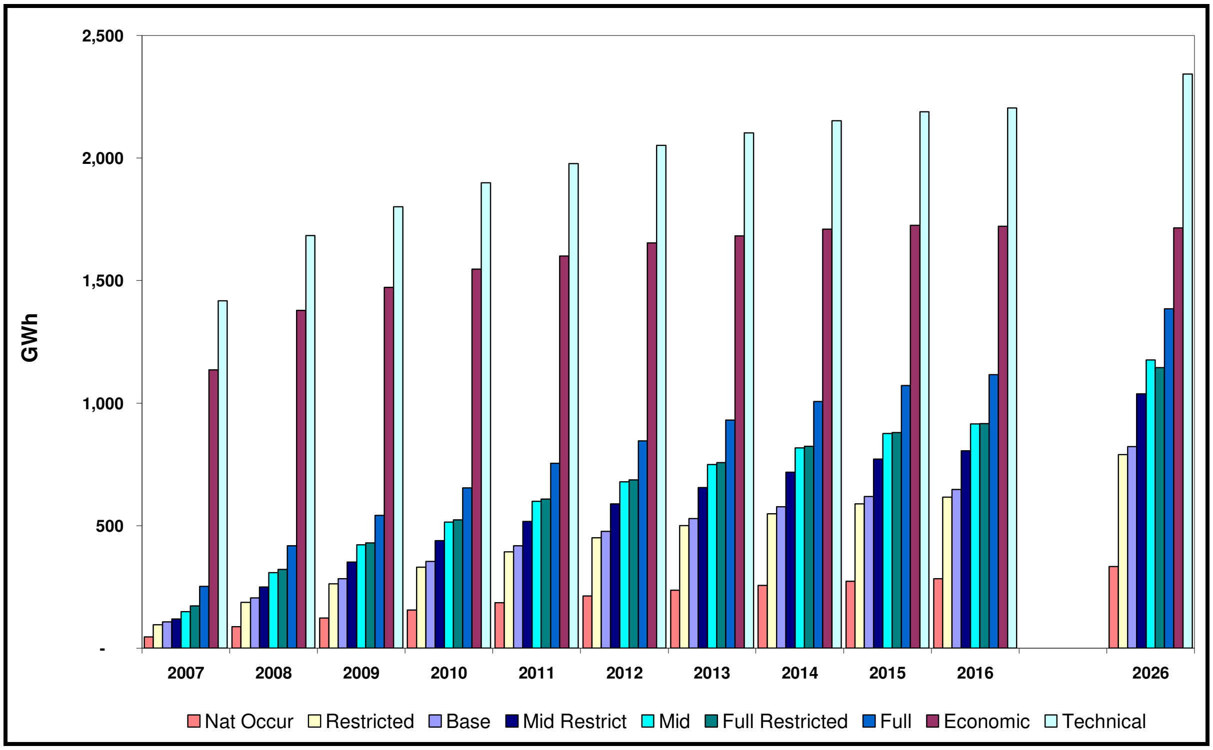
The results listed in Table 5-15 present the energy savings from existing homes in SDG&E's service territory. Figure 5-11 illustrates SDG&E's energy savings by scenario. Estimated gross savings potential under the Base scenario is 647 GWh for 2007 through 2016 and 823 GWh for 2007 through 2026. Slightly more than three-fourths of the forecast potential savings under current rebate levels are derived from the residential lighting end use. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases forecast potential savings to 914 GWh for 2007-2016, a 41% increase in savings. In 2026, the Mid scenario's total gross market potential is 1,175 GWh, a 43% increase over the Base scenario estimates for 2026. Further increasing incentives to full incremental measure cost increases potential savings to 1,116 GWh for 2007-2016 and 1,385 GWh for 2007-2026.

Table 5-15: SDG&E Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (GWh)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Base Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	1,417	1,135	106	96	45	98	50	149	119	251	172	154	123	46
2008	1,683	1,378	204	187	87	194	99	307	249	417	321	319	256	89
2009	1,801	1,471	283	262	123	274	144	421	351	542	429	464	378	126
2010	1,899	1,545	354	330	155	349	189	515	438	653	523	606	492	159
2011	1,976	1,600	418	393	185	421	233	599	516	754	608	722	588	189
2012	2,051	1,653	476	450	212	489	277	678	588	846	687	822	673	217
2013	2,102	1,682	528	500	236	550	318	748	654	930	757	911	746	242
2014	2,151	1,709	576	548	256	605	356	816	718	1,005	824	991	815	263
2015	2,188	1,725	619	588	273	649	390	875	771	1,071	879	1,058	873	280
2016	2,204	1,720	647	615	283	677	414	914	806	1,116	915	1,107	911	291
2026	2,342	1,714	823	790	333	815	528	1,175	1,037	1,385	1,144	1,380	1,140	346

Refer to Table 5-2 for a description of the scenarios.

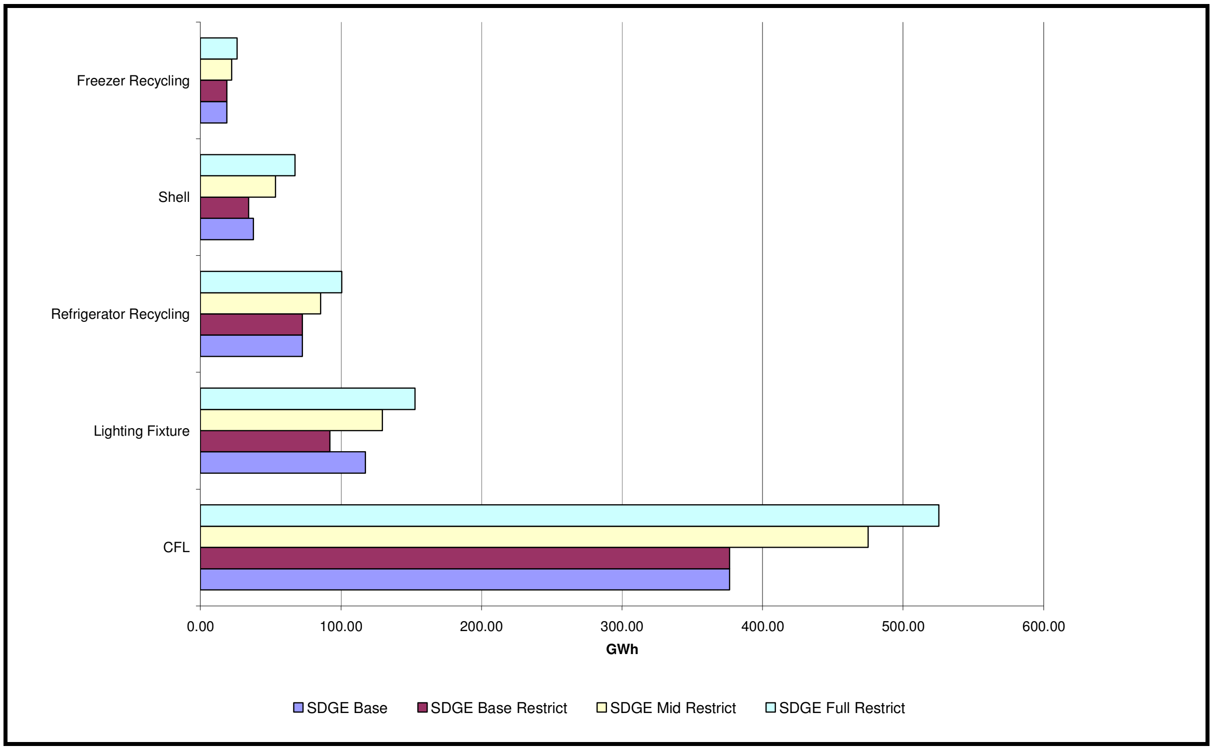
Figure 5-11: SDG&E Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Energy Potential for Existing Residential Buildings – 2007-2016



Refer to Table 5-2 for a description of the scenarios.

Figure 5-12 illustrates the existing residential market energy savings estimates from the top five measure savings groups in SDG&E's service territory. Screw-in CFLs are estimated to contain substantially more energy savings potential than other measure groups. Lighting fixtures and refrigerator recycling followed by shell measures and freezer recycling round out the top five energy potential measure groups.

Figure 5-12: SDG&E Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 5-2 for a description of the scenarios.

PG&E Potential Demand Savings Forecasts for Existing Residential Buildings

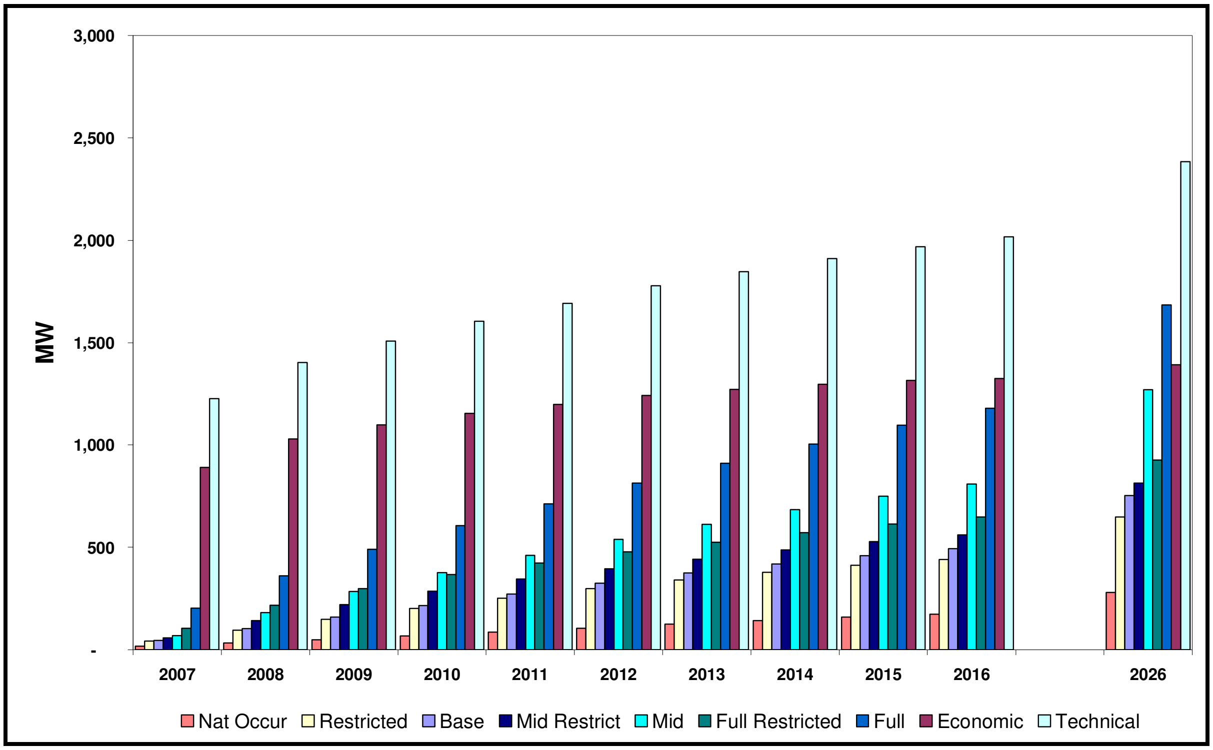
The results in Table 5-16 list the coincident peak demand savings from existing homes in PG&E's service territory, while Figure 5-13 illustrates these estimates. The estimated coincident peak demand savings potential under the Base scenario is 493 MW for 2007-2016 and 752 MW for 2007-2026. Restricting the measures to those with a TRC 0.85 or higher reduces the Base scenario estimate to 440 MW for 2007 through 2016 and 648 MW for 2007 through 2026. Increasing incentives to the average between current incentives and full incremental measure costs (the Mid scenario), increases the estimate of coincident peak demand savings to 809 MW for 2007-2016 and 1,270 MW for 2007-2026. The growth rate in the coincident peak demand estimates between the Base and Mid scenarios is about 65%. Restricting the estimate of potential savings to measures that are cost-effective reduces the Mid scenario's estimate of coincident peak demand savings to 561 MW for 2007-2016 and 814 MW for 2007-2026. Restricting the measures to those that are cost-effective (TRC > 0.85) leads to a growth rate between the Base and Mid scenarios of about 27%. The large difference in the growth rates between the non-restricted and the restricted Base to Mid incentive scenario is largely due to the large increase in non-cost-effective measure adoption between the Base and Mid scenarios. Increasing incentives from Base levels to the average between current (base) incentives and full incremental measure costs (Mid scenario) leads to a significant increase in the adoption of measures that are not cost-effective. Many of these non-cost-effective measures are in the IOU's programs during the 2004-2005 program years, but the incentives and the focus of the programs are such that these measures have few adoptions. The model predicts that if incentives were increased significantly, these measures would have substantially more adoptions. Further increasing incentives from 2006 levels to full incremental measure cost increases demand potential savings to 1,179 MW for 2007-2016 and 1,683 MW for 2007-2026.

Table 5-16: PG&E Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	1,226	890	44	41	16	46	20	69	57	202	105	74	62	16
2008	1,402	1,030	101	95	32	106	45	181	142	361	216	195	154	32
2009	1,507	1,097	158	148	49	167	72	284	219	491	298	347	245	49
2010	1,604	1,154	215	201	67	225	101	375	285	605	366	520	329	68
2011	1,691	1,198	272	251	86	274	130	460	344	711	424	653	397	87
2012	1,777	1,242	325	297	105	320	158	538	395	813	477	770	455	106
2013	1,845	1,270	374	340	124	362	185	612	442	911	525	878	507	125
2014	1,910	1,296	418	377	142	402	212	683	487	1,005	570	978	554	143
2015	1,968	1,314	458	412	159	438	236	750	527	1,095	613	1,073	598	161
2016	2,016	1,324	493	440	174	468	259	809	561	1,179	648	1,161	636	176
2026	2,384	1,392	752	648	280	671	405	1,270	814	1,683	926	1,673	913	284

Refer to Table 5-2 for a description of the scenarios.

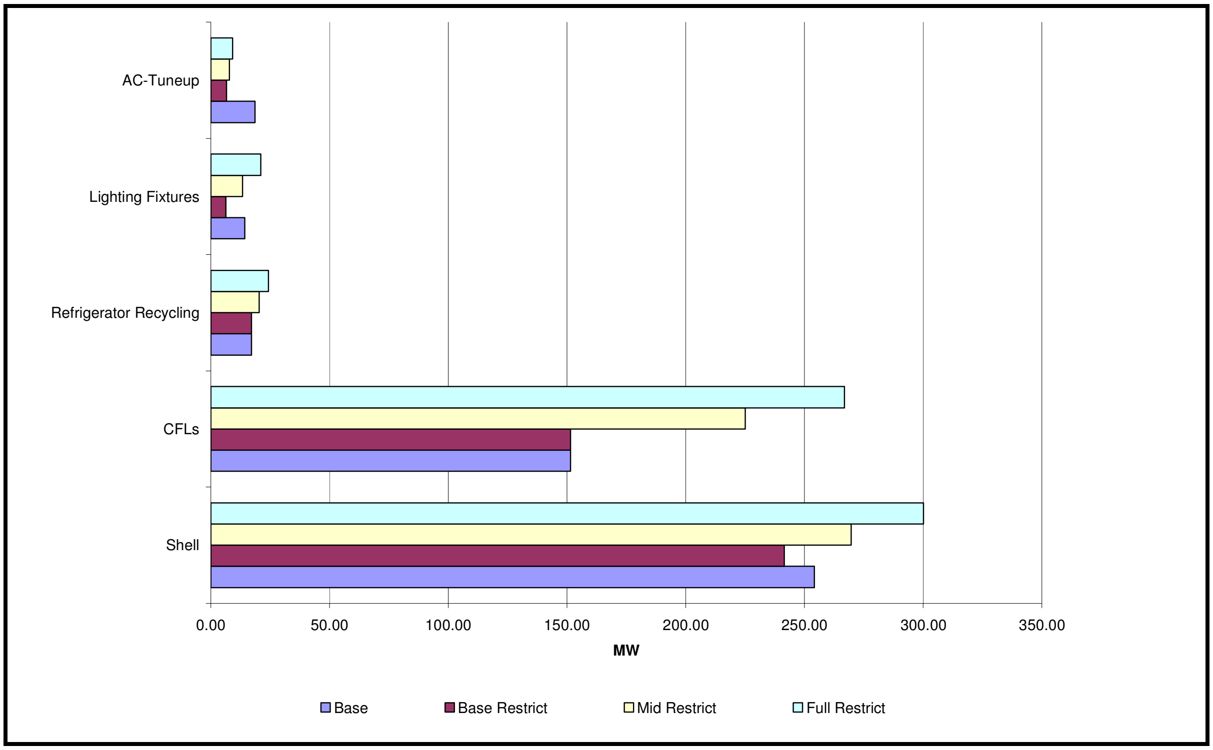
Figure 5-13: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Existing Residential Buildings – 2007-2016 and 2026 (MW)



Refer to Table 5-2 for a description of the scenarios.

Figure 5-14 illustrates the coincident peak demand savings potential from the top five measure groups. In PG&E's existing residential sector, shell measures (insulation, ducts, and windows) offer the highest coincident peak demand savings potential. For the Mid Restricted and Full Restricted scenarios, the coincident peak demand savings potential from all CFLs closely follows shell measures. Completing the top five measure groups are refrigerator recycling, lighting fixtures, and ac-tune-ups.

Figure 5-14: PG&E Total Market Gross Coincident Peak Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 5-2 for a description of the scenarios.

SCE Potential Demand Savings Forecasts for Existing Residential Buildings

The results in Table 5-17 list the coincident peak demand savings from existing homes in SCE's service territory. The estimated demand savings potential under the Base scenario is 291 MW for 2007 through 2016 and 373 MW for 2007 through 2026. Increasing incentives to the average between current incentives and full incremental measure costs increases forecast savings to 434 MW for 2007-2016 and 578 for 2007-2026. Increasing incentives to full incremental measure cost increases demand potential savings to 582 MW for 2007-2016 and 755 MW for 2007-2026.

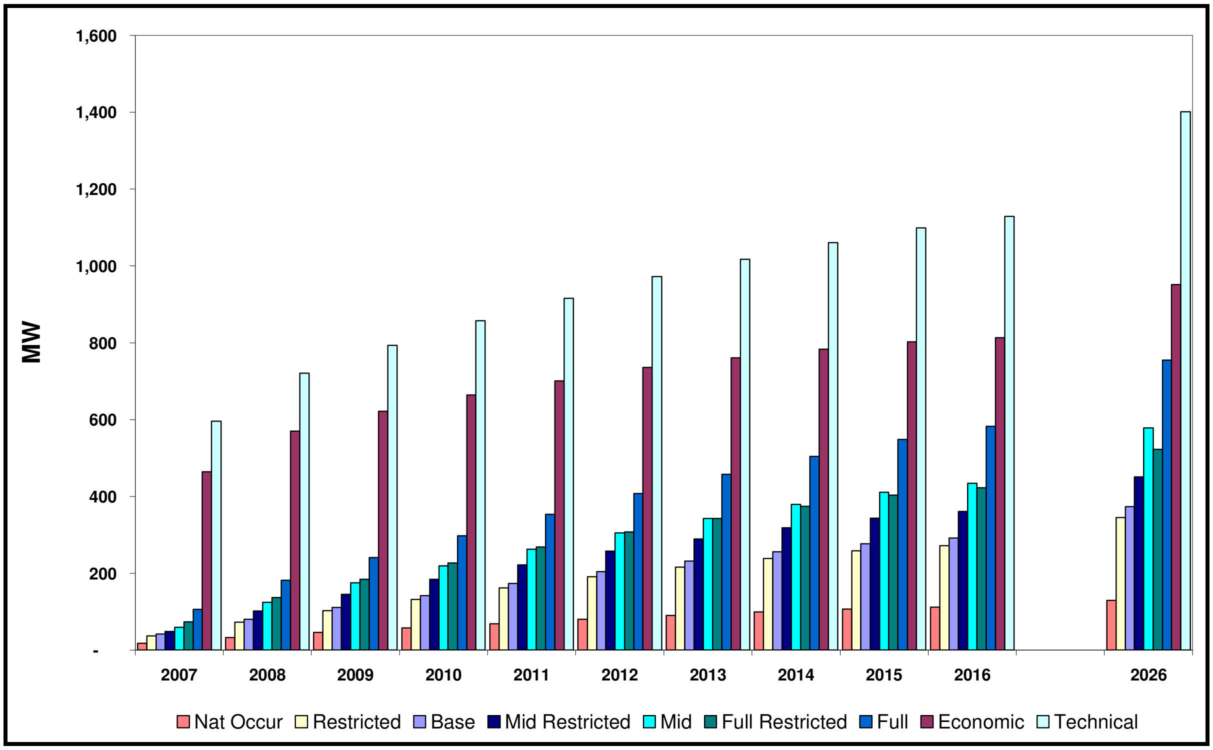
Table 5-17: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (MW)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Base Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	595	464	41	37	17	38	19	59	48	105	73	61	49	17
2008	721	569	79	72	32	75	37	124	101	181	137	129	104	33
2009	793	621	111	102	46	108	54	174	145	240	183	196	158	47
2010	857	664	141	131	57	141	70	219	183	297	226	268	210	59
2011	915	700	174	161	68	176	88	262	221	353	268	332	258	70
2012	972	735	204	190	80	210	107	304	257	407	307	390	300	81
2013	1,017	760	231	216	90	240	124	342	289	457	342	443	336	92
2014	1,060	783	255	238	99	268	141	378	318	504	374	491	369	101
2015	1,099	802	276	258	107	291	155	410	343	547	403	535	398	109
2016	1,129	813	291	271	112	307	166	434	360	582	422	571	419	114
2026	1,401	951	373	344	129	359	209	578	450	755	522	748	518	133

Refer to Table 5-2 for a description of the scenarios.

Figure 5-15 presents the potential coincident peak demand savings for the market scenarios and the economic and technical potential estimates for SCE.

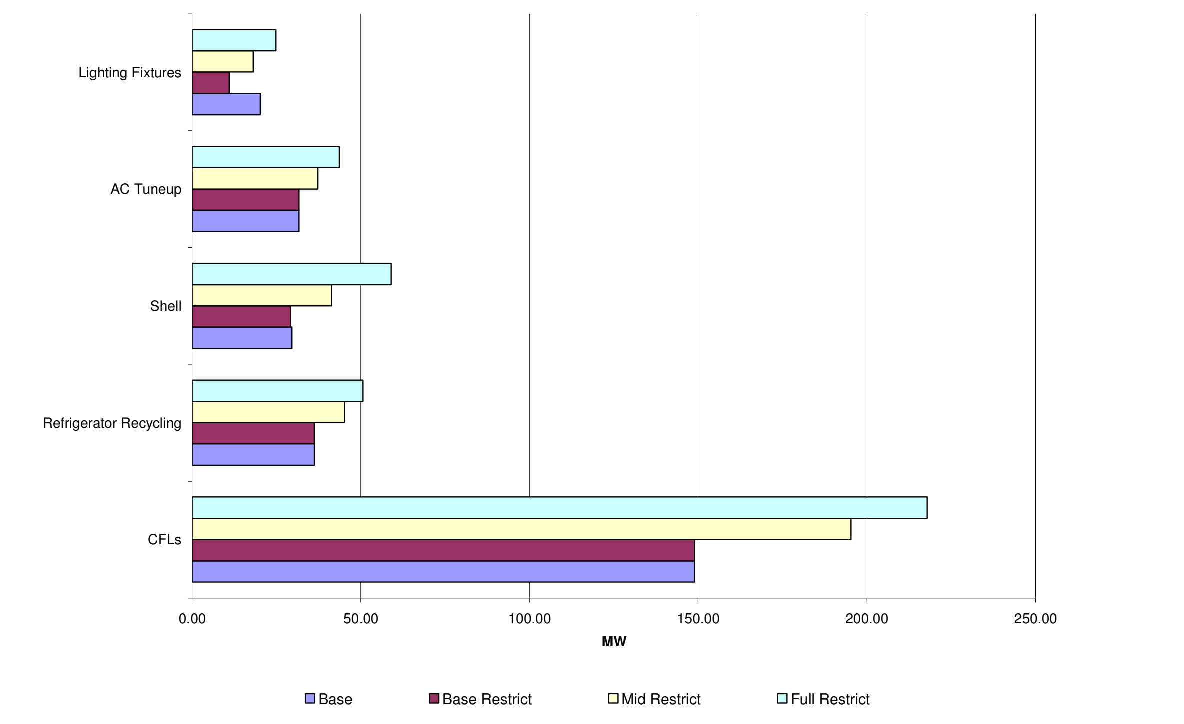
Figure 5-15: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Existing Residential Buildings – 2007-2016 and 2026 (MW)



Refer to Table 5-2 for a description of the scenarios.

Figure 5-16 lists the measure groups with the top five coincident peak demand savings potential. For SCE's residential sector, the CFL measure group has the top coincident demand savings potential. Following CFLs, refrigerator recycling, shell measures (insulation, ducts, and windows), AC tune-ups, and lighting fixtures are the four measure groups that finish out the top five coincident peak demand savings potential measure groups. For SCE's service territory, the demand potential from shell measures is not similar to CFLs in potential quantity. Given that SCE only provides electricity, its insulation and duct peak demand savings potential is limited to households with electric heat. The savings potential for households with gas heat is attributed to SCG.

Figure 5-16: SCE Total Market Gross Coincident Peak Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 5-2 for a description of the scenarios.

SDG&E Potential Demand Savings Forecasts for Existing Residential Buildings

The results in Table 5-18 list the coincident peak demand savings from existing homes in SDG&E's service territory. The estimated gross coincident peak demand savings potential under the Base scenario (2006 incentive levels) is 109 MW for 2007 through 2016 and 162 MW for 2007 through 2026. In the Base scenario estimates, HVAC accounts for approximately 34% of peak demands savings, with lighting capturing 54% of potential coincident peak demand savings. Increasing incentives to the average between current incentives and full incremental measure costs increases the forecast of coincident peak demand potential to 178 MW for 2007-2016 and 260 MW for 2007-2026. Under the Mid scenario, both HVAC and lighting contribute about 45% of the coincident peak demand potential. Increasing incentives to full incremental measure cost increases demand potential savings to 238 MW for 2007-2016 and 325 MW for 2007-2026. At full incremental cost incentives, HVAC measures contribute 50% of the coincident peak demand potential while lighting measures contribute 40% of the potential. Restricting the Full incentive scenario to those measures that are nearly cost-effective (TRC >0.85) reduces the coincident peak demand potential to 164 MW for 2007-2016 and 225 MW for 2007-2026. Under the restricted Full incentive scenario, lighting contributes 50% of the coincident demand potential while HVAC contributes 40%. Restricting measures to those that are cost-effective significantly reduces the HVAC potential due to the elimination of residential CAC measures from the TRC restricted IOU programs.

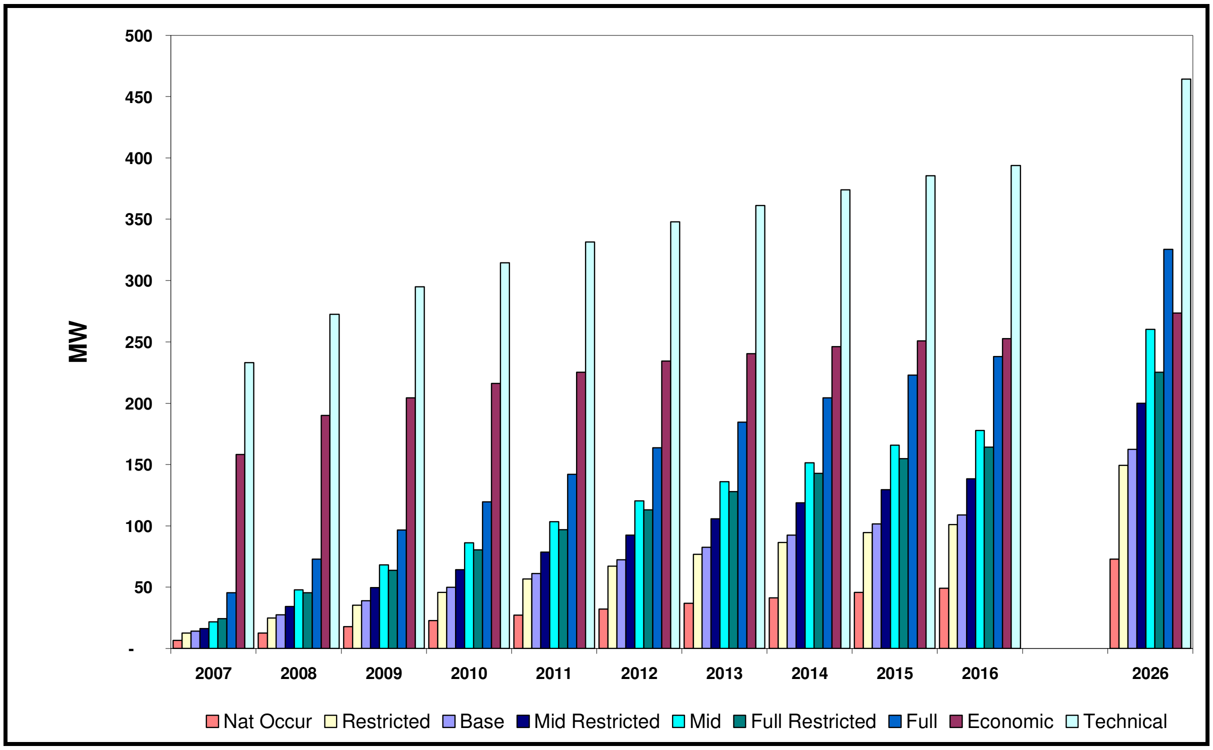
Table 5-18: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (MW)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Base with Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	233	158	14	13	6	13	7	22	16	45	24	22	17	7
2008	273	190	27	25	12	26	14	48	34	73	45	50	35	13
2009	295	204	39	35	18	37	21	68	50	97	64	78	54	18
2010	314	216	50	46	23	49	29	86	64	119	80	108	73	23
2011	331	225	61	57	27	62	37	103	78	142	97	134	91	28
2012	348	234	72	67	32	74	45	120	92	164	113	157	108	33
2013	361	240	82	77	37	86	53	136	106	184	128	179	124	38
2014	374	246	92	86	41	98	62	151	119	204	143	199	139	42
2015	385	251	101	94	46	107	69	166	130	223	155	218	151	46
2016	394	253	109	101	49	115	76	178	138	238	164	234	160	50
2026	464	274	162	149	73	156	116	260	200	325	225	323	222	75

Refer to Table 5-2 for a description of the scenarios.

Figure 5-17 illustrates SDG&E's potential coincident peak demand savings associated with technical, economic, and the market scenarios.

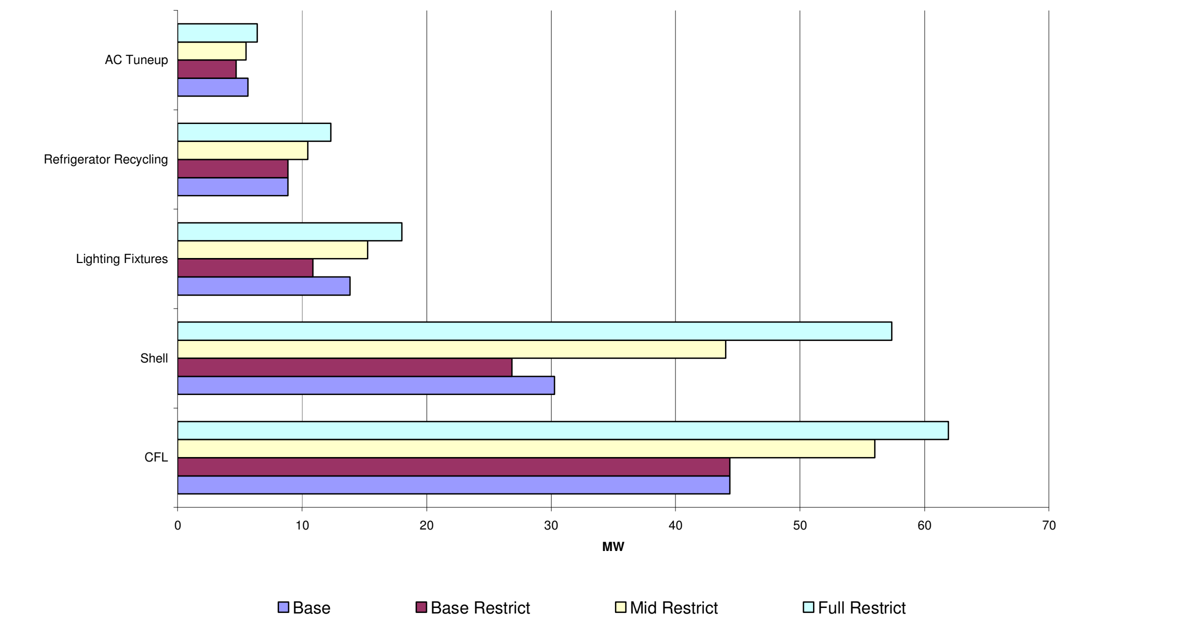
Figure 5-17: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Existing Residential Buildings – 2007-2016, and 2026 (MW)



Refer to Table 5-2 for a description of the market funding scenarios.

Figure 5-18 illustrates the coincident peak demand potential from the top five savings measure groups. The screw-in CFL measure group is estimated to provide SDG&E with the largest peak demand potential, followed closely by the shell measure group (insulation, ducts, and windows). Under the Mid TRC Restricted scenario, CFLs will account for about 40% of the estimated coincident peak demand savings, and shell measures are estimated to saving approximately 32% of the peak demand potential. Lighting fixtures, refrigerator recycling, and AC tune-ups complete the list of the top five coincident demand savings measure groups.

Figure 5-18: SDG&E Total Market Gross Coincident Peak Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 5-2 for a description of the market funding scenarios.

Utility-Specific Cost and Benefits for Existing Residential Buildings

The utility-specific present discounted value of costs and benefits and the total resource cost ratios are presented in Table 5-19 through Table 5-21. The forecast shows that under the Base scenario estimates, all three utilities offer cost-effective programs. For PG&E, the Base scenario benefit-to-cost ratio is 1.20; the ratio is 1.16 for SCE and 1.52 for SDG&E.

Restricting the utilities' portfolios to measures with a TRC > 0.85 significantly increases the benefit-to-cost ratio relative to the Base scenario. The Base scenario TRC for PG&E jumps from 1.20 for the Base scenario to 2.05 for the Base Restricted scenario, SCE's increases from 1.16 for the Base scenario to 2.46 for the Base Restricted scenario, while SDG&E's increases from 1.52 for the Base scenario to 2.57 for the Base Restricted scenario. These increases indicate that there are substantial measure-level costs and savings in the current portfolio that are not cost-effective. Including non-cost-effective measures in the portfolio is consistent with the utilities' goals of encouraging energy efficiency and the evolution and acceptance of new efficiency measures. When these measures are included in the portfolio, however, the utilities carefully determine the rebate level and the scope of the program to ensure that the non-cost-effective measures do not swamp the cost-effectiveness of their portfolio. When the incentives are increased in the non-restricted Mid and the Full Scenarios, the utilities' implicit restraints are eliminated and the adoption of non-cost-effective measures are forecast to grow substantially.

For the Mid and the Full scenario, the presentation of costs and benefits is limited to the Restricted scenarios. Only the Restricted scenarios are presented for the Mid and Full analyses because it is highly unlikely that the utilities would over Mid or Full incentives on measures with very low TRCs.

Table 5-19: Summary of PG&E Electric Market Potential Cost and Benefits by Scenario for Existing Residential Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	708	339	730	1,243
PDV Net Measure Costs	1,072	437	765	994
PDV Gross Program Costs	143	134	199	248
PDV Net Elec Avoided Cost Benefits	1,454	1,171	2,052	2,722
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	1.20	2.05	2.13	2.19

Refer to Table 5-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 5-20: Summary of SCE Electric Market Potential Cost and Benefits by Scenario for Existing Residential Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	557	335	666	1,048
PDV Net Measure Costs	1,210	397	643	814
PDV Gross Program Costs	120	113	150	174
PDV Net Elec Avoided Cost Benefits	1,546	1,255	2,001	2,472
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	1.16	2.46	2.52	2.50

Refer to Table 5-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 5-21: Summary of SDG&E Electric Market Potential Cost and Benefits by Scenario for Existing Residential Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	114	62	174	297
PDV Net Measure Costs	233	91	178	227
PDV Gross Program Costs	38	34	44	50
PDV Net Elec Avoided Cost Benefits	411	322	522	646
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	1.52	2.57	2.35	2.33

Refer to Table 5-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

5.3 Gas Efficiency Potential in Existing Residential Buildings

In the presentation of natural gas saving potential below, measures are aggregated into two end uses: HVAC and water heating. The Itron 2006 study and the KEMA 2002/2003 study included residential natural gas potential for a miscellaneous end use: high efficiency dryers. This measure was not included in the Itron 2008 analysis.

5.3.1 Market Total Natural Gas Potential in Existing Residential Buildings

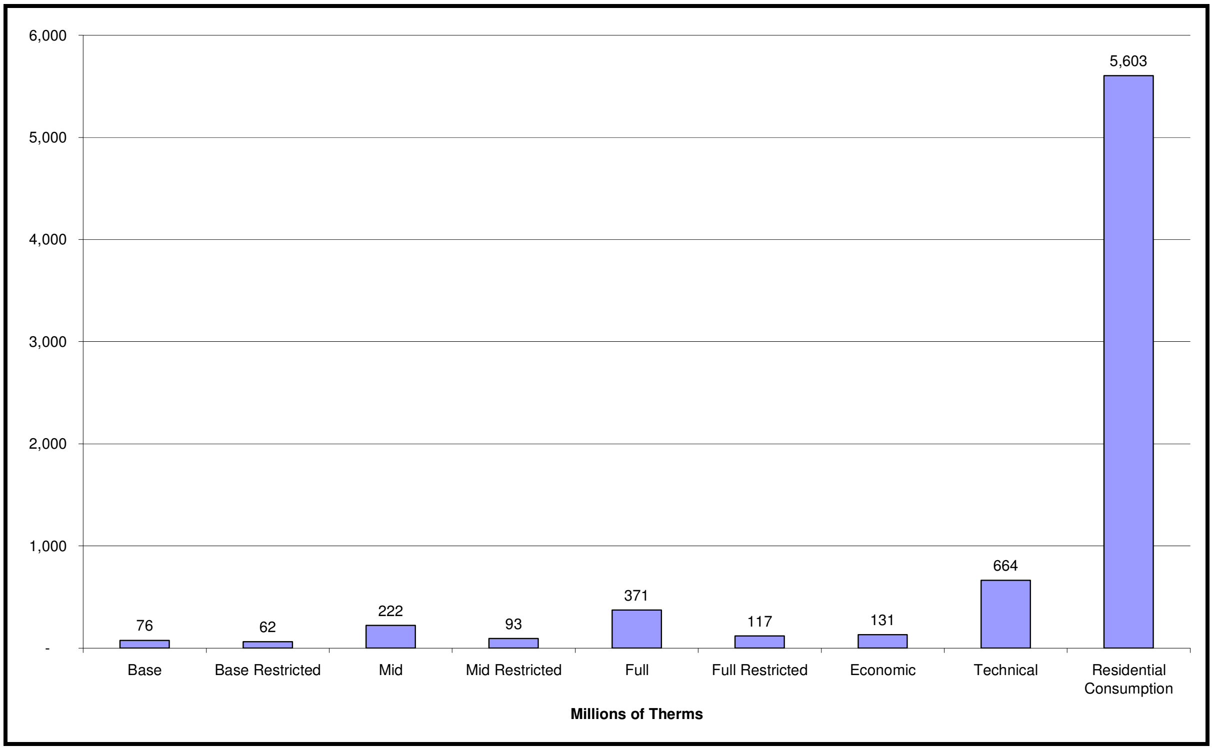
Total IOU Residential Market Potential

Figure 5-19 presents the total estimated gas usage and potential estimates from the analysis for the state investor-owned gas utilities of PG&E, SDG&E, and SCG.[17] The values are provided for the last year of the short-term analysis, 2016.

As shown, total estimated consumption is 5,603 million therms in 2016. The estimated technical potential is 664 million therms for 2007-2016, total economic potential is 131 million therms, and the Full scenario estimate is 371 million therms for 2007-2016. The technical potential is about 12% of expected residential consumption, the economic potential is about 2.2%, and the Full incentive potential estimate is approximately 6.6% of estimated natural gas consumption. The Full scenario does not restrict measures by cost-effectiveness. Limiting the measures in the Full scenario to those with a TRC ≥ 0.85 reduces the estimate of potential to 117 million therms or 2% of estimated consumption.

[17] CEC December 2007, 2007 Final Natural Gas Market Assessment, Tables J1, J2, and J3.

Figure 5-19: Estimated California IOU Gas Consumption in 2016, Technical, Economic, and Gross Market Potential for Existing Residential Buildings – 2007-2016



Refer to Table 5-2 for a description of the market funding scenarios.

Table 5-22 presents natural gas potential estimates by scenario for 2007-2016 and 2007-2026 across all three California IOUs (PG&E, SCG, and SDG&E). Total IOU market potential under the Base scenario is 76 million therms of gross natural gas potential for 2007-2016 and 135 million therms for 2007-2026. The base net potential is 37 million therms for 2007-2016 and 69 million therms for 2007-2026. These savings are the estimated energy savings potential if the IOUs continue their 2006 incentive levels and limit their program offerings to those measures incentivized in their 2004-2005 programs.[18] Increasing incentives to full incremental costs and expanding the measure list to include a limited number of additional technologies increases the total gross market forecast to 371 million therms from 2007 through 2016 and 581 million therms for 2007 through 2026. The net potential estimates are 327 million therms for 2007-2016 and 508 million therms for 2007-2026. Limiting

[18] The 2004-2005 energy efficiency programs included residential thermostats. These measures contributed substantially to the ex ante residential programs' natural gas savings. There is substantial uncertainty surrounding the ability of these measures to reduce electric and/or natural gas consumption in residential settings. The ex post savings estimates from the evaluation of the 2004-2005 single family retrofit program (*2004/2005 Statewide Residential Retrofit Single Family Energy Efficiency Rebate Evaluation*, Oct 2, 2007, Itron) were substantially lower than their claimed savings. These measures have been dropped from the 2006 residential energy efficiency programs and are not included in this analysis

technologies in the Full scenario to those with a TRC > 0.85 reduces the potential estimates to 117 million therms of gross potential for 2007-2016 and 233 million therms for 2007-2026. The net Full Restricted potential estimates are 73 million therms 2007-2016 and 160 million therms for 2007-2026. If program incentives are set halfway between current incentives and full incremental costs (the Mid scenario) estimated gross natural gas potential savings are 222 million therms for 2007-2016 and 417 million therms for 2007-2026.

Table 5-22: Estimated California IOU Total Market Potential by Scenario for Existing Residential Buildings – 2007-2016 and 2007-2026 (Millions of Therms)

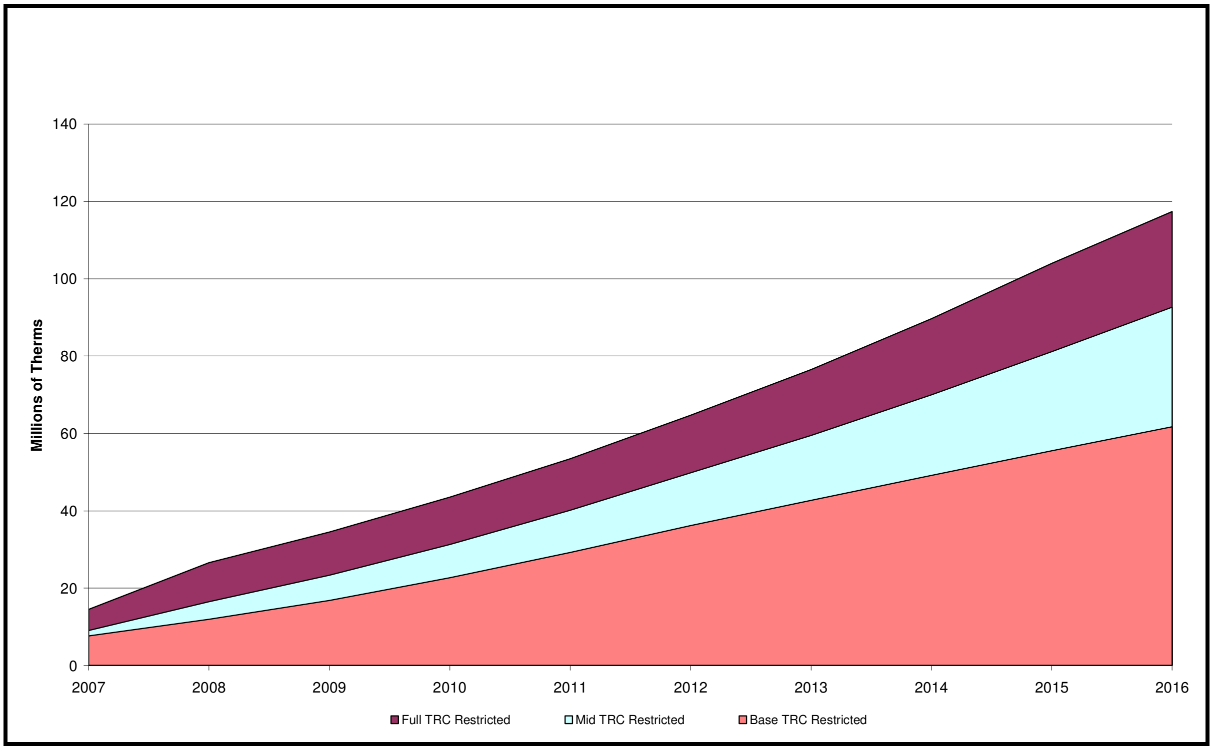
Funding Level	Gross Market Potential, 2016	Naturally Occurring, 2016	Gross Market Potential, 2026	Naturally Occurring, 2026
Base	76	39	135	66
Base Restricted	62	39	108	66
Mid	222	44	417	73
Mid Restricted	93	44	191	73
Full	371	44	581	73
Full Restricted	117	44	233	73
Full Gradual	353	44	578	73
Full Restrict Gradual	110	44	228	73

Refer to Table 5-2 for a description of the market funding scenarios.

Table 5-22 also presents potential estimates for a scenario in which the incentive levels were gradually increased from current incentive levels (in 2006) to full incentive levels (by 2010). The results from this scenario indicate that the slower ramp-up of incentives, relative to the jump from 2006 current to 2007 full incentives, leads to a minor loss of potential relative to the Full and Full Restricted scenarios. Given the similarities in these forecasts, the remaining tables and figures will not present the potential estimates for the Full Gradual and the Full Restricted Gradual scenarios.

The results for the TRC restricted gross market scenarios are illustrated in Figure 5-20. These graphs illustrate the yearly estimates of market potential for the TRC restricted scenarios.

Figure 5-20: Estimated California IOU Gross Total Energy Market Potential for TRC Restricted Funding Levels for Existing Residential Buildings – 2007-2016 (Millions of Therms)



Refer to Table 5-2 for a description of the market funding scenarios.

Market and Naturally Occurring Potential with Higher Awareness

The natural gas potential model was evaluated under the assumption that the continued expansion of energy efficiency programs and the growing awareness about global warming would lead to a faster increase in the public's awareness and willingness to install energy efficiency measures. To model this possibility, the Base TRC Restricted Higher Awareness scenario assumes a faster growth rate for the awareness than in the Base TRC Restricted scenario. In addition, this scenario assumes that the awareness and willingness of the naturally occurring estimate gross at a rate set equal to 75% of the growth rate of the program analysis.[19]

Table 5-23 lists the estimated natural gas savings for the Base Restricted and the Base Restricted with Higher Awareness scenarios. Comparing the 2007-2016 gross market estimate, assuming a higher growth rate of awareness increases the gross potential from 62 million therms to 70 million therms. The additional 8 million therms is an increase in potential associated with high levels of knowledge, a substantial benefit to society.

19 In all other scenarios, the awareness and willingness of the naturally occurring estimate is held fixed at the 2007 levels, it is not allowed to grow over time.

Increasing awareness, however, also leads to a large increase in the adoption of high efficiency devices occurring even if there are no energy efficiency rebates–the naturally occurring savings. The naturally occurring estimate is forecast to grow from 39 million therms to 57 million therms (for 2007-2016) as awareness and willingness to install energy efficiency devices grows. This growth in naturally occurring, however, is dependent upon the growth in awareness and willingness that is, at least in part, due to the continuous implementation of energy efficiency programs in California. In the Base Restricted scenario, the implied net-to-gross ratio is 37% while the net-to-gross ratio in the Base Restricted with Higher Awareness scenario is 19%. Growing public awareness of energy efficiency is estimated to increase total savings while reducing the net savings attributable to utility programs.

Table 5-23: Estimated California IOU Total Market Potential for the Base Restricted and Base Restricted, Higher Awareness Scenarios – 2007-2016 and 2007-2026 (Millions of Therms)

Funding Level	Market Potential, 2016	Naturally Occurring, 2016	Market Potential, 2026	Naturally Occurring, 2026
Base Restricted	62	39	108	66
Base Restricted - Higher Awareness	70	57	117	100

Refer to Table 5-2 for a description of the market funding scenarios.

Natural Gas Market Potential by End Use for Existing Residential Buildings

Table 5-24 and Table 5-25 summarize the residential market natural gas potential results by end use and funding level for 2007-2016 and 2007-2026, respectively. Increasing funding for HVAC measures from the Base scenario to the Mid scenario increases natural gas potential from 40 million therms to 102 million therms for 2007 through 2016, a 160% increase, while increasing funding for water heating measures increase natural gas potential by 84 million therms or 230%. Much of this increase in savings potential, however, is associated with non-cost-effective measures.[20] If HVAC measures are restricted to those with a TRC > 0.85, increasing funding from the Base to the Mid scenario increases potential by 10 million therms or 30% for 2007 through 2016, while the increase in the potential from water heating measures is 21 million therms or about 70% over the same period.

[20] The water heating potential for the Mid and Full incentive scenarios includes solar water heating. Solar water heating potential is limited to the single family segment and has a feasibility restriction of 50%. The natural gas potential associated with solar water heating, however, is not cost-effective, contributing to the large reduction in potential between the Mid and Mid Restricted scenarios (and the Full and Full Restricted).

Table 5-24: California IOU Estimated Gross Total Market Natural Gas Potential by funding Level and End Use for Existing Residential Buildings – 2007-2016 (Millions of Therms)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	40	32	14	102	42	183	56	14
Water Heating	36	30	26	120	51	188	62	31
Total	**76**	**62**	**39**	**222**	**93**	**371**	**117**	**44**

Refer to Table 5-2 for a description of the market funding scenarios.

Table 5-25: California Estimated Gross Total Market Natural Gas Potential by funding Level and End Use for Existing Residential Buildings – 2007-2026 (Millions of Therms)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	83	66	34	190	84	283	112	34
Water Heating	52	42	32	227	107	299	121	40
Total	**135**	**108**	**66**	**417**	**191**	**581**	**233**	**73**

Refer to Table 5-2 for a description of the market funding scenarios.

Increasing funding for HVAC natural gas measures leads to a substantial increase in the number of consumers who would choose to adopt high efficiency furnaces and add to their home's insulation. For most climate zones, however, high efficiency furnaces and additional ceiling insulation is not cost-effective, while wall insulation more commonly passes the cost-effectiveness restrictions in the restricted scenarios.[21] Increasing funding for water heating measures leads to an increase in the adoption of higher efficiency clothes washers, dishwashers, and solar water heaters. Given the current cost of solar water heating, this measure does not pass the cost-effectiveness standards.

Examining the market and naturally occurring potential in Table 5-24 and Table 5-25, the net water heating potential is only 10 million therms in the Base scenario and 4 million therms in the Base Restricted scenario. The low level of net savings is largely due to the high naturally occurring savings associated with clothes washers and dishwashers. The adoption of higher

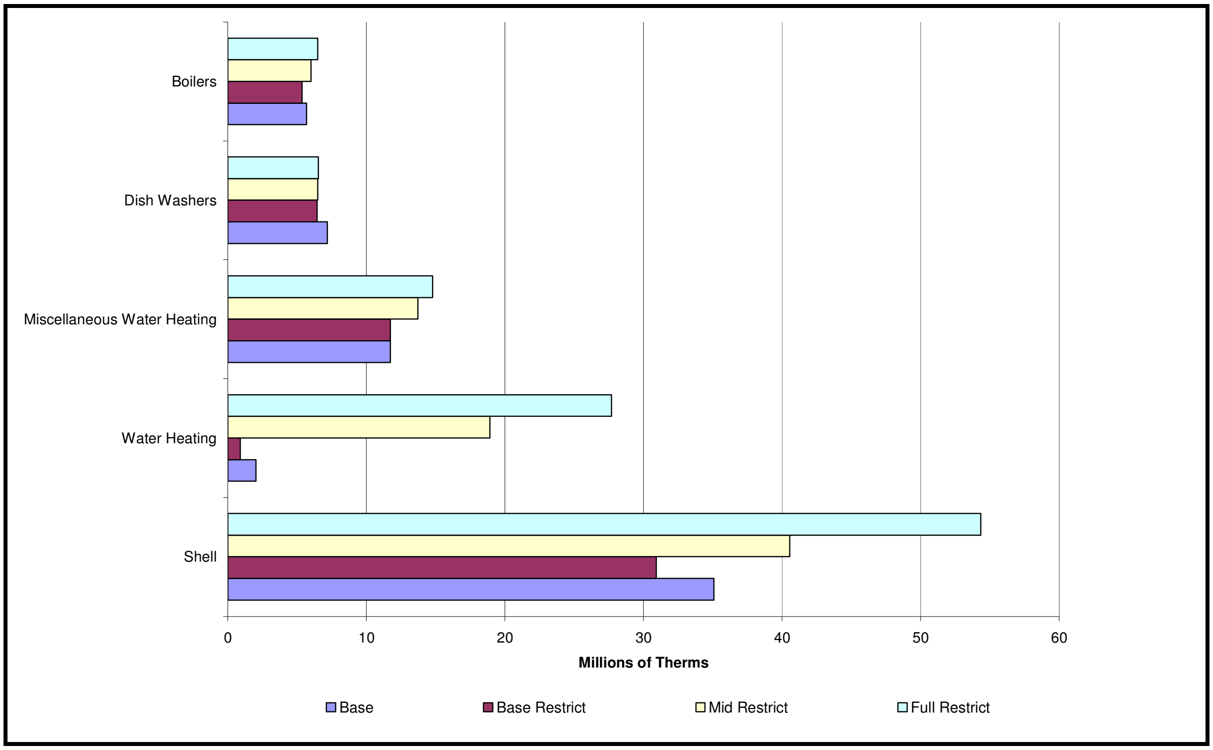
[21] The ceiling insulation modeled in this analysis is the addition of ceiling insulation necessary to go from R19 to R30. Installing ceiling insulation in a home with no insulation is usually cost-effective; adding insulation to a home with R18 pre-existing levels, however, is usually not cost-effective. The team chose to measure the potential associated with R19-R30 instead of R0-R30 because RASS survey data indicated that most homeowners believe they have some pre-existing ceiling insulation.

efficiency clothes washers and dishwashers is occasionally cost-effective, but the net savings associated with these appliances are often relatively low. The IOU energy efficiency programs work to encourage consumers to purchase a higher level of efficiency than they were planning to, but many of these customers may have been planning on adopting a high efficiency washer prior to the program. The energy efficiency rebate simply led them to adopt an even higher efficiency unit, leading to high naturally occurring savings. The high naturally occurring savings significantly reduces the net savings when compared to the gross findings.[22] This relationship, however, is consistent with the belief that previous energy efficiency programs have changed the buying habits of consumers with regard to energy-efficient appliances and that current programs are continuing to move these preferences and purchasing behavior forward.

Figure 5-21 lists the total gross market potential for the top five natural gas savings measure groups. The measure group with the largest potential is shell measures, including wall and ceiling insulation and duct repairs. The measure group with the second highest natural gas potential is water heating, which includes high efficiency tank water heaters, point of use or instantaneous water heaters, and solar water heating. The restricted scenarios presented in Figure 5-21 only include the natural gas savings potential associated with high efficiency tank water heaters. The third highest efficiency measure group is miscellaneous water heating measures, which includes faucet aerators, low flow showerheads, and pipe wrap. The fourth and fifth highest efficiency measure groups are dishwashers and multifamily boilers.

[22] See data on the percent ENERGY STAR clothes washers and dishwasher in the California Residential Efficiency Market Share Tracking: Appliances 2005.

Figure 5-21: Total California IOU Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 5-2 for a description of the market funding scenarios.

5.3.2 Gas Cost and Benefit Results for Existing Residential Buildings

Table 5-26 presents a final summary of the residential gas market estimates of costs, benefits, and TRC ratios for four of the market funding levels and TRC restrictions.[23]

[23] The avoided cost benefits include electric benefits associated with dual fuel measures. Dual fuel measures save both electricity and gas. These measures include insulation in a gas-heated home, duct insulation in a gas-heated home, and high efficiency dishwashers in homes with gas hot water heaters.

Table 5-26: Summary of California IOU Gas Market Potential Results by Scenario for Existing Residential Buildings – 2007-2026

(The cost and benefits are in $1,000,000)	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	662	328	646	1,449
PDV Net Measure Costs	1,570	288	562	1,062
PDV Gross Program Costs	52	25	41	56
PDV Net Elec Avoided Cost Benefits	248	157	265	411
PDV Net Gas Avoided Cost Benefits	694	288	479	761
TRC	0.58	1.42	1.23	1.05

Refer to Table 5-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

As shown at the statewide level, the portfolio of gas programs is not cost-effective based on the results of the TRC test. The Base scenario TRC is 0.58. The results in Table 5-26 indicate that the Base Restricted TRC is 1.42.

5.3.3 Utility-Level Residential Gas Potential, Benefits, and Costs

In this section, market, technical, and economic potential are presented at the utility level. The utility-specific costs, savings, and TRC test results are listed below. Figure 5-22 through Figure 5-27 illustrate and Table 5-27 through Table 5-29 list the estimates of potential natural gas energy savings for the various market scenarios for PG&E, SCG, and SDG&E, respectively.

The yearly illustration of technical and economic potential need to be analyzed carefully. For retrofit and conversion models, the technical potential assumes an instantaneous installation of energy efficiency measures wherever applicable and feasible. For replace-on-burnout models, the technical potential is phased in as the previous measures burn out. Economic potential is similar to technical, with the further consideration of costs. Both the technical and economic potential should be viewed as theoretical constructions that do not reflect the market barriers that must be overcome to achieve voluntary market adoptions. Given the definitions of economic and technical potential, the technical potential illustrated for each utility in 2007 illustrates what the utility could achieve if it could force all households that could adopt the measure to adopt the measure. Increases in technical potential over time are due to population growth and the burnout of existing measures.

PG&E Potential Natural Gas Savings Forecasts for Existing Residential Buildings

The results in Table 5-27 list the natural gas savings potential from existing homes in PG&E's service territory, while Figure 5-22 illustrates the natural gas estimates. Estimated gross market savings potential under current incentives are 37 million therms for 2007 through 2016 and 60 million therms for 2007 through 2026, with about 58% of the savings from HVAC measures and 42% from water heating. Increasing incentives to the average between current incentives and full incremental measure costs (Mid incentives scenario) increases the estimate of savings to 98 millions of therms for 2007-2016 and 177 million therms for 2007-2026. Much of the increase in natural gas potential associated with increasing rebates, however, is from non-cost-effective measures. Restricting the Mid scenario to measures with a TRC > 0.85 reduces the potential for 2007-2016 to 44 million therms and 83 million therms for 2007-2026. Increasing incentives to full incremental measure cost while restricting measures to those with a TRC > 0.85 increases the cost-effective potential savings to 55 million therms for 2007-2016 and 95 million therms for 2007-2026. The modest increase in cost-effective potential with increasing rebate levels reiterates the importance of carefully selecting which high efficiency to rebate.

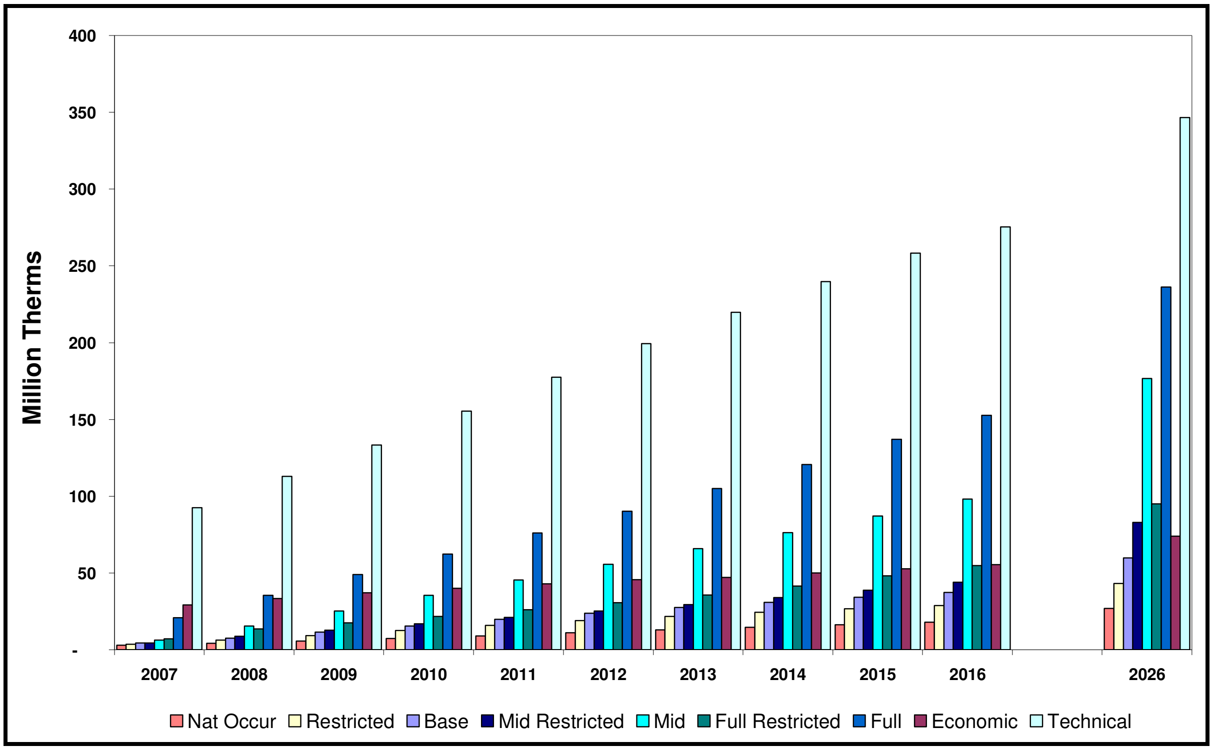
Figure 5-22 illustrates the yearly by scenario natural gas potential savings. The results presented in this figure show the importance of considering cost-effectiveness when determining measures to incentivize or focus on for large shares of the natural gas energy efficiency program budget. In Figure 5-22, it is not uncommon for the Mid and Full scenarios to exceed the economic potential, while the Mid Restricted and the Full Restricted scenarios may reflect more cost-effective program developments.

Table 5-27: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	92	29	4	4	3	4	3	6	4	21	7	7	5	3
2008	113	33	8	6	4	7	5	15	9	35	13	17	10	4
2009	133	37	11	9	5	10	7	25	13	49	17	33	14	6
2010	155	40	15	12	7	14	10	35	17	62	22	51	18	8
2011	177	43	20	16	9	17	12	45	21	76	26	66	22	10
2012	199	46	24	19	11	20	15	56	25	90	31	81	27	12
2013	220	47	27	22	13	23	17	66	29	105	36	97	32	14
2014	240	50	31	24	15	26	20	76	34	120	41	113	38	17
2015	258	53	34	27	16	28	22	87	39	137	48	130	45	19
2016	275	55	37	29	18	31	24	98	44	153	55	146	52	21
2026	347	74	60	43	27	47	38	177	83	236	95	235	93	30

Refer to Table 5-2 for a description of the scenarios.

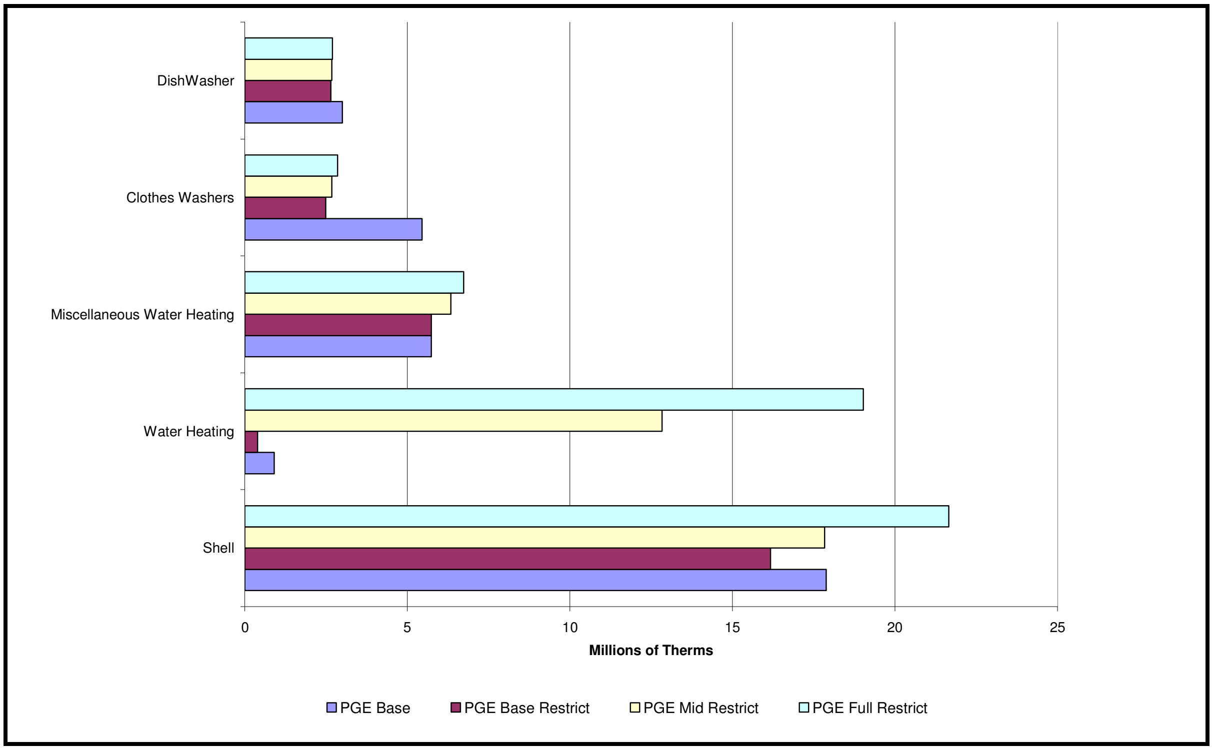
Figure 5-22: PG&E Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Natural Gas Potential for Existing Residential Buildings – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 5-2 for a description of the market funding scenarios.

Figure 5-23 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all shell measures into one measure group illustrates the importance of this measure in PG&E's residential energy efficiency natural gas program. Water heaters closely follow shell measures in the quantity of remaining market energy efficiency potential. The remaining three top savings measure groups are all measures that receive the majority of their savings through water savings, miscellaneous water heating measures, dishwashers, and high efficiency clothes washers.

Figure 5-23: PG&E Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 5-2 for a description of the market funding scenarios.

SCG Potential Natural Gas Savings Forecasts for Existing Residential Buildings

The results in Table 5-28 list the natural gas savings potential from existing homes in SCG's service territory, while Figure 5-24 illustrates the natural gas potential. Estimated gross market savings potential under current incentives are 28 million therms for 2007 through 2016 and 58 million therms for 2007 through 2026, with the savings split nearly evenly between HVAC and water heating. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 97 million therms for 2007-2016 and 192 million therms for 2007-2026. Much of the increase in natural gas potential associated with increasing rebates, however, is from non-cost-effective measures. Restricting the Mid scenario to those measures with a TRC > 0.85 reduces the potential for 2007-2016 to 36 million therms and 82 million therms for 2007-2026. Increasing incentives to Full incremental measure cost while restricting measures to those with a TRC > 0.85 increases the cost-effective potential savings to 47 million therms for 2007-2016 and 109 for 2007-2026. The modest increase in cost-effective potential with increasing rebate levels illustrates the importance of carefully selecting which high efficiency measures to rebate or to significantly increase rebates if the objective is to achieve a high share of the cost-effective energy savings.

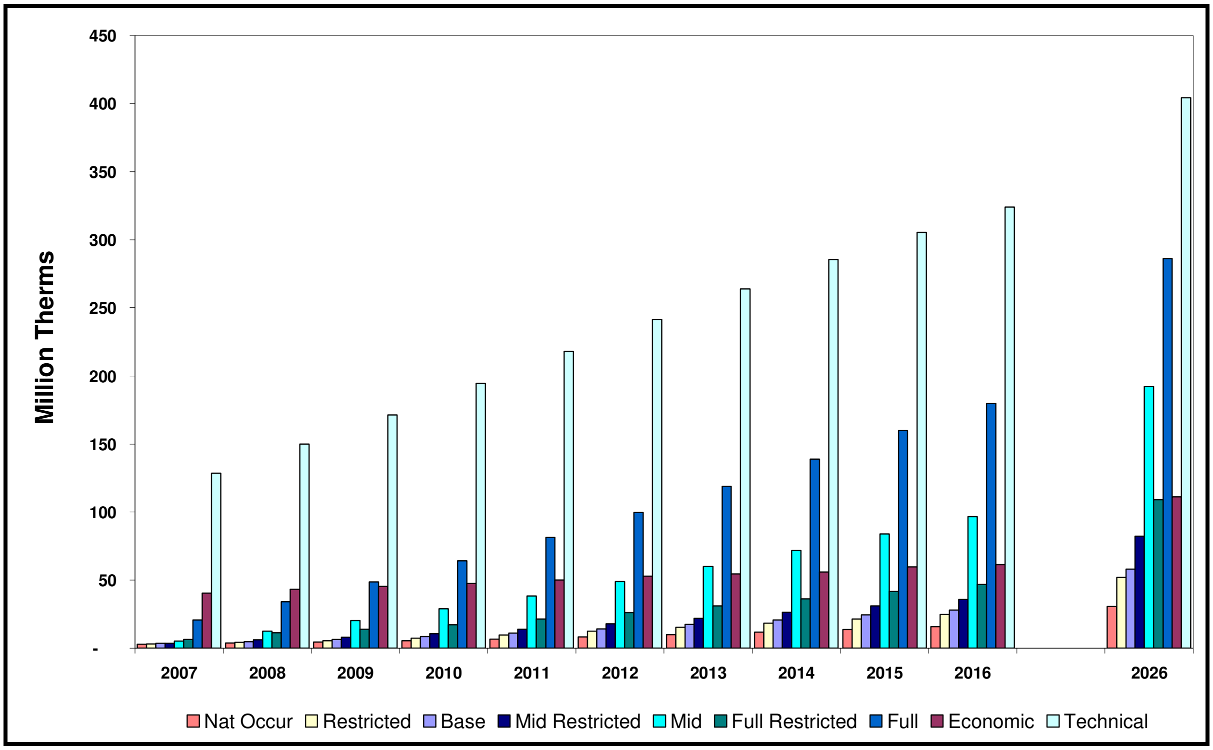
The results presented in Figure 5-24 show the importance of considering cost-effectiveness when determining which measures should receive significant increases in incentives. Achieving significant cost-effective energy savings in residential natural gas will require a careful examination of the tradeoffs between energy savings potential and cost-effectiveness.

Table 5-28: SCG Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	128	40	3	3	3	3	3	5	4	21	6	5	4	3
2008	150	43	5	4	4	4	4	13	6	34	11	13	6	4
2009	171	45	6	6	5	6	5	20	8	49	14	28	9	5
2010	195	47	8	7	5	8	7	29	11	64	17	48	13	6
2011	218	50	11	10	7	11	9	38	14	81	21	66	17	7
2012	241	53	14	12	8	14	12	49	18	100	26	86	22	9
2013	264	54	17	15	10	18	15	60	22	119	31	106	27	10
2014	285	56	21	18	12	22	18	72	26	139	36	127	32	12
2015	305	60	24	21	14	26	21	84	31	160	42	148	38	14
2016	324	61	28	25	16	30	25	97	36	180	47	170	43	17
2026	404	111	58	52	31	56	49	192	82	286	109	284	107	32

Refer to Table 5-2 for a description of the market funding scenarios.

Figure 5-24: Estimated SCG Total Technical, Economic, Gross Market, and Naturally Occurring Gas Potential for Existing Residential Buildings – 2007-2016



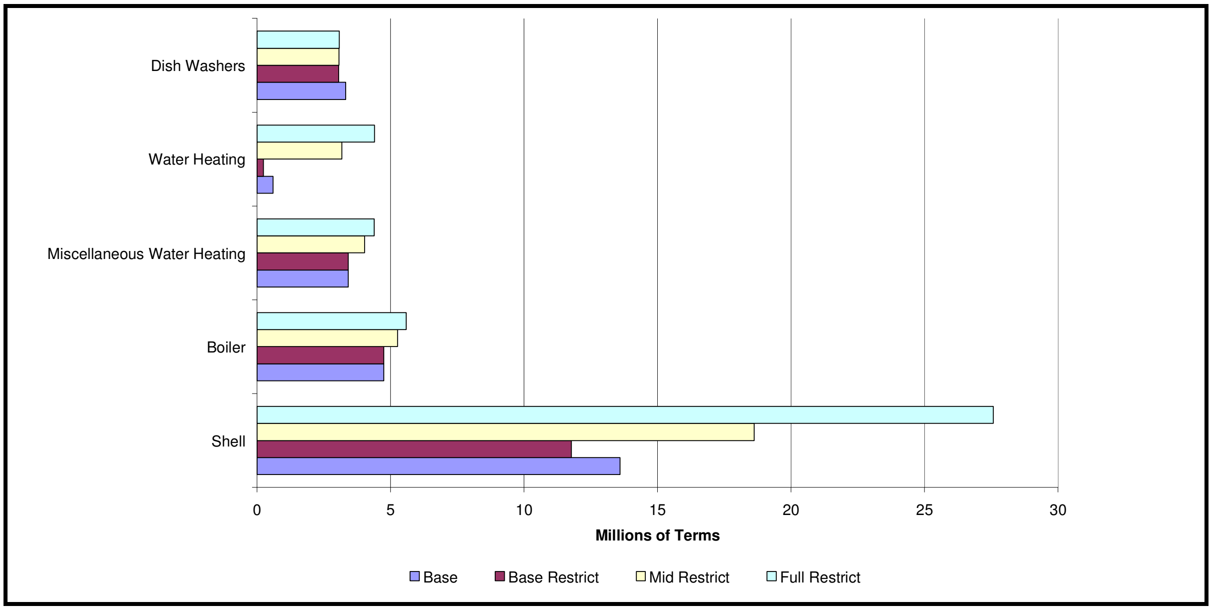
Refer to Table 5-2 for a description of the market funding scenarios.

Figure 5-25 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all shell measures into one measure group illustrates the importance of this measure in SCG's residential energy efficiency natural gas program. The following top four saving measures include boilers, miscellaneous water heating measures, water heaters, and dishwashers. SCG's top five measures differ slightly from those illustrated in

In both SCG and PG&E, tank water heaters are nearly cost-effective. PG&E's avoided costs are slightly higher than those for SCG, contributing to PG&E's tank water heaters passing the TRC requirements necessary to be included in the restricted Mid and Full scenarios (TRC > 0.85) while SCG's tank water heaters seldom pass the restriction.[24]

[24] SCG's average gas avoided cost values are slightly lower than PG&E's average gas avoided costs across most years evaluated in this study. The TRC value for tank water heaters is seldom above 1 for either utility, but is above the 0.85 restriction in PG&E's service territory more commonly than in SCG's. If gas avoided costs continue to rise, it is likely that this measure will be cost-effective in the near future.

Figure 5-25: SCG Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 5-2 for a description of the market funding scenarios.

SDG&E Potential Gas Savings Forecasts for Existing Residential Buildings

Table 5-29 lists the natural gas potential savings for SDG&E's existing residential sector by end use and scenario. At 2006 incentive levels, the natural gas potential savings are 11 million therms for 2007-2016 and 18 million therms for 2007-2026. Increasing incentives to the average between the 2006 level and full incremental measure cost (Mid scenario) is estimated to increase natural gas savings to 28 million therms for 2007-2016 and 48 million therms for 2007-2026. Restricting measures to those passing the TRC restriction (TRC > 0.85), the Mid Restricted potential is 13 million therms for 2007-2016 and 26 million therms for 2007-2026. Several gas measures included in the analysis do not pass the TRC restrictions; these include solar water heating, point of use water heaters, and furnaces.

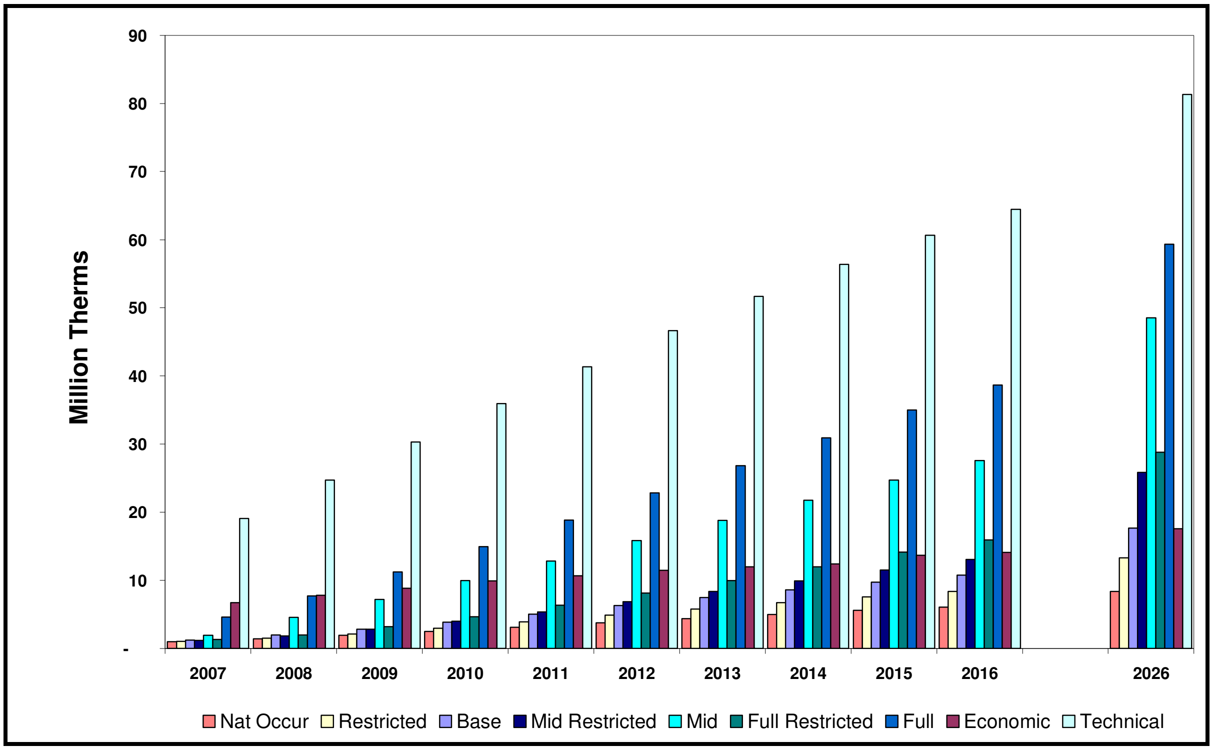
Table 5-29: SDG&E Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Potential by Scenario for the Existing Residential Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	19	7	1	1	1	1	1	2	1	5	1	2	1	1
2008	25	8	2	2	1	2	1	5	2	8	2	5	2	2
2009	30	9	3	2	2	2	2	7	3	11	3	9	3	2
2010	36	10	4	3	2	3	3	10	4	15	5	13	5	3
2011	41	11	5	4	3	4	4	13	5	19	6	17	6	4
2012	47	11	6	5	4	5	5	16	7	23	8	21	8	4
2013	52	12	7	6	4	7	6	19	8	27	10	25	10	5
2014	56	12	9	7	5	8	7	22	10	31	12	29	12	6
2015	61	14	10	8	6	9	8	25	12	35	14	33	14	7
2016	64	14	11	8	6	10	9	28	13	39	16	37	16	7
2026	81	18	18	13	8	14	13	49	26	59	29	59	29	10

Refer to Table 5-2 for a description of the market funding scenarios.

Figure 5-26 illustrates the technical, economic, and market forecasts of natural gas savings potential for SDG&E's existing residential sector for the years 2007-2016 and 2026.

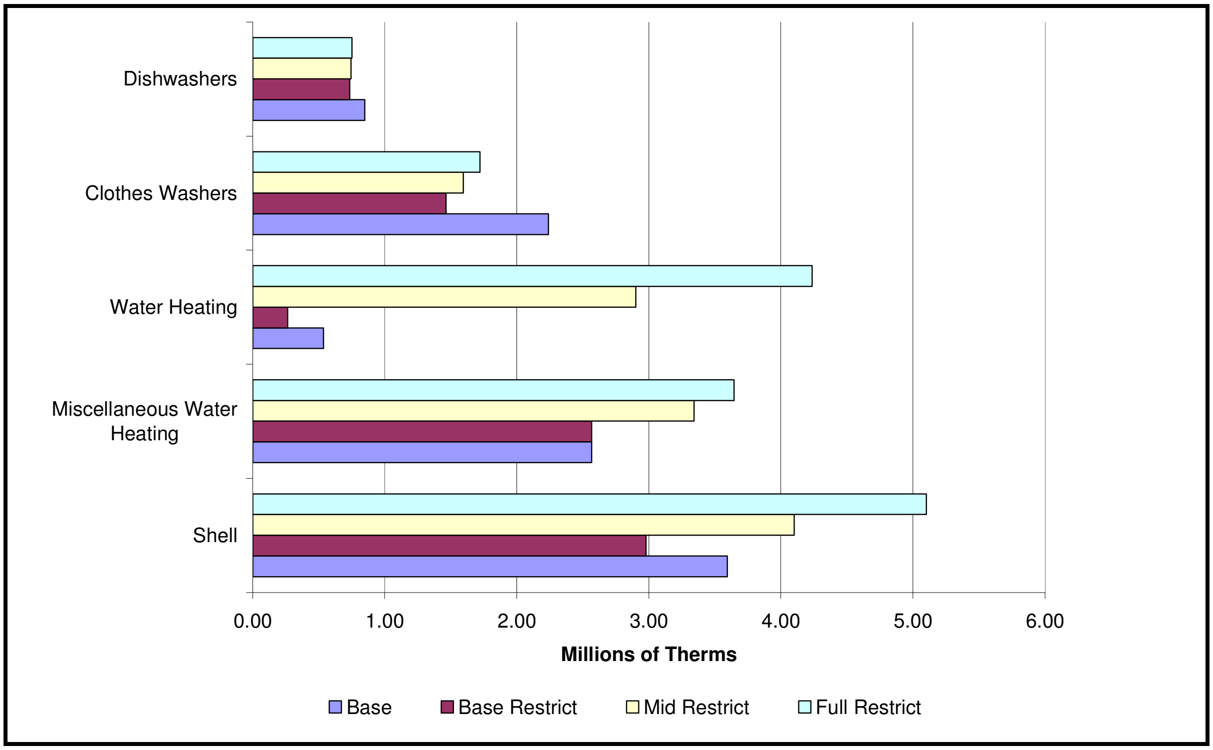
Figure 5-26: Estimated SDG&E Total Technical, Economic, Gross Market, and Naturally Occurring Natural Gas Potential for Existing Residential Buildings – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 5-2 for a description of the market funding scenarios.

Figure 5-27 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all shell measures into one measure group illustrates the importance of this measure in SDG&E's residential energy efficiency natural gas program. The following top four saving measures include miscellaneous water heating measures, water heaters, clothes washers, and dishwashers

Figure 5-27: SDG&E Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 5-2 for a description of the market funding scenarios.

Natural Gas Utility-Specific Cost and Benefits for Existing Residential Buildings

Table 5-30 through Table 5-32 present the present discounted value of costs and benefits associated with the alternative funding levels for each utility. These tables show that the estimate of the total resource cost for the Base scenario is less than 1 for all utilities. PG&E's Base scenario TRC is 0.57, while SDG&E's Base scenario TRC is 0.37, and SCG's is 0.72. Increasing funding and restricting measures to those with a TRC > 0.85, the Full Restricted TRC for PG&E is 1.14, for 1.20 SDG&E, and 1.00 for SCG.

Table 5-30: Summary of PG&E Gas Market Potential Costs and Benefits by Scenario for Existing Residential Buildings – 2007-2026

Costs and Benefits are in $1,000,00	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	497	311	364	513
PDV Net Measure Costs	798	149	189	292
PDV Gross Program Costs	19	8	11	13
PDV Net Electric Avoided Cost Benefits	88	62	72	89
PDV Net Gas Avoided Cost Benefits	379	142	184	260
TRC	0.57	1.30	1.28	1.14

Refer to Table 5-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 5-31: Summary of SCG Gas Market Potential Costs and Benefits by Scenario for Existing Residential Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	91	17	251	861
PDV Net Measure Costs	475	139	336	720
PDV Gross Program Costs	30	17	28	40
PDV Net Elec Avoided Cost Benefits	132	95	174	300
PDV Net Gas Avoided Cost Benefits	231	144	263	461
TRC	0.72	1.52	1.20	1.00

Refer to Table 5-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 5-32: Summary of SDG&E Gas Market Potential Costs and Benefits by Scenario for Existing Residential Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	75	0.5	31	75
PDV Net Measure Costs	296	0.1	37	51
PDV Gross Program Costs	4	0.1	2	3
PDV Net Elec Avoided Cost Benefits	28	0.0	19	23
PDV Net Gas Avoided Cost Benefits	84	2	31	41
TRC	0.37	9.46	1.27	1.20

Refer to Table 5-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

5.3.4 Costs and Benefits for the Existing Residential Program

This section combines the present discounted value of costs and benefits from the electric and gas existing residential estimates, creating an aggregate statewide sum of costs, benefits, and benefit-to-cost ratios.

Table 5-33: Summary of the California IOU Costs and Benefits by Scenario for the Existing Residential Sector – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	2,041	1,065	2,215	4,037
Net Measure Costs	4,085	1,213	2,149	3,098
Gross Program Costs	353	306	434	528
Net Elec Avoided Cost Benefits	3,659	2,905	4,840	6,252
Net Gas Avoided Cost Benefits	694	288	479	761
TRC	0.98	2.10	2.06	1.93

Refer to Table 5-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

The TRC test indicates that the Base scenario estimate is almost cost-effective. Restricting measures to those with a TRC > 0.85 significantly increases the benefit to cost ratio. Results presented in the electric and the gas sections above support the hypothesis that targeted funding increases may be necessary in the residential sector to increase energy efficiency savings while maintaining portfolio cost-effectiveness.

5.4 Key Residential Results and Future Research Recommendations

5.4.1 Summary of Key Results for Existing Residential Buildings

The statewide market potential for electric energy efficiency at the currently funded level (Base scenario) is 5,205 gross GWh and 3,181 net GWh over a 10-year period. The gross base energy savings market potential is 25% of estimated technical potential and 32% of estimated economic potential while the net base savings potential is 16% of technical and 20% of economic potential estimates. Increasing incentives to a level equal to the mid-point between current incentives and full incremental costs (Mid scenario) is estimated to lead to energy savings of 8,034 GWh in 2016, a 54% increase. Further ramping up incentives to cover full incremental measure costs increases gross electric energy potential to 10,165 GWh in 2016. The Full market scenario is 50% of estimated technical potential and 63% of estimated economic potential.

The estimates of technical and market potential include high efficiency measures that are not cost-effective. While the IOUs' current programs include a small subset of measures that are not cost-effective, they are required to have cost-effective portfolios. In an attempt to simulate the practice of designing cost-effective portfolios while including a limited number of non-cost-effective measures, the Base, Mid, and Full scenarios were re-estimated restricting measures to those with a TRC ≥ 0.85. Restricting the Base scenario to measures with a TRC > 0.85 reduces the gross potential to 4,890 GWh and the net potential to 2,866 GWh. The gross base TRC restricted potential savings are about 6% less than the gross Base scenario savings estimates. Restricting measures to those with a TRC > 0.85 while increasing incentives to halfway between current and full incremental costs (Mid Restricted scenario) leads to 6,828 GWh of gross electric savings potential in 2016 and 4,751 GWh of net potential. Limiting the Mid scenario's potential estimates to those measures that are nearly cost-effective reduces the forecast by approximately 15% when compared to the Mid scenario. The Full Restricted scenario is estimated to provide 7,976 GWh of potential in 2016, 22% less than the Full scenario.

Restricting the Base scenario to measures that are nearly cost-effective leads to only a small decrease in potential relative to the non-restricted Base scenario. At current incentive levels, the non-cost-effective measures do not account for a significant percentage of the IOU portfolio. The current adoption rate of non-cost-effective measures allows the utilities to offer these measures and still maintain a cost-effective portfolio. Increasing incentives for all measures, including those that are not cost-effective, however, is forecast to lead to a large jump in the number of adoptions for non-cost-effective measures. These results suggest that the IOUs may have reasons for wanting the non-cost-effective measures in their portfolio, but they should take care to examine the cost-effectiveness of a measure prior to significantly increasing incentives.[25]

The Base scenario gross market potential for coincident peak demand reduction is 974 MW over a 10-year period, while the Base scenario potential is 605 MW. The gross base coincident peak demand potential is 24% of the estimated technical potential and 35% of estimated economic potential, while the net estimate is 15% of estimated technical potential and 24% of estimated economic potential. Increasing incentives to cover full incremental costs increases the gross coincident peak demand potential to 2,377 MW and the net potential to 2,002 MW. The Full market scenario estimate of gross coincident peak demand potential is 58% of estimated technical potential and 93% of estimated economic potential. The full net coincident peak demand potential is 49% of estimated technical potential and 78% of estimated economic potential.

Restricting the Base scenario to measures that are nearly cost-effective leads to only a 3% drop in the ratio of gross market to technical potential (24% to 21%), and a 4% drop in the ratio of gross market to economic potential (35% to 31%). Restricting the Full scenario to measures that are nearly cost-effective reduces the ratio of market to technical potential by 24% (58% to 34%) and the ratio of market to economic potential by 39% (93% to 54%). At current incentive levels, the non-cost-effective measures do not account for a significant percentage of the IOU portfolio. Increasing incentives for all measures, including those that are not cost-effective, however, is forecast to lead to a large jump in the number of adoptions for non-cost-effective measures.

The market potential for gross gas efficiency at the currently funded level (Base scenario) is 76 million therms over a 10-year period, while the net base potential estimate is 37 million therms. The gross base market potential is 11% of estimated technical potential and 58% of estimated economic potential. Ramping up incentives to cover full incremental costs increased the estimates of gross savings to 371 million therms. The Full market scenario

[25] The IOUs may want to include non-cost-effective measures in their portfolio for several reasons. The utilities may hope that an increase in the production of the measure can lower the measure's cost, leading to future cost-effectiveness. Alternatively, the measure may be popular with customers and may be viewed as a measure commonly installed with other cost-effective measures. Limiting the exposure of the IOU to non-cost-effective measures may be a better position for the utilities than eliminating all non-cost-effective measures.

estimate of potential is 56% of estimated technical potential and 284% of estimated economic potential. Restricting the Base scenario to measures whose TRC ≥ 0.85 reduces the market potential estimates to 62 million terms while the net potential estimate falls to 23 million therms. Restricting the Full scenario measures to those that are nearly cost-effective (Full Restricted scenario) leads to a gross forecast of 117 million therms and a net forecast of 73 million therms.

TRC results for electric programs under the current, Mid, and Full market scenarios showed that the Base and Mid incentive levels are cost-effective. Specifically, the current incentive program resulted in a statewide benefit-cost ratio of 1.5, while the statewide Mid scenario produced a TRC of 1.02 and the full incremental cost incentive program scored 0.57. Limiting the residential electric program to measures with a TRC > 0.85 increased to program-level TRC to about 2.75.

TRC results for gas programs under the three funding scenarios showed that none of the non-TRC restricted incentive scenarios was cost-effective. Specifically, continuing with the current incentive program resulted in a statewide benefit-cost ratio of 0.89, while the Full cost incentive scenario scored 0.49 and the Mid scenario-level incentive program scored 0.44. Restricting measures to those with a TRC > 0.85 increased the TRC to 2.25 in the Base scenario and 1.67 in the Full scenario. Several low-cost gas water heating measures are cost-effective, but the current IOU programs include many residential gas HVAC and appliance measures that are not cost-effective. The 2004-2005 program accomplishments showed that the current utility natural gas energy efficiency program relies on savings from many measures that are not cost-effective, significantly reducing the benefit-cost ratio for the market forecasts. The TRC values reported in this report use the 2006 rates and avoided costs. Subsequent, and future, increases in the natural gas avoided costs will increase the benefits of natural gas energy efficiency measures relative to their benefits in 2007.[26]

5.4.2 Key Assumptions and Areas Needing Research

The input data for residential measure technology density and base shares are largely derived from the Residential Appliance Saturation Survey of 2004 (RASS) and the California Lighting Appliance Saturation Survey of 2005 (CLASS).[27] The RASS survey was a mail survey with over 22,000 respondents. This survey's responses provide recent data on the saturation and the fuel type of appliances in homes by utility and climate zone. These data ensure that the fuel type and technology density assumptions used in the model accurately

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26 Increases in the IOU gas rates and avoided costs since the Itron 2006 study have contributed to the increase in the natural gas program-level TRCs.

27 KEMA-Xenergy, Inc. *California Statewide Residential Appliance Saturation Study.* Prepared for the California Energy Commission. June 2004. and RLW, Inc, *2005 California Statewide Residential Lighting and Appliance Efficiency Saturation Study*, August 2005.

represent the distribution in California homes in 2004. Relying on these data, however, has drawbacks. Respondents to mail surveys are likely to know if their home has a clothes washer or dryer, but they are less likely to know if their home is insulated. Mail surveys are also poor sources of data for many high efficiency measures. The CLASS survey is an on-site survey of about 850 homes. Data from this study were used as the primary source of base share data on the fraction of homes with high efficiency gas heaters, dishwashers, air conditioners, refrigerators, and water heaters. These data were also used to help determine the share of high efficiency lighting in California homes. Future potential analyses would benefit from improved information on residential insulation and the need for duct sealing, HVAC diagnostics, and infiltration control.

Table 5-34: Key Considerations and Uncertainties in the Existing Residential Sector

End Use	Key Consideration
HVAC	1) **Standards**: New standards for air conditioners were incorporated into the analysis. The start date for the analysis was 2005, when SEER 10 central air conditioners were base technology. In 2007 SEER 13 was the base technology. The change in the base SEER level reduces the forecast incremental savings associated with a SEER 15 high efficiency measure. The model was calibrated to utility program rebates for 13 and 15 SEER air conditioners. While ASSET is designed to automatically incorporate the base technology change, the change in base technology increases the uncertainty associated with the potential estimates. Until additional behavior is observed, it is uncertain how consumers will modify their purchases due to the changes in standards. The change in air conditioning standards in 2007 have worked to ensure that residential high efficiency air conditioning is not cost-effective except in the hottest locations in California. If an increase in the production of SEER 15 air conditioners leads to a fall in their incremental costs, these measures may become cost-effective over the time horizon of this forecast.
	2) **Uncertainty in Cost and Savings**: Cool roofs and CAC tune-ups are cooling measures with a high degree of uncertainty in their assumed costs and savings. Each of these measures could be classified as a secondary cooling measure. The savings associated with the measure are going to be very dependent upon the baseline condition of the existing cooling equipment.
	3) **Uncertainty in the Existing High Efficiency Share**: The existing share of high efficiency HVAC equipment is highly uncertain. The RASS data set provides the most up-to-date information on the saturation of air conditioners but it does not provide information on the share of high versus base efficiency models. The distribution of air conditioning efficiency was determined using data on the existence of a high efficiency air conditioner from the CLASS on-site data set. The CLASS data, however, do not list the actual SEER level. Changes in high efficiency air conditioning standards occurred after the 2005 CLASS data collection, requiring that the high efficiency share observed in the CLASS analysis be split between a 13 and 15 SEER based upon professional judgment.
	4) **Insulation, Duct Repair and AC Tune-up**: The CLASS on-site data do not include information on insulation and the need for duct repairs and HVAC tune-ups. The existing saturation of ceiling and wall insulation was determined using self-reports from the RASS database. The RASS survey responses indicated that nearly all homes have R0-R19 ceiling insulation, leading the group to focus on R19-R30 ceiling insulation. If the self-reports are incorrect, there may be significantly more cost-effective potential than the model estimated. To determine the accuracy of the RASS data, an on-site analysis would be necessary.
	5) **Windows**: Windows were modeled as a replace-on-burnout measure. The high performance window was a spectral Low E (U-value = 0.25). Modeling windows as a replace-on-burnout measure limits their incremental costs and savings and in many cases windows were not found to be cost-effective. It is likely, however, that the retrofit of very old single pane, aluminum frame windows with high performance windows is cost-effective in some locations.

Table 5-34 (Cont'd): Key Considerations and Uncertainties in the Existing Residential Sector

End Use	Key Consideration
Lighting	1) **Lights per Home**: Lighting potential depends significantly on the number of lights per home and the fraction of these lights which are eligible for screw-in CFLs or fixtures. The number of lights per home was determined using the CLASS database. The number of lights per home in the CLASS database increased significantly between the 2001 and 2005 CLASS. This analysis used the 2005 count of lights per home. The increase in lighting counts raises questions about the applicability of the small sample sizes used in the CLASS on-site data collection efforts (approximately 850 homes). If the CLASS databases accurately reflects the average increase in the number of lights per home, however, it raises additional questions. If the number of lights per home continues to grow, the current assumption of a constant technology density will under count the future lighting potential. Alternatively, if the increase in the average number of lights was a result of the small sample sizes, the use of the higher lighting counts will lead to an over count in the future lighting potential.
	2) **CLF screw-ins and fixtures**: There are substantial potential savings in screw-in CLFs and fixtures. The allocation of potential between screw-ins and fixtures required that the team designate the fraction of lights applicable to screw-in lamps and those applicable to fixtures. The differential costs and market acceptance of these measures, however, is significant and the allocation of lights between lamps and fixtures impacts the economic and market potential. At this time, however, it is difficult to determine weather an existing incandescent light will be replaced with a lamp or a fixture.
	3) **Expected Useful Life of CFLs**: The DEER database uses an eight-year EUL. Recent analysis of CFLs in residential applications, however, indicates that the EUL is closer to five years. This study used an EUL of 5.5 years. Within the ASSET model, the shorter EUL works to reduce the cost effectiveness of CFLs and increase the first-year program potential, but has no significant impact on the total market potential.
	4) **CFL feasibility**: A key factor determining CFL potential is the feasibility of installing CFL lamps in existing incandescent fixtures. The feasibility assumed for this analysis ranged from 66% for the low wattage lamps to 90% for the highest wattage CFLs.
	5) **Per Unit Savings from CFLs**: The DEER database calculates per lamp savings in residential applications based on hours of operation determined from on-site logger analyses of existing CFL lamps. Using the current distribution of lamps within homes, however, leads to a higher average hours of operation than would be observed if CFLs were installed in all feasible applications. Per unit savings assumptions were reduced to more accurately reflect usage hours in all feasible applications.

Table 5-34 (Cont'd): Key Considerations and Uncertainties in the Existing Residential Sector

End Use	Key Consideration
Refrigeration	1) **Refrigeration and Freezer Recycling**: Most of the refrigeration savings are associated with refrigeration and freezer recycling. The potential associated with these measures is hard to estimate. Recycling a measure does not leave the consumer with a consistent energy service, the assumed standard in energy efficiency modeling. Eliminating the assumption of consistent energy service is likely to lead to an over-estimate of market potential associated with this measure. The underlying efficiency of refrigerators and freezers has improved, reducing the potential associated with future recycling. The model attempted to simulate the improvements in efficiency with falling per unit savings from recycling.
Pool Pumps	1) **Standards**: The model incorporated two-speed and variable-speed high efficiency pool pumps. Changes in standards, however, will move the base efficiency to the two-speed pool pump in 2008. This change in standard effectively eliminates both high efficiency measures. The current study did not incorporate any additional high efficiency measures after 2008. While it is likely that a higher efficiency pool pump with market acceptance will emerge, it is not currently clear what the savings will be for the measure.
Water Heating	1) **Uncertainty of Solar Water Heating Costs and Savings**: Solar water heating was modeled as a back up to either an electric or a gas water heater in the single-family residential segment. While there is currently substantial interest in the savings potential associated with solar water heating, there is very little scientific research on appropriate savings assumptions. This measure is not currently in the DEER database or the utility workbooks. The assumed savings used in this analysis were 1.5 times the savings associated with instantaneous water heaters. The assumed level of savings is also consistent with savings determined from the RASS analysis. The RASS analysis, however, included very few solar water heaters. Additional research is needed to help determine the appropriate savings level. Currently the CPUC is directing a pilot project in the SDG&E service territory to help determine appropriate savings and the cost-effectiveness of this measure.
	2) **Clothes Washer Standards**: The model incorporated recent code changes which apply to clothes washers. The changes increase the base MEF from 1.04 to 1.26. These changes reduce the cost-effectiveness of this measure.

Table 5-34 lists key concerns and considerations to be aware of when assessing the energy efficiency potential in the residential sector. Potential analyses are dependent on a full understanding of high efficiency measure impacts. The concerns listed in the above table indicate that there are several places where additional information would help to reduce the uncertainty associated with this analysis.

The residential ASSET analysis used a combination of information from RASS, CLASS, and DEER to determine the energy savings of high efficiency technologies. For many measures, this analysis used the percentage savings from the 2005 DEER in combination with the UEC estimate by IOU and housing type or IOU, climate zone, and housing type for weather-sensitive measures to calculate high efficiency measure savings.[28] Additional research on the energy savings of duct sealing and HVAC refrigerant recharging (tune-ups) would help to

[28] The weather sensitive measures were also weighted by the percentage of homes in a given vintage as reported by the RASS analysis. Given the age of the RASS, this may slightly under estimate the number of new homes. The undercount of new homes may lead to a slightly higher estimate of savings than is actually attainable.

reduce the level of uncertainty surrounding the energy savings associated with these measures.

The model results are also highly dependent on assumptions concerning the influence of increased rebates on consumer behavior. The ASSET model relies on payback parameters estimated from previous research in the Midwest.[29,30] These parameters were established from a conjoint analysis of consumers' responses concerning their likelihood of purchasing high efficiency technology under different rebate levels. For this potential study, these parameters have been examined and updated where necessary. The parameters were updated if the potential estimates of market and naturally occurring potential were not consistent with currently available information. These parameters, however, could benefit from a new conjoint analysis to establish numbers justified by statistical analysis of California consumers.

Additional conjoint analysis will help to establish payback parameters consistent with current utility programs and with consumers' expectations of their responses to increases in funding levels. As funding levels grow, and incentives rise, to encourage consumers to purchase high efficiency measures in an attempt to approach full incentive potential, the models estimates become ever more uncertain. As incentives are increased in the model, the model is asked to forecast far outside known utility and consumer behavior. These types of forecasts are highly uncertain and contain a significant amount of downside risk.

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[29] These data come from *Northern States Power Company Customer Survey Final Report* prepared by Regional Economic Research, Inc. and Opinion Dynamics Corporation, March 1995. While the parameter estimates from the conjoint analysis are dated, to the best of our knowledge, this research has not been replicated more recently in California or elsewhere. Increases in energy prices have reduced payback lengths, Middle Eastern conflicts have introduced concerns about the supply of energy, and global warming may have increased concerns about the environment and energy usage; all of these changes may have led to changes in the payback parameter in unexpected and conflicting ways. A new conjoint or double bounded analysis of the influence of rebate levels on consumer choices would help to reduce the level of uncertainty surrounding these parameters. Alternatively, a time-series analysis of energy efficiency measure adoptions, rebate levels, and measure costs would add to our understanding of the influence of economic variables on energy efficiency measure adoptions.

[30] The results from the KEMA 2002/2003 study are also sensitive to KEMA's assumptions concerning the influence of increased rebates on consumer behavior. KEMA's sensitivity parameters were derived from expert professional judgment derived from years of study but not from analytical research on the influence of alternative rebates on consumer behavior.

6

Energy Efficiency Potential in Existing Commercial Buildings

This section presents the estimates of commercial energy efficiency potential in existing commercial buildings. Estimates of potential are presented for the period 2007 through 2016, and for 2026. Market potential was estimated over a 20-year horizon for 10 scenarios. The scenarios assume alternative levels of measure incentives, cost-effectiveness tests, measure awareness, and the availability of incandescent lighting.[1] All market results are presented as both gross and net total savings associated with cumulative adoptions over the estimation period.[2] An estimate of commercial consumption, technical potential, and economic potential is presented for comparison purposes.

6.1 Overview

One hundred and five individual high efficiency measures were analyzed for the commercial energy efficiency analysis. These measures were all commercially available at the time of the analysis and most of the measures have IOU-specific accomplishments for the 2004-2005 program year. This analysis did not attempt to model the energy efficiency potential associated with emerging technologies in the commercial sector. In the presentation of results below, measures are aggregated into five electric end uses and three gas end uses. The 105 high efficiency measures break down into 88 electric measures and 17 gas measures. Table 6-1 lists the individual measures that correspond to each end use in the analysis.

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1 The Huffman Bill passed by the California legislature requires that commercial lighting intensity decline by 25%. To achieve this level of lighting reduction, we assume that CFLs will need to become the base lighting assumption and re-calculated the nine scenarios without CFL lighting potential.

2 The energy savings potential presented in the 2006 Itron forecast were gross savings. The 2006 study did not contain a baseline or naturally occurring estimate. The 2002/2003 KEMA forecasts were reported as net savings with an estimate of naturally occurring savings.

Table 6-1: Commercial Measure Descriptions

End Use	Measure Description	Fuel Type
Food	Convection Oven (Electric) HE ≥70%	Electric
Food	Convection Oven (Gas) HE ≥40%	Gas
Food	Fryer (Electric) EStar ≥80%	Electric
Food	Fryer (Gas) EStar ≥50%	Gas
Food	Griddle (Electric) HE ≥70%	Electric
Food	Griddle (Gas) HE ≥38%	Gas
Food	Holding Cabinet (Electric) HE (<=20W/ft3)	Electric
Food	Pressureless Steamer (Electric) EStar ≥50%	Electric
Food	Pressureless Steamer (Gas) EStar ≥38%	Gas
Food	Combination Oven (Electric) HE ≥60%	Electric
Food	Combination Oven (Gas) HE ≥40%	Gas
Food	Commercial Ice Machine Tier 2	Electric
Food	Solid-Door Reach-In Refrigerator Tier 2	Electric
Food	Solid-Door Reach-In Freezer Tier 2	Electric
Food	Glass-Door Reach-In Refrigerator Tier 2	Electric
HVAC	High-Efficiency Centrifugal Chiller	Electric
HVAC	Reciprocating Chillers	Electric
HVAC	VSD Chilled Water Loop Pumps	Electric
HVAC	Cool Roofs	Electric
HVAC	Window Film	Electric
HVAC	Gas Space Heating Boilers 85%	Gas
HVAC	Gas Space Heating Boilers 95% - current emerging tech	Gas
HVAC	HE Gas Furnace - AFUE 85	Gas
HVAC	Condensing Gas Furnace - AFUE 94	Gas
HVAC	26-49 hp Vent Motor PremEff	Electric
HVAC	50+ hp Vent Motor PremEff	Electric
HVAC	0-10 hp Vent Motor PremEff	Electric
HVAC	11-25 hp Vent Motor PremEff	Electric
HVAC	Packaged A/C (<65k 13 SEER)	Electric
HVAC	Packaged A/C (<65k 15 SEER)	Electric
HVAC	Packaged A/C (>=65k 11 EER)	Electric
HVAC	Packaged A/C (>=65k 12 EER)	Electric
HVAC	PTAC (> 9 EER)	Electric
HVAC	PTHP 10 EER & 3 COP	Electric
HVAC	Package AC/DX Tune Up	Electric
HVAC	Retro-commissioning	Electric
HVAC	Electric Chiller Retro-commissioning	Electric
HVAC	10-25 hp VSD for VAV System	Electric
HVAC	26-49 hp VSD for VAV System	Electric
HVAC	50-100 hp VSD for VAV System	Electric

Table 6-1 (cont'd.): Commercial Measure Descriptions

End Use	Measure Description	Fuel Type
Lights	T8 Fixture, 4 ft 2 lamp	Electric
Lights	Second generation T8, 4ft, 2 lamp	Electric
Lights	T8 Fixture, 8 ft 2 lamp	Electric
Lights	Second generation T8, 8 ft, 2 lamp	Electric
Lights	Fixture, Pin based CFL less than 15 watts	Electric
Lights	Fixture, Pin based CFL 15-24 watts	Electric
Lights	Fixture, Pin based CFL greater than 24 watts	Electric
Lights	Screw-in CFL less than 15 watts	Electric
Lights	Screw-in CFL 15-24 watts	Electric
Lights	Screw-in CFL greater than 24 watts	Electric
Lights	CFL reflector	Electric
Lights	Daylighting with dimmable ballast	Electric
Lights	LED Exit Sign	Electric
Lights	High Bay T8 (Over 14 ft)	Electric
Lights	Interior Pulse Start Metal Halide under 151 watts	Electric
Lights	Interior Mercury Vapor under 301 watts	Electric
Lights	Interior Pulse Start Metal Halide under 151 watts	Electric
Lights	Interior Pulse Start Metal Halide over 150 watts	Electric
Lights	Delamping 4 Ft T12 to T8	Electric
Lights	Delamping 8 Ft T12 to T8	Electric
Lights	Exterior Pulse Start Metal Halide under 151 watts	Electric
Lights	Exterior Pulse Start Metal Halide under 151 watts	Electric
Lights	Exterior Pulse Start Metal Halide over 150 watts	Electric
Lights	LED Signs	Electric
Lights	Motion sensor	Electric
Lights	Plug load motion sensor	Electric
Lights	Photo cell exterior lighting control	Electric
Lights	Time clock exterior lighting control	Electric
Lights	Photo cell and time clock exterior lighting control	Electric
Misc.	Small Copier Energy Star	Electric
Misc.	Computer with 80+ power supply	Electric
Misc.	Refrigerated Vending Machine Controller	Electric
Misc.	Vending Machine (NonRefrigerated) Controller	Electric
Misc.	Commercial Gas Pool Heater - HE	Gas
Misc.	Gas Water Heating Boiler - HE 85	Gas
Misc.	Gas Water Heating Boiler - HE 95 - CET	Gas
Misc.	Commercial Clothes Washer – MEF 2.0 (Gas)	Gas
Misc.	Gas Storage Water Heater - HE (Thermal efficiency>=0.86)	Gas
Misc.	Instantaneous Water Heater - Gas	Gas
Misc.	Solar Water Heating back-up for Gas Storage Water Heater	Gas
Misc.	Water Heater Setback Gas	Gas

Table 6-1 (cont'd.): Commercial Measure Descriptions

End Use	Measure Description	Fuel Type
Refrig	Night Covers - LowTemp Coffin Cases	Electric
Refrig	Night Covers - MedTemp Vertical Cases	Electric
Refrig	Auto Closer for Walk-in Solid-Door	Electric
Refrig	Auto Closer for Walk-In Glass-Doors	Electric
Refrig	Strip Curtains for Walk-ins	Electric
Refrig	Walk-In Cooler/Freezer Door Gaskets	Electric
Refrig	Anti-Sweat Heater Controls	Electric
Refrig	Suction Line Insulation	Electric
Refrig	Evaporator Fan Controller for Walk-Ins	Electric
Refrig	Evaporator Fan Motors - PSC	Electric
Refrig	Evaporator Fan Motors - ECM	Electric
Refrig	Open Multi-Deck to New HiEff Glass Door Reach-in (HiEff)	Electric
Refrig	New HiEff LowTemp NoASH Glass Door Case (Base)	Electric
Refrig	Single Compressor to Multiplex AirCooled System	Electric
Refrig	Single Compressor to Multiplex EvapCooled System	Electric
Refrig	Multiplex Air-Cooled System with FHP (Fixed setpoint)	Electric
Refrig	Energy Efficient Air-Cooled Condenser	Electric
Refrig	Multiplex Evap-Cooled System with FHP (Fixed setpoint)	Electric
Refrig	Energy Efficient Evap-Cooled Condenser	Electric

The analysis was conducted for 12 building types: colleges, grocery stores, health-related buildings, lodging, large office buildings, refrigerated buildings, retail, restaurants, schools, small office buildings, warehouses, and miscellaneous.[3] In addition, forecasts were divided into the same 21 climate zones used in the residential analysis.[4] The analysis of market potential considered 10 scenarios. The scenarios names and a short description are in Table 6-2.

[3] The miscellaneous building type includes many different types of buildings and businesses. Miscellaneous would include laundries, churches, strip mall retail, dry cleaners, gyms, prisons, and social centers. Miscellaneous is not limited to these types of businesses, this is only a partial listing to provide information on the wide range of business types and sizes included in this category.

[4] Please see Table 3-2 for a list of Climate Zones, by IOU, used in the analysis.

Table 6-2: Scenario Descriptions

Scenario Name	Scenario Description
Base Incentive	Includes measures incentivized in the 2004-2005 program year with incentives that were available in 2006.
Mid Incentive	Includes all measures analyzed in the study with incentives half way between those that were available in 2006 and full incremental costs.
Full Incentive	Includes all measures analyzed with incentives set to full incremental costs.
Base Incentive TRC Restricted	Current incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Mid Incentive TRC Restricted	Mid incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Incentive TRC Restricted	Full incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Gradual	Includes all measures analyzed with incentives increasing from 2006 levels to full incremental costs in 2010.
Full Gradual TRC Restricted	Full gradual scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Base TRC Restricted Higher Awareness	The current incentive TRC restricted scenario with a higher level of awareness for both the program and the naturally occurring analysis.
CFLs as Base Lighting	A re-calculation of the previous nine scenarios assuming that CFL are the base lighting technology.

For the Mid and the Full Restricted and Non-restricted market scenarios and the Economic and Technical theoretical analyses, there were a limited number of measures added to the IOU measures included in the 2004/2005 program accomplishments (measures analyzed in the Base and Base Restricted scenarios). The added measures include measures that were added to the 2006-2008 programs and measures the IOUs are interested in adding to their programs in the near future. Table 6-3 lists the measures added to all scenarios other than the Base and Base Restricted scenarios.

Table 6-3: High Efficiency Measures Added to the Mid, Full, Economic, and Technical Scenarios

EndUse	Measure Description	Fuel Type
Food	Convection Oven (Electric) HE ≥70%	Elec
Food	Convection Oven (Gas) HE ≥40%	Gas
Food	Fryer (Electric) EStar ≥80%	Elec
Food	Fryer (Gas) EStar ≥50%	Gas
Food	Griddle (Electric) HE ≥70%	Elec
Food	Griddle (Gas) HE ≥38%	Gas
Food	Combination Oven (Electric) HE ≥60%	Elec
Food	Combination Oven (Gas) HE ≥40%	Gas
HVAC	HE Gas Furnace - AFUE 85	Gas
HVAC	Condensing Gas Furnace - AFUE 94	Gas
Lights	Daylighting with dimmable ballast	Elec
Other	Small Copier Energy Star	Elec
Other	Computer with 80+ power supply	Elec
WH	Solar Water Heating back-up for Gas Storage Water Heater	Gas
WH	Water Heater Setback Gas	Gas

6.2 Electric Efficiency Potential

Total Commercial Market Potential

In this subsection, the results of the analysis of the potential for existing commercial buildings are presented under the alternative market scenarios. Figure 6-1 and Figure 6-2 present the total estimated market, technical, and economic electric energy and demand savings potential resulting from the analysis for the three state electric IOUs: PG&E, SCE, and SDG&E. Also shown in these figures is the forecasted electricity use and demand for these utilities, as estimated by the CEC.[5] The values are provided for 2016, the last year of the short-run analysis.

As shown in Figure 6-1, the total CEC-estimated commercial electric consumption for 2016 is 89,177 GWh. The estimated technical potential for energy savings for 2007 through 2016 is 14,101 GWh and the total estimated electric economic potential is 12,514 GWh. For the market scenarios, the total gross Full incentive potential is 6,552 GWh, and the Base forecast, is 3,357 GWh for 2007 through 2016.[6] The technical potential is about 16% of expected consumption; the economic potential is about 14%, while the Full scenario potential estimate is approximately 7% of expected electric energy consumption. Figure 6-2 shows total

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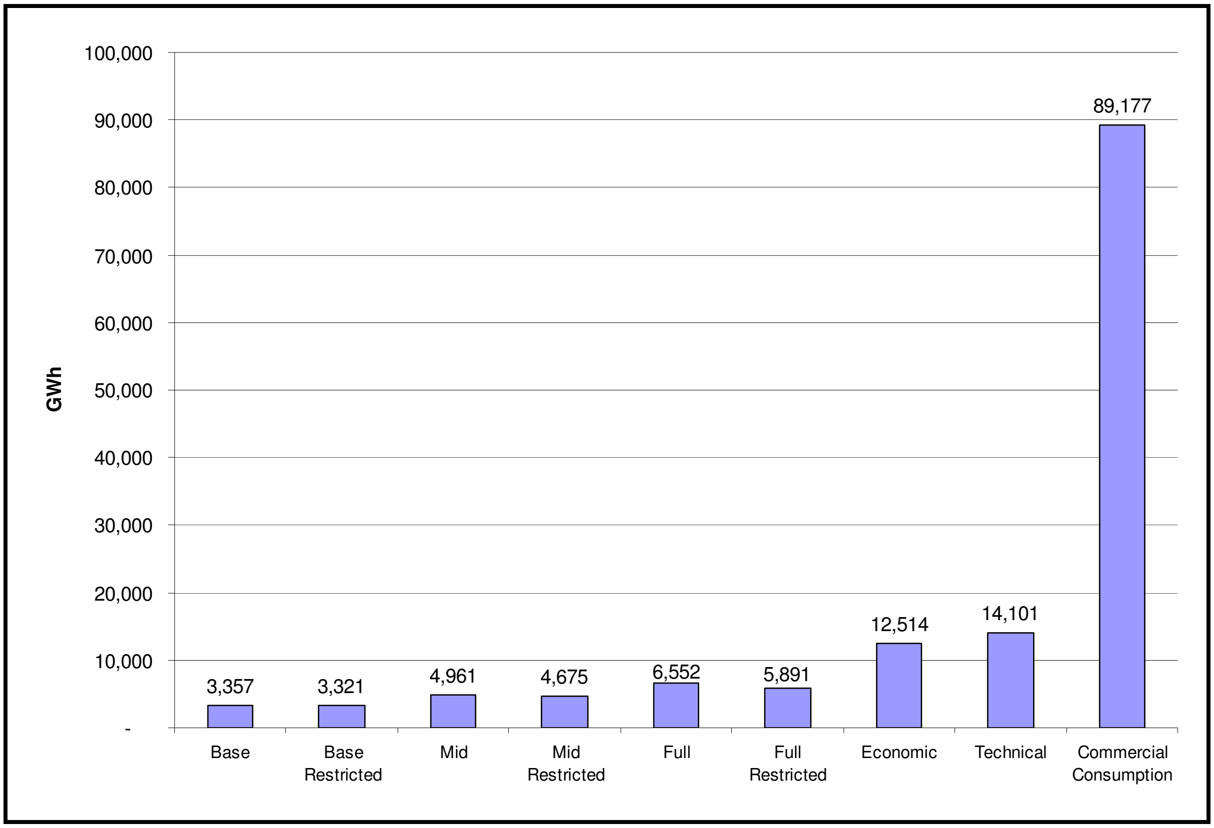
[5] California Energy Commission. *California Energy Demand 2008-2018: Staff Energy Demand Forecast.* June 2005.

[6] The energy savings potential presented in this report is at the generation level.

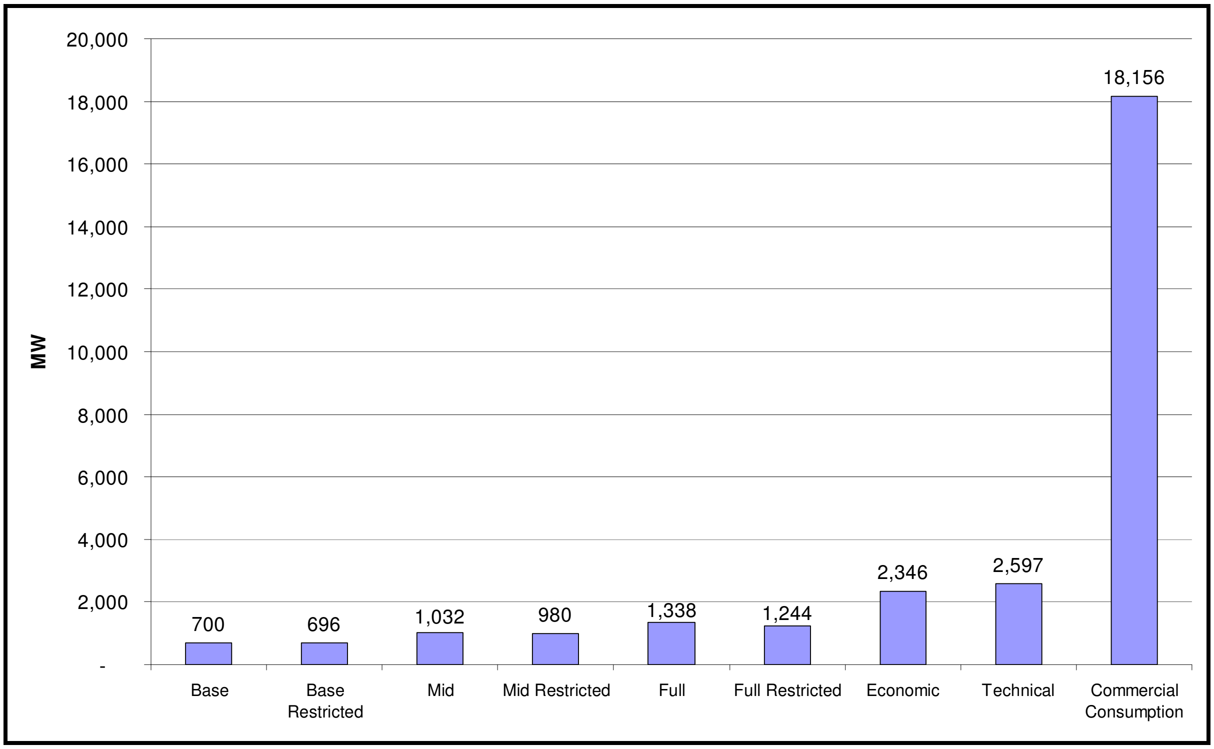
estimated commercial coincident peak demand of 18,156 MW in 2016. The estimated technical potential for coincident peak demand reduction is 2,597 MW and the estimated economic potential is 2,346 MW for 2007 through 2016. The total gross coincident peak demand potential under the Full scenario is 1,338 MW for 2007 through 2016. The technical potential is about 14% of the expected coincident peak demand in 2016. Economic potential is about 13% and full incentive potential is approximately 7% of coincident peak demand in 2016.

Figure 6-1: Forecasted California IOU Commercial Electricity Usage in 2016 and Gross Market, Economic, and Technical Potential for Existing Commercial Buildings – 2007-2016 (GWh)



The forecast of commercial consumption uses data from the *California Energy Demand 2008-2018 Staff Revised Forecast* (November 2007). The commercial consumption numbers are derived from a combination of data from Form 1.1b and Form 1.1c. The 2016 commercial consumption numbers are multiplied by the ratio of IOU-specific consumption relative to the total statewide consumption (ratio = .75546). Refer to Table 6-2 for a description of the scenarios.

Figure 6-2: Forecasted California IOU Commercial Electricity Coincident Peak Demand in 2017 and Gross Market, Economic, and Technical Coincident Peak Demand Potential for Existing Commercial Buildings – 2007-2016 (MW)



The forecast of commercial consumption uses data from the *California Energy Demand 2008-2018 Staff Revised Forecast* (November 2007). The commercial coincident peak demand numbers are derived from a combination of data from Form 1.3 and Form 1.4b. The 2016 commercial coincident peak demand numbers are multiplied by the ratio of IOU-specific coincident peak demand relative to the total statewide coincident peak demand (ratio = .74993). Refer to Table 6-2 for a description of the scenarios.

The total existing commercial market electric potential by scenario, across all three electric California IOUs, is listed in Table 6-4. Total potential estimates over a 10-year (2007-2016) and a 20-year (2007-2026) period are provided. Total IOU market potential under the Base 10-year scenario is 3,357 GWh of gross energy savings and 1,871 GWh of net energy savings. These savings are the estimated 10-year energy savings potential if the IOUs continue the 2006 incentive levels and limit their program offerings to those measures with program accomplishments during the 2004-2005 program cycle. The 20-year Base scenario forecast is 4,189 GWh of gross energy savings and 2,404 GWh of net energy savings.

The average yearly addition to the total energy forecast is substantially larger for the 10-year estimate of potential (336 GWh per year) than the 20-year estimate (210 GWh per year). During the first 10 years of the forecast period, businesses are installing new, energy-saving measures. During the last 10 years of the forecast, many businesses have either already installed the high efficiency measures, increasing the saturation of high efficiency measures and limiting the opportunity for additional energy savings from the existing set of measures.

Extending the forecast out to 20 years, with the technologies that are currently available, illustrates the importance of future advancement in high efficiency measure technologies. Improvements in existing high efficiency measures and the invention of new approaches to saving energy are necessary to maintain a high level of new energy efficiency savings.

Increasing incentives to Full incremental costs and expanding the measure list to include a limited number of additional technologies increases the total 10-year gross market potential estimates to 6,552 GWh and the net potential energy estimates to 5,039 GWh. The 10-year Full scenario potential estimates are approximately 95% larger than the Base scenario. The 20-year Full scenario estimates of gross energy savings potential are 7,304 GWh and the 20-year net potential energy savings are 5,493 GWh. If program incentives were set halfway between current incentives and full incremental costs (the Mid scenario), estimated gross energy savings potential is 4,961 GWh in 2016 and net energy savings potential is 3,453 GWh. The Mid scenario potential estimates are about 48% higher than the Base scenario estimates.

Limiting measures to those that are cost-effective makes only a modest reduction in savings in all of the scenarios: 36 GWh of reduction in the 2007-2016 Base Restricted scenario, 286 GWh of reduction in the 2007-2016 Mid Restricted scenario, and 661 GWh of reduction in the 2007-2016 Full-Restricted scenario. The design of the current programs, as reflected by the Base scenario, is largely restricted to measures that are cost-effective or nearly cost-effective. While the Mid and the Full incentive scenarios add a limited number of measures not currently in the IOU portfolios, all of the measures analyzed for this analysis are commercially available and most were assumed to be cost-effective prior to including them in this analysis. These results indicate that if the IOUs significantly increase the incentives for commercial measures, they would increase the program expenses and energy savings without leading to a large increase in non-cost-effective adoptions.

Total IOU market coincident peak demand potential is listed in Table 6-4. The total IOU gross existing commercial market coincident peak demand potential under the Base scenario is 700 MW for 2007-2016 and 926 MW for 2007-2026. The net potential base energy savings potential is 399 MW for 2007-2016 and 542 MW for 2007-2026. Increasing incentives to the halfway point between current and full incremental cost incentives increases the estimate of gross coincident peak demand potential to 1,032 MW for 2007-2016 and 1,230 MW for 2007-2026. The Mid scenario net potential estimate is 728 MW for 2007-2016 and 843 MW for 2007-2026. Further increasing incentives to full incremental measure cost increases gross commercial coincident peak demand potential to 1,338 MW for 2007-2016 and 1,568 MW for 2007-2026. Restricting incentivized measures to those that are cost-effective leads to only a very small reduction in potential. Restricting the Base 10-year net scenario to those measures with a TRC > 0.85 reduces potential by only 4 MW, a 0.6% reduction in coincident peak demand potential.

Table 6-4: Estimated California IOU Total Market Potential by Scenario for Existing Commercial Buildings – 2007-2016 and 2007-2026 (GWh)

Level	Gross Energy (GWh) - 2016	Naturally Occurring Energy (GWh) - 2016	Coincident Peak Demand (MW) - 2016	Naturally Occurring Coincident Peak Demand (MW) - 2016	Gross Energy (GWh) - 2026	Naturally Occurring Energy (GWh) - 2026	Coincident Peak Demand (MW) - 2026	Naturally Occurring Coincident Peak Demand (MW) - 2026
Base	3,357	1,486	700	301	4,189	1,785	926	384
Base Restricted	3,321	1,486	696	301	4,138	1,785	919	384
Mid	4,961	1,508	1,032	304	5,656	1,812	1,230	387
Mid Restricted	4,675	1,508	980	304	5,301	1,812	1,186	387
Full	6,552	1,513	1,338	305	7,304	1,811	1,568	387
Full Restricted	5,891	1,513	1,244	305	6,410	1,811	1,442	387
Full Gradual	6,394	1,513	1,309	305	7,297	1,812	1,566	387
Full Restrict Gradual	5,711	1,513	1,214	305	6,398	1,812	1,439	387

Refer to Table 6-2 for a description of the scenarios.

Table 6-4 also presents potential estimates for a scenario in which the incentives levels are gradually increased from current (2006) incentive levels to full incentive levels (by 2010). The results from this scenario indicate that the slower ramp-up of incentives, when compared to the instantaneous jump from current incentives in 2006 to full incentives in 2007, leads to only a minor loss in potential relative to the Full scenario.

The results for the TRC restricted gross market scenarios are illustrated in Figure 6-3 and Figure 6-4. These graphs illustrate the yearly estimate of TRC restricted market potential from cumulative adoptions from 2007 to 2016.[7] While the savings potential from 2007-2026 is not illustrated, the results presented in Table 6-4 clearly indicate that an illustration of the 20-year forecast would show a continuing decline in increment increases to potential or a further flattening on the curve in Figure 6-3.

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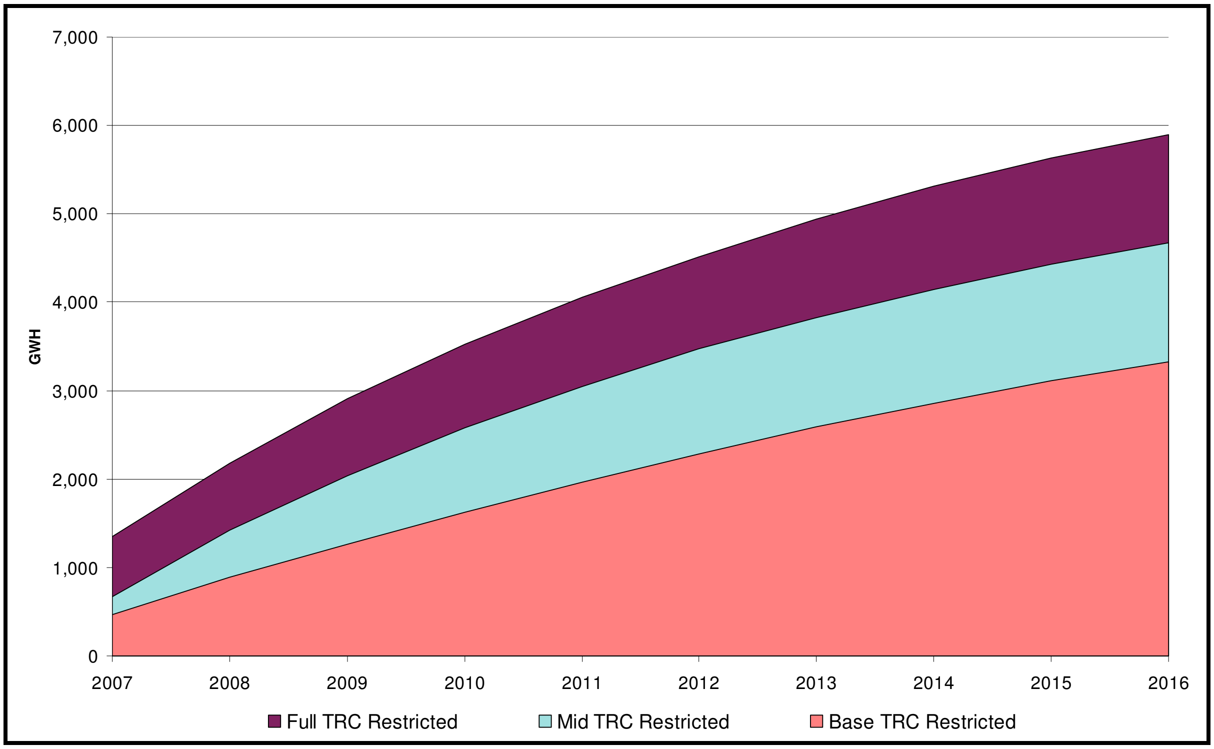
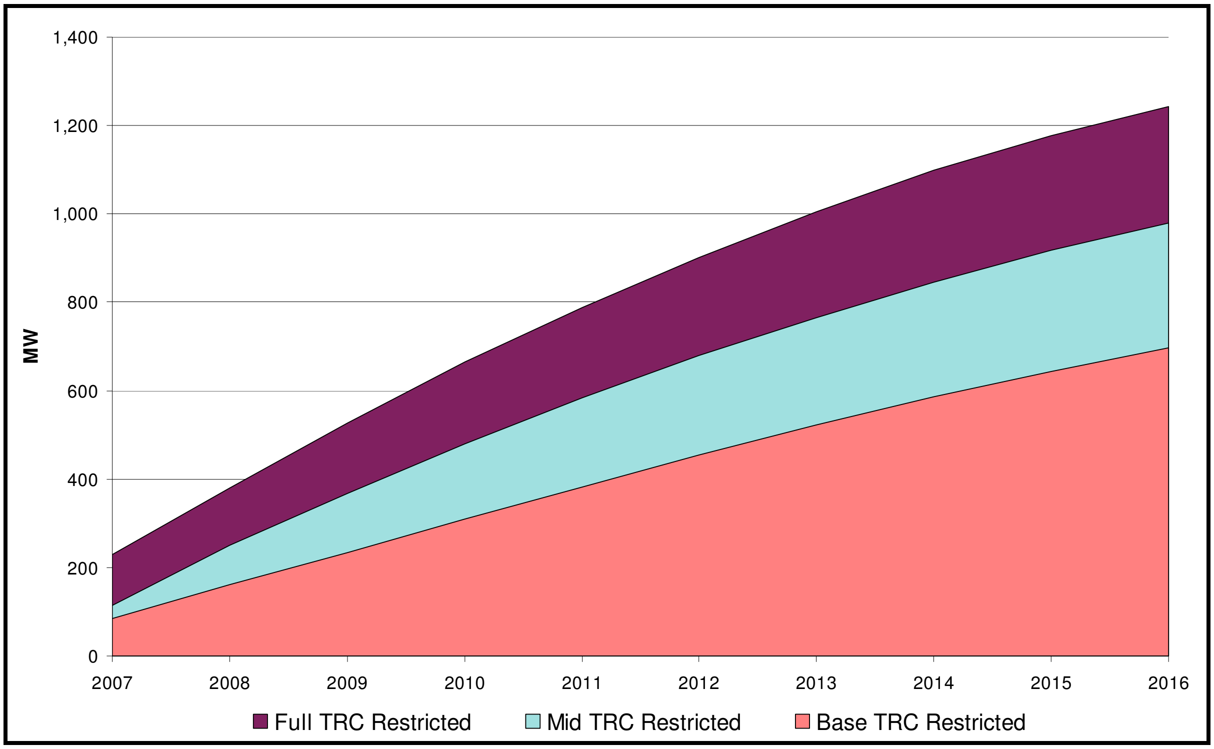
[7] The results presented in these figures are gross program savings estimates. The savings estimates have not been reduced by the naturally occurring estimate of savings.

Figure 6-3: Estimated California IOU Gross Total Energy Market Potential by TRC Restricted Funding Levels for Existing Commercial Buildings – 2007-2016 (GWh)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-4: Estimated California IOU Gross Total Coincident Peak Demand Market Potential by TRC Restricted Funding Levels for Existing Commercial Buildings – 2007-2016 (MW)



Refer to Table 6-2 for a description of the scenarios.

Market and Naturally Occurring Potential with Higher Awareness

Voluntary energy efficiency programs have been used to encourage Californians to adopt efficiency technologies for approximately three decades. During this time, their basic knowledge of energy efficiency measures and their willingness to install these measures has grown. The ongoing emphasis on expanding energy efficiency savings and the growing public concern about global warming may lead to a faster future growth in the awareness and willingness of consumers to adopt energy efficiency devices. In particular, it may lead to an increase in the awareness of efficiency measures and willingness of customers to adopt these measures without receiving rebates. To model this possibility, the Base TRC Restricted Higher Awareness scenario assumes a faster growth rate for the awareness than in the Base TRC Restricted scenario. In addition, this scenario assumes that the awareness and willingness of the naturally occurring estimate grows at a rate set equal to 75% of the growth rate of the program analysis.[8]

Table 6-5 lists the estimated electric savings for the Base TRC Restricted with Higher Awareness scenario. Comparing the 2007-2016 market energy potential with the Base TRC Restricted estimates presented in Table 6-4, the gross market energy savings with higher awareness increases by 351 GWh (from 3,321 to 3,708 GWh) or 10% while the naturally occurring energy savings increased by 738 GWh (from 1,486 to 2,223 GWh) or 50%. The large increase in the naturally occurring estimate leads to a reduction in the net-to-gross ratio. The net-to-gross ratio for the Base TRC Restricted scenario is about 55% for 2007-2016 while the net-to-gross for the Base TRC Restricted Higher Awareness scenario is approximately 40% for 2007-2016.

Table 6-5: Estimated Total California IOU Market Potential for the Base TRC Restricted with Higher Awareness for Existing Commercial Buildings – 2007-2016 and 2007-2026 (GWh and MW)

	Gross Base TRC Restricted Higher Awareness	Naturally Occurring Base TRC Restricted Higher Awareness	Gross Base TRC Restricted Higher Awareness 2026	Naturally Occurring Base TRC Restricted Higher Awareness 2026
2016, GWh	3,708	2,223	4,317	2,740
2016, MW	778	448	966	581

Refer to Table 6-2 for a description of the scenarios.

<u>Market Potential by End Use for Existing Commercial Buildings</u>

Table 6-6 and Table 6-7 summarize the energy market potential estimates by funding level and end use for 2007-2016 and 2007-2026, respectively. Table 6-8 and Table 6-9 present similar results for market coincident peak demand reduction.

Increasing funding for HVAC, lighting, miscellaneous, refrigeration, and food measures from current funding levels to full incremental cost increases gross energy savings estimates for 2007-2016 by 74%, 109%, 126%, 76%, and 242%, respectively.[9] Given the levels of

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8 In all other scenarios, the awareness and willingness of the naturally occurring estimate is held fixed; it does not grow. For the Base TRC Restrict Higher Awareness scenario, the growing awareness and willingness for the naturally occurring analysis is intended to reflect the possible influence of market effects and growing awareness of global warming on the probability of adoption outside the program. The awareness and willingness of the naturally occurring estimate is never allowed to exceed 95%. The awareness and willingness of the program estimate commonly reaches 100% prior to the end of the forecast period.

9 Increasing incentives for food measures leads to a 242% increase in potential, in part due to the increase in the types of electric cooking measures covered by the full program relative to the base program.

savings, the increase in potential is most important in the HVAC, lighting, and refrigeration end uses. Limiting the measure list to those with a TRC ≥ 0.85 reduces the impact of an increase in funding from Base incentive to Full incentive, increasing gross energy savings by 65% for HVAC measures, 88% for lighting, 123% for miscellaneous, 65% for refrigeration, and 67% for food. The large percentage drop in the increase in potential for food measures should not cause undue alarm; these are new measures in the programs with a high level of uncertainty and a low level of expected savings.

Table 6-6: Estimated California IOU Total Gross Market and Naturally Occurring Energy Potential by Funding Level and End Use for Existing Commercial Buildings – 2007-2016 (GWh)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
HVAC	1,021	1,021	423	1,434	1,369	1,779	1,685	423
Lighting	1,689	1,671	719	2,535	2,440	3,528	3,148	720
Misc.	30	30	20	56	56	68	67	42
Refrig.	567	553	296	838	747	1,011	913	298
Food	49	46	24	98	62	167	77	31
Total	3,357	3,321	1,482	4,961	4,675	6,552	5,891	1,513

Refer to Table 6-2 for a description of the scenarios. The miscellaneous electric end use includes vending machine controllers, high efficiency computers, and high efficiency copiers.

Table 6-7: Estimated California IOU Total Gross Market and Naturally Occurring Energy Potential by Funding Level and End Use for Existing Commercial Buildings – 2007-2026 (GWh)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
HVAC	1,386	1,376	555	1,790	1,745	2,211	2,113	555
Lighting	1,996	1,975	829	2,641	2,484	3,542	3,003	829
Misc.	40	40	26	72	72	77	76	46
Refrig.	688	673	344	990	901	1,215	1,103	345
Food	79	74	29	162	99	260	114	37
Total	4,189	4,138	1,781	5,656	5,301	7,304	6,410	1,812

Refer to Table 6-2 for a description of the scenarios. The miscellaneous electric end use includes vending machine controllers, high efficiency computers, and high efficiency copiers.

The distribution of energy savings potential, for both 2007-2016 and 2007-2026, by end use indicates that approximately 50% of the Base scenario's energy savings potential is in lighting, 30% of the total Base potential is in the HVAC end use, and 17% is in refrigeration. Restricting IOU portfolios to those measures with a TRC ≥ 0.85 does not significantly change the share of potential for these end uses. If incentives increase to Full incremental costs and measures are restricted to those with a TRC > 0.85, lighting's share in 2016 is 53%, HVAC's share is 29%, and refrigeration's share 15% of the Full TRC Restricted scenario.

Table 6-8: Estimated California IOU Total Gross Market and Naturally Occurring Coincident Peak Demand Potential by Funding Level and End Use for Existing Commercial Buildings – 2007-2016 (MW)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	376	376	156	553	517	714	662	156
Lighting	245	243	104	358	357	472	453	104
Misc.	4	4	3	8	8	10	9	6
Refrig.	68	67	36	101	90	122	110	36
Food	6	5	3	12	7	20	9	4
Total	700	696	301	1,032	980	1,338	1,244	305

Refer to Table 6-2 for a description of the scenarios. The miscellaneous electric end use includes vending machine controllers, high efficiency computers, and high efficiency copiers.

Table 6-9: Estimated California IOU Total Gross Market and Naturally Occurring Coincident Peak Demand Potential by Funding Level and End Use for Existing Commercial Buildings – 2007-2026 (MW)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	541	539	216	723	702	921	870	216
Lighting	286	284	119	357	352	457	414	119
Misc.	6	6	4	10	10	11	11	6
Refrig.	84	82	42	121	110	147	134	42
Food	9	9	4	19	12	31	14	4
Total	926	919	384	1,230	1,186	1,568	1,442	387

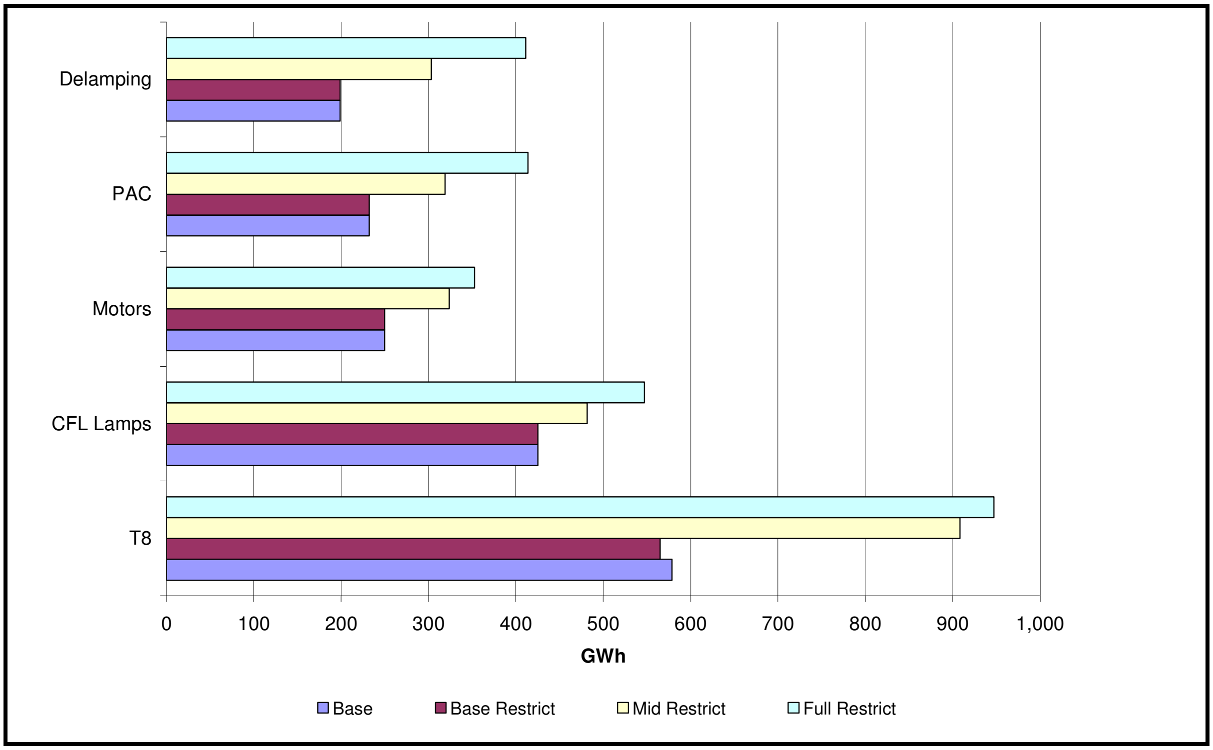
Refer to Table 6-2 for a description of the scenarios. The miscellaneous electric end use includes vending machine controllers, high efficiency computers, and high efficiency copiers.

Figure 6-5 and Figure 6-6 present estimates of total market gross potential at the grouped measure level for the top five savings measures for 2007 through 2016.[10] As shown, grouping all T8s (4 ft. and 8 ft. first- and second- generation) into one measure group results

[10] The ordering of the top five measure groups was determined by their mid restricted potential.

in T8s contributing significantly more savings potential than any other measure grouping.[11] After T8s, CFL lamps, motors, packaged air conditioning units (PAC), and delamping round out the top five energy savings measures.[12] In the commercial analysis, CLF lamps are screw-in CFLs and CFL reflectors. Three of the top five energy savings measure groups are from the lighting end use, reflecting the importance of lighting in the IOU programs and that 50% of the remaining technical potential in commercial buildings is from the lighting end use.

Figure 6-5: Total California IOU Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-6 illustrates the top five demand saving measure groups for existing commercial buildings for 2007 through 2016. The top coincident peak demand savings measure group is packaged air conditioning units (PAC), followed by T8s, tune-ups, chillers, and

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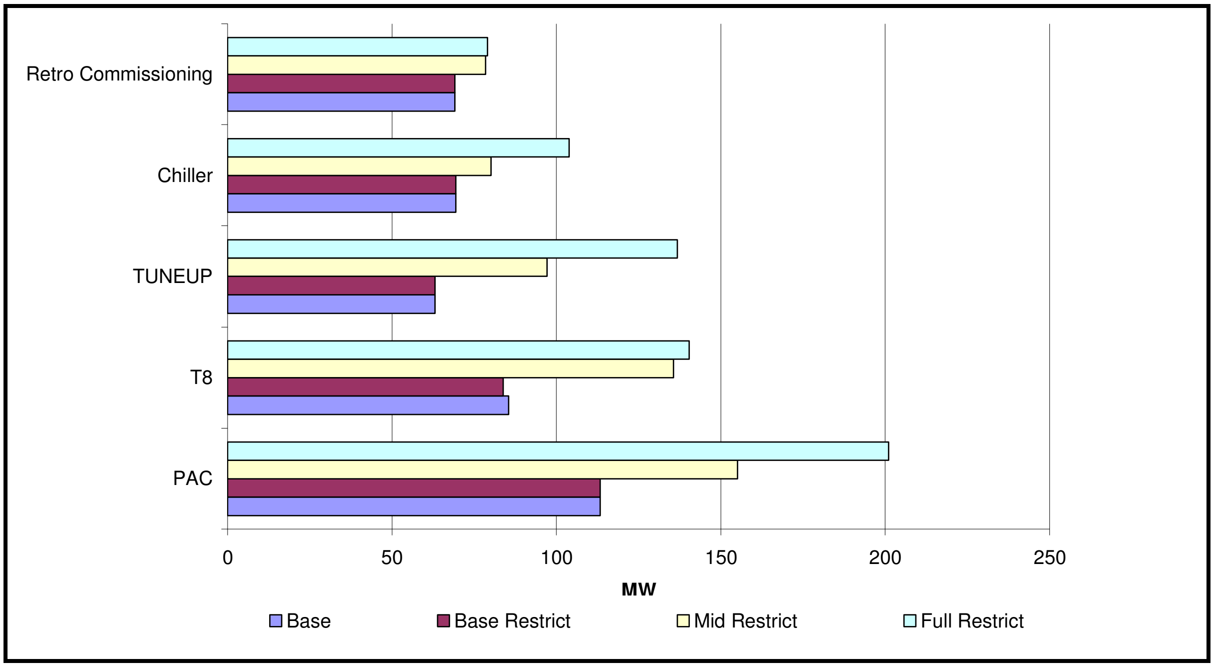
[11] The model assumes that T12s convert to T8s. T12s can convert to T8 first or second generations. First-generation T8s do not convert into second-generation T8s. Current IOU programs incentivize converting T12s to T8s. Current programs do not incentivize converting first-generation T8s into second- or higher generation T8s.

[12] Delamping is reducing the number of bulbs and changing the remaining T12 bulbs into T8s. This definition of delamping is consistent with the 2006-2008 program cycle incentivized delamping measures.

retrocommissioning. Four of the five top coincident peak demand saving measure groups are from the HVAC end use, reflecting the importance of HVAC measures to meet coincident demand savings goals.

Figure 6-6: Total California IOU Market Gross Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 6-2 for a description of the scenarios.

Existing Commercial Potential if CFL Lighting becomes Base Technology

The California legislature recently passed Assembly Bill 1109 (Huffman Bill). The Huffman Bill requires a 25% reduction in the average statewide commercial lighting energy intensity for indoor commercial lighting between 2007 and 2018. In an attempt to provide the IOUs with a very quick estimate of the impact of this legislation on their energy efficiency lighting potential, each of the above scenarios was re-calculated without the CFL lighting potential.

Table 6-10 and Table 6-11 list the existing commercial energy and coincident peak demand savings potential for lighting by scenario. The first and third rows of results are the lighting potential with screw-in incandescent as base technology for 2007-2016 and 2007-2026, while the second and fourth rows assume screw-in CFLs are base technologies and there are no high efficiency technologies for screw-in lighting. Eliminating screw-in CFLs from the commercial voluntary energy efficiency program will reduce the lighting technical and economic potential by 2,155 GWh for 2007-2016.[13] The Base TRC Restricted gross lighting energy potential will fall from 1,671 GWh to 1,245 GWh for 2007-2016, while the Full TRC Restricted gross potential will fall from 3,148 GWh to 2601 GWh.

Table 6-10: Estimated California IOU Total Technical, Economic, Gross Market, and Naturally Occurring Energy Potential for Commercial Lighting by Scenario, with Incandescent and CFL Base – 2007-2016 and 2007-2026(GWh)

	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid Restrict	Full Restrict	Mid and Full Naturally Occurring
Lighting Incandescent Base, 2016	7,451	6,568	1,689	1,671	719	2,440	3,148	720
Lighting CFL Base, 2016	5,296	4,412	1,264	1,245	505	1,959	2,601	506
Lighting Incandescent Base, 2026	6,544	5,480	1,996	1,975	829	2,484	3,003	829
Lighting CFL Base, 2026	4,555	3,491	1,534	1,512	631	1,990	2,483	631

Refer to Table 6-2 for a description of the scenarios. The lighting technical and economic potential falls between 2016 and 2026 due to the combination of short measure lives and the assumed decline in the existing floorstock. As the floorstock declines, those measures with a shorter measure life are eliminated from the potential forecast.

13 Eliminating incandescents and assuming CFLs are base technology reduces the commercial lighting potential by significantly less than for the residential sector. In commercial lighting, linear fluorescents are the most common type of lighting while screw-in bulbs are the most common type of lighting in the residential sector.

Table 6-11: Estimated California IOU Total Technical, Economic, Gross Market, and Naturally Occurring Total Coincident Peak Demand Potential for Existing Commercial Lighting by Scenario, with Incandescent and CFL Base – 2007-2016 and 2007-2026 (MW)

	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid Restrict	Full Restrict	Mid and Full Naturally Occurring
Lighting Incandescent Base, 2016	1,014	932	245	243	104	357	453	104
Lighting CFL Base, 2016	737	655	196	194	78	345	389	79
Lighting Incandescent Base, 2026	871	761	286	284	119	352	414	119
Lighting CFL Base, 2026	617	506	233	231	95	335	372	95

Refer to Table 6-2 for a description of the scenarios. The lighting technical and economic potential falls between 2016 and 2026 due to the combination of short measure lives and the assumed decline in the existing floorstock. As the floorstock declines, those measures with a shorter measure life are eliminated from the potential forecast.

Costs and Benefits for Electric Potential

Table 6-12 presents a summary of the present discounted value of costs and benefits, and the TRC ratios for the market potential forecasts. The cost and savings estimates for the Base scenario lead to statewide programs that are cost-effective, with a TRC of 1.55. The TRC for the Base Restricted scenario is only slightly higher than the Base scenario's, a 1.77. The relatively small increase in the TRC when measures are restricted to those with a TRC > 0.85 indicates that most measures in the commercial portfolio are cost effective. Restricting measures to those with a TRC > 0.85 within the Base scenario reduces utility incentives my 4% and customer expenditure on non-cost effective measures by approximately 18%. The TRC for the Mid and Full Restricted scenarios is 1.74.[14]

[14] While the TRC inputs for the Mid and Full scenario are not explicitly presented, the TRC for the Mid scenario is 1.25 and the TRC for the Full scenario is 1.15.

Table 6-12: Summary of the California IOU Electric Market Potential Results for Existing Commercial Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	760	674	1,513	2,982
PDV Net Measure Costs	1,097	889	1,673	2,457
PDV Gross Program Costs	306	292	378	459
PDV Net Electric Avoided Cost Benefits	2,181	2,089	3,565	5,060
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	1.55	1.77	1.74	1.74

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

Existing Commercial Utility-Level Potential

In this section, market, technical and economic potential are presented at the utility level. Figure 6-7 through Figure 6-12 illustrate and Table 6-13 through **Error! Reference source not found.** list the estimates of potential electric energy savings for the various market scenarios for PG&E, SCE, and SDG&E, respectively.

The yearly illustration of technical and economic potential need to be analyzed carefully. For retrofit and conversion models, the technical potential assumes an instantaneous installation of energy efficiency measures wherever applicable and feasible. For replace-on-burnout models, the technical potential is phased in as the previous measures burn out. Economic potential is similar to technical, with the further consideration of costs. Both the technical and economic potential should be viewed as theoretical constructions that do not reflect the market barriers that must be overcome to achieve voluntary market adoptions. Given the definitions of economic and technical potential, the technical potential illustrated for each utility in 2007 illustrates what the utility could achieve if it could force all households that could adopt the measure to adopt the measure. Increases in technical potential over time are due to population growth and the burnout of existing measures, which are then replaced with high efficiency measures.

<u>PG&E Existing Commercial Potential Electric Energy Savings Forecasts</u>

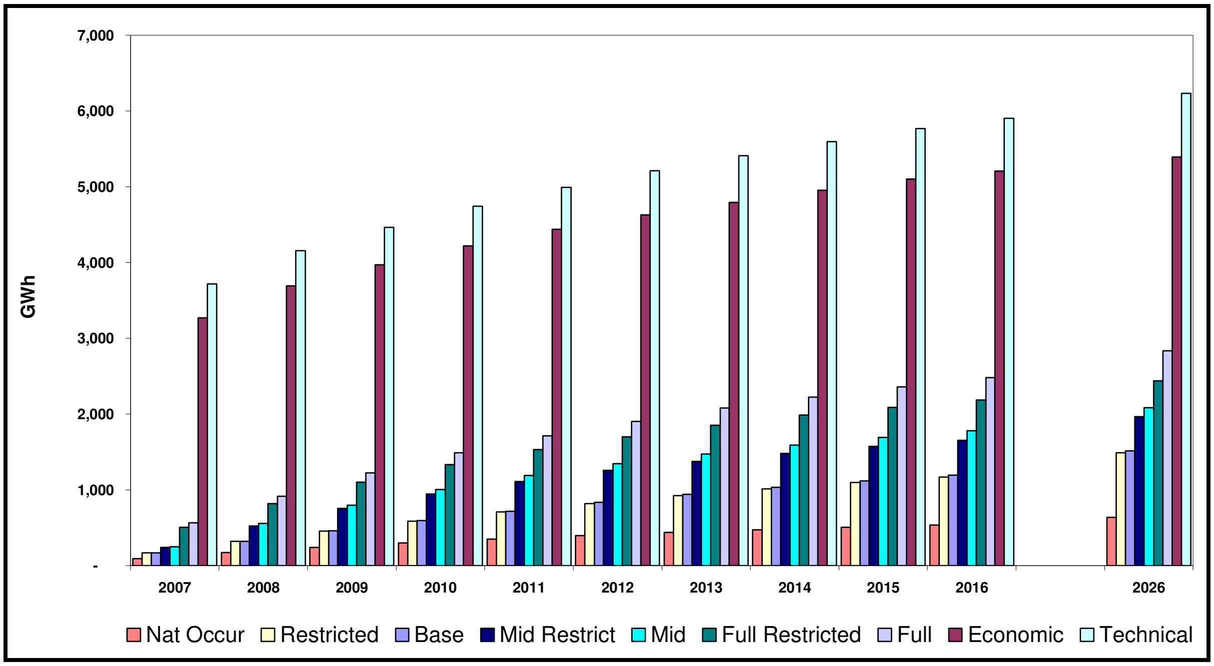
The results in Table 6-13 list the energy savings potential from existing businesses in PG&E's service territory, while Figure 6-7 illustrates the savings estimates. Estimated gross market savings potential under the Base scenario are 1,194 GWh from 2007 through 2016 and 1,514 GWh from 2007 through 2026, with about 51% of these savings derived from commercial lighting, 27% from HVAC, and 20% from refrigeration. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 1,781 GWh for 2007-2016 and 2,083 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 2,479 GWh for 2007-2016 and 2,833 GWh for 2007-2026. If PG&E increases its incentives to full incremental costs, lighting will account for about 56% of savings, HVAC for 20%, and refrigeration for 15%.

Table 6-13: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	3,716	3,273	167	166	93	174	108	248	238	564	506	259	248	94
2008	4,156	3,691	321	319	174	341	213	556	525	915	820	593	561	176
2009	4,464	3,973	460	457	241	499	308	796	754	1,223	1,099	945	883	245
2010	4,743	4,221	593	586	300	652	400	1,005	943	1,489	1,333	1,308	1,183	304
2011	4,990	4,438	717	708	351	795	485	1,187	1,110	1,712	1,530	1,571	1,408	357
2012	5,212	4,628	833	820	398	922	563	1,345	1,255	1,903	1,699	1,785	1,593	404
2013	5,408	4,795	938	922	438	1,034	630	1,474	1,375	2,077	1,853	1,974	1,756	445
2014	5,594	4,954	1,033	1,014	474	1,135	691	1,588	1,481	2,226	1,985	2,133	1,894	482
2015	5,767	5,102	1,120	1,097	506	1,218	747	1,691	1,574	2,360	2,090	2,274	2,002	515
2016	5,905	5,210	1,194	1,168	535	1,292	795	1,781	1,655	2,479	2,183	2,403	2,100	545
2026	6,230	5,395	1,514	1,489	634	1,555	973	2,083	1,966	2,833	2,438	2,811	2,413	645

Refer to Table 6-2 for a description of the scenarios.

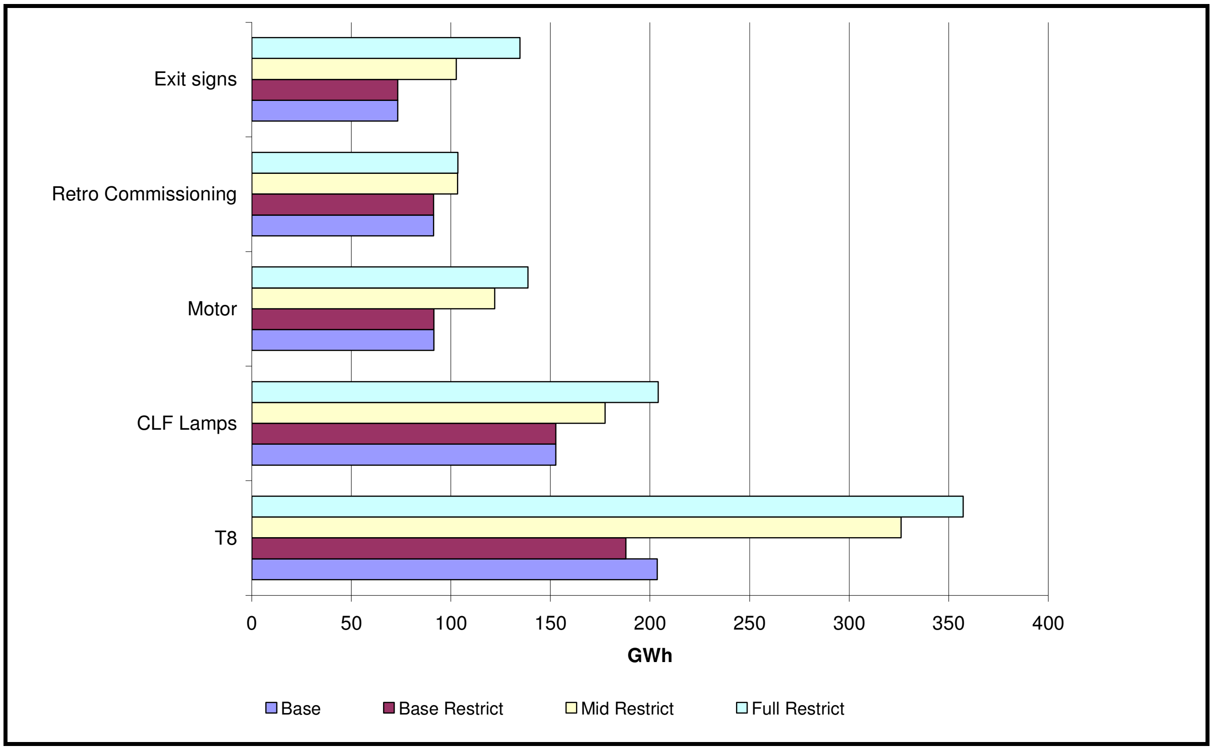
Figure 6-7: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Energy Potential for Existing Commercial Buildings – 2007-2016 and 2026 (GWh)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-8 illustrates the energy savings potential from the top five energy savings measure groups. For PG&E's existing commercial sector, T8s have the largest measure group potential, followed closely by CFL lamps (screw-in CFLs and reflectors). Following T8s and CFL lamps, the measure groups with the highest energy savings potential include motors, retro-commissioning, and exit signs. The presence of three lighting technology groups in the top five measures is consistent with the finding that lighting potential accounts for about 50% of PG&E's existing commercial potential.

Figure 6-8: PG&E Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 6-2 for a description of the scenarios.

SCE Potential Electric Energy Savings Forecasts

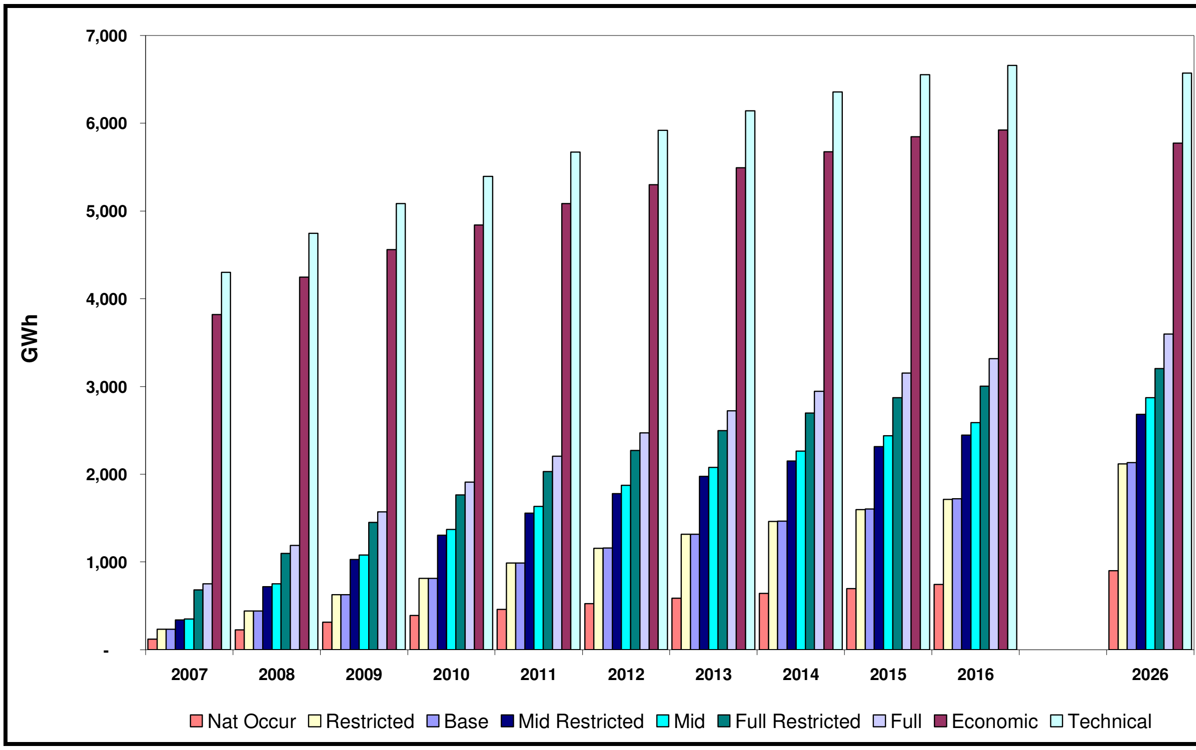
The results in Table 6-14 list the energy savings potential from existing businesses in SCE's service territory, while Figure 6-9 illustrates the savings estimates. Estimated gross market savings potential under the Base scenario are 1,719 GWh from 2007-through 2016 and 2,131 GWh from 2007 through 2026. The Base scenario estimates for 2007-2016 indicate that approximately 98% of SCE's existing commercial potential is in lighting, HVAC, and refrigeration. Approximately 48% of the Base scenario's energy savings potential is derived from commercial lighting, 33% from HVAC, and 17% from refrigeration. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 2,585 GWh for 2007-2016 and 2,873 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 3,316 GWh for 2007-2016 and 3,595 GWh for 2007-2026. If SCE increases its incentives to Full incremental costs, the savings from all end uses will increase, but the savings from lighting will increase more than those from HVAC. Under the Full scenario, lighting will account for about 52% of savings, HVAC for 29%, and refrigeration for 16%.

Table 6-14: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	4,300	3,820	233	233	120	244	140	347	338	748	682	362	353	121
2008	4,745	4,244	441	441	224	472	275	750	716	1,185	1,094	802	765	226
2009	5,085	4,558	627	626	311	686	399	1,076	1,024	1,570	1,450	1,272	1,190	314
2010	5,394	4,839	811	810	389	902	519	1,369	1,304	1,910	1,762	1,729	1,589	393
2011	5,669	5,085	988	986	459	1,111	635	1,634	1,555	2,204	2,029	2,066	1,888	465
2012	5,919	5,300	1,157	1,155	525	1,305	745	1,871	1,778	2,469	2,269	2,352	2,144	532
2013	6,143	5,494	1,316	1,313	585	1,485	846	2,077	1,974	2,721	2,495	2,617	2,380	594
2014	6,356	5,676	1,463	1,460	641	1,654	941	2,264	2,152	2,944	2,695	2,848	2,587	651
2015	6,554	5,847	1,601	1,596	694	1,800	1,032	2,438	2,312	3,150	2,871	3,060	2,767	705
2016	6,657	5,922	1,719	1,712	741	1,929	1,112	2,585	2,446	3,316	3,004	3,250	2,923	754
2026	6,569	5,772	2,131	2,116	901	2,213	1,385	2,873	2,682	3,595	3,204	3,611	3,216	911

Refer to Table 6-2 for a description of the scenarios.

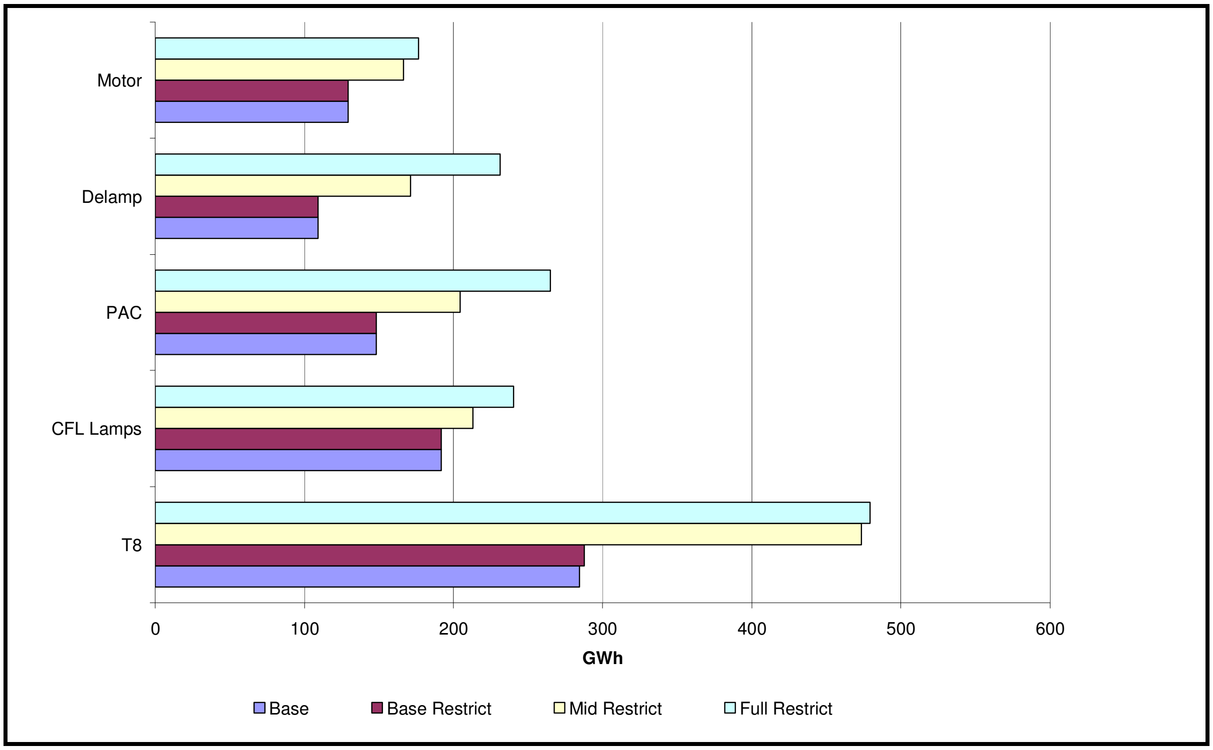
Figure 6-9: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Energy Potential for Existing Commercial Buildings – 2007-2016 and 2026 (GWh)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-10 illustrates the energy savings potential from SCE's top five energy savings measure groups. For SCE's existing commercial sector, T8s have the largest measure group potential, with this potential growing significantly under the Mid scenario relative to the Base scenario. The estimated growth in T8 potential if SCE increases rebates from their 2006 incentive level to halfway between 2006 incentives and full incremental costs is due to the relatively low incentive level in 2006 and the high level of success that SCE has had with the measure group at the current incentive rate. The model predicts that increasing the incentives on these measures will significantly increase the adoption of this measure group, with many of the remaining T12 customers choosing to adopt second-generation T8s. High efficiency lamps (screw-in CFLs and reflectors) are the measure group with the second highest energy savings potential, followed closely by packaged air conditioning units, delamping, and motors. The presence of three lighting technology groups in the top five measures is consistent with the finding that lighting potential accounts for about 50% of SCE's existing commercial potential.

Figure 6-10: SCE Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 6-2 for a description of the scenarios.

SDG&E Potential Electric Energy Savings Forecasts

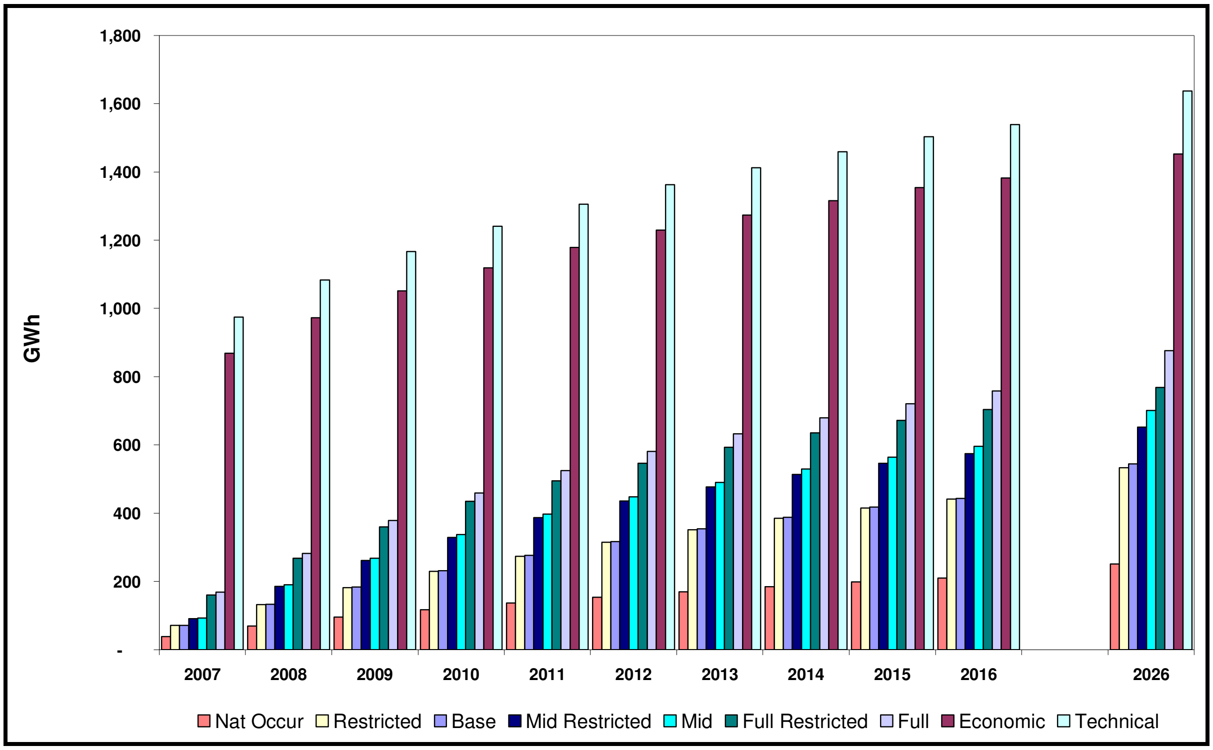
The results in Table 6-15 list the energy savings potential from existing businesses in SDG&E's service territory, while Figure 6-11 illustrates the savings estimates. Estimated gross market savings potential under the Base scenario are 433 GWh from 2007 through 2016 and 544 GWh from 2007 through 2026. The Base scenario estimates for 2007-2016 indicate that approximately 96% of SDG&E's existing commercial potential is in lighting, HVAC, and refrigeration. Approximately 54% of the Base scenario's energy savings potential is derived from commercial lighting, 28% from HVAC, and 14% from refrigeration. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 595 GWh for 2007-2016 and 700 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 758 GWh for 2007-2016 and 876 GWh for 2007-2026. If SDG&E increases its incentives to Full incremental costs, lighting will account from about 55% of savings, HVAC for 25%, and refrigeration for 15%.

Table 6-15: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	974	868	71	71	38	74	44	93	90	168	160	96	94	38
2008	1,083	972	133	131	70	140	86	190	185	281	267	203	198	71
2009	1,166	1,051	184	182	95	199	123	268	261	378	359	312	301	97
2010	1,240	1,119	231	229	117	256	159	337	329	459	434	416	399	120
2011	1,305	1,178	276	273	136	308	193	397	387	524	495	492	468	140
2012	1,362	1,229	317	314	154	354	223	447	436	581	546	554	524	158
2013	1,412	1,274	354	351	170	394	250	490	477	633	593	610	574	174
2014	1,459	1,315	387	385	184	430	275	529	514	679	635	658	617	189
2015	1,503	1,353	418	415	198	461	297	564	546	720	671	701	654	203
2016	1,538	1,382	443	441	210	488	317	595	574	758	703	741	688	215
2026	1,637	1,452	544	533	250	549	382	700	652	876	768	874	769	255

Refer to Table 6-2 for a description of the scenarios.

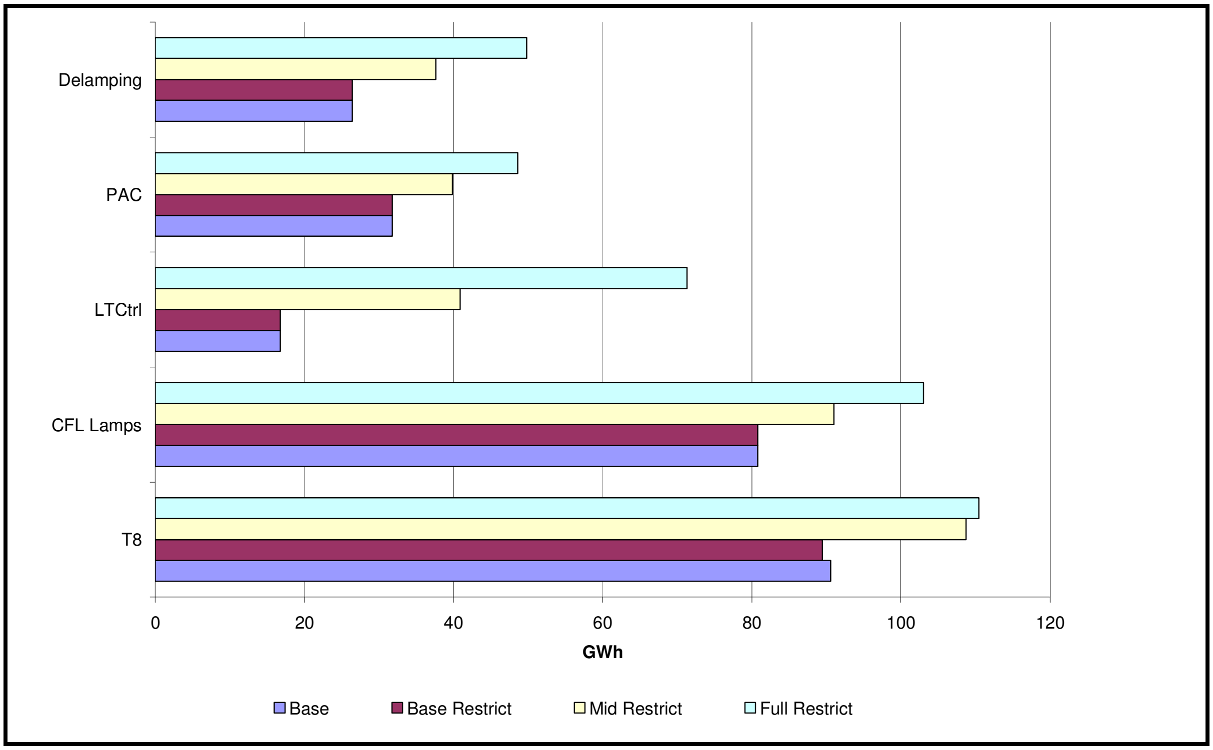
Figure 6-11: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Energy Potential for Existing Commercial Buildings – 2007-2016 and 2026 (GWh)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-12 illustrates the energy savings potential from the top five energy savings measure groups. For SDG&E's existing commercial sector, grouping four-foot and eight-foot T8s into a single measure group results in T8s having the largest measure group potential, closely followed by high efficiency lamps (grouping all screw-in CFLs and reflectors into a single measure group). The third highest measure savings group for SDG&E's commercial sector is lighting controls, followed by packaged air conditioning units and delamping. The presence of four lighting technology groups in the top five measures is consistent with the finding that lighting potential accounts for about 55% of SDG&E's existing commercial potential.

Figure 6-12: SDG&E's Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 6-2 for a description of the scenarios.

PG&E Potential Coincident Peak Demand Savings

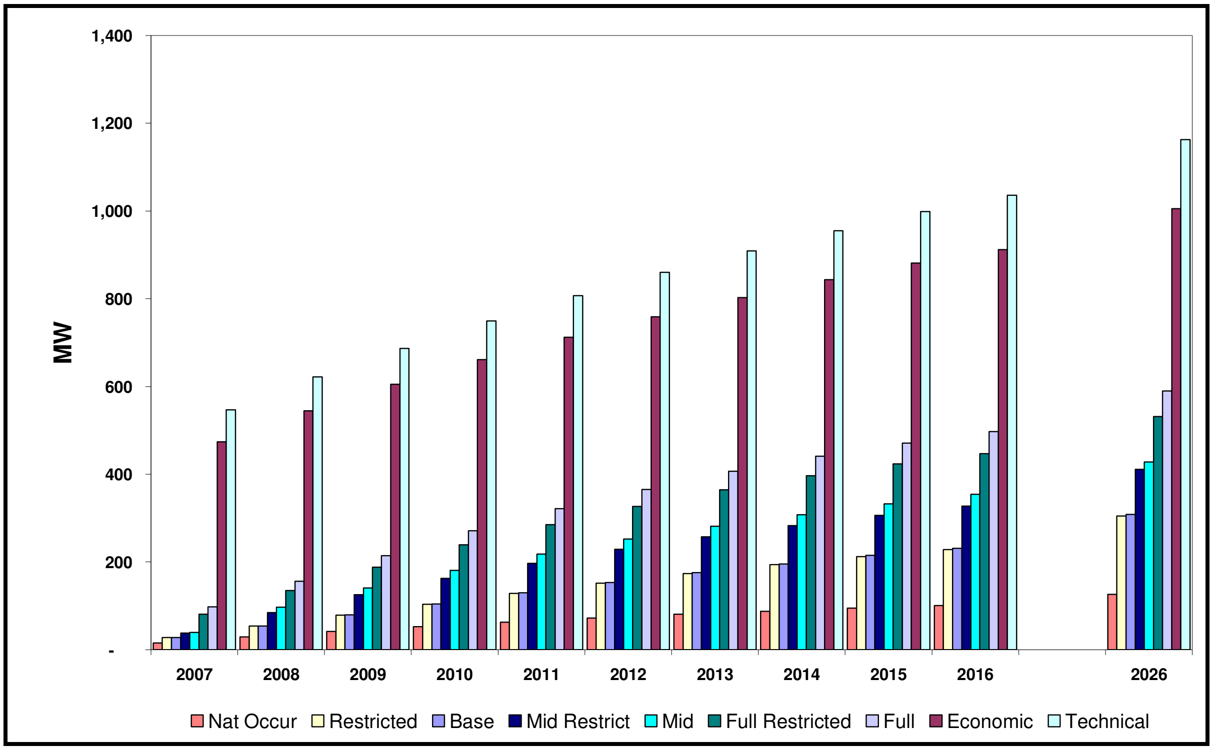
Table 6-16 lists the coincident peak demand savings potential from existing businesses in PG&E's service territory. Figure 6-13 illustrates the savings estimates. Estimated gross market savings potential under current incentives are 231 MW from 2007-2016 and 308 MW from 2007-2026. Ninety-eight percent of the coincident peak demand savings potential is derived from three end uses: HVAC (54%), lighting (33%), and refrigeration (11%). Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 354 MW for 2007-2016 and 427 MW for 2007-2026. Comparing estimates from the Mid scenario with those from the Mid TRC Restricted scenario, restricting measures to those with a TRC > 0.85 does not lead to a large reduction in the coincident peak demand potential. The Mid TRC Restricted potential estimates of savings are 327 MW for 2007-2016 and 411 MW for 2007-2026. The long run times associated with commercial HVAC, lighting, and refrigeration, along with the pre-screening of measures by the energy efficiency potential study PAC, has resulted in the analysis of largely cost-effective measures within the commercial sector. Increasing incentives to Full incremental measure cost increases potential savings to 497 MW for 2007-2016 and 589 MW for 2007-2026. If PG&E increases its incentives to Full incremental costs, HVAC will account for about 56% of coincident peak demand savings, lighting for 33% and refrigeration for 8%.

Table 6-16: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	546	473	28	28	15	29	18	39	38	97	80	41	39	15
2008	621	544	54	54	29	57	36	96	84	156	134	103	90	29
2009	686	604	79	78	41	86	53	140	125	214	188	170	148	41
2010	749	661	104	104	52	116	70	181	162	271	239	242	212	53
2011	806	712	129	128	62	145	86	218	197	321	285	299	263	63
2012	859	759	153	151	72	171	102	252	229	365	326	346	307	72
2013	909	802	175	173	80	195	115	281	257	406	364	390	347	81
2014	955	843	196	193	88	218	127	308	283	440	396	425	380	88
2015	998	881	215	212	94	236	138	332	306	470	423	456	408	95
2016	1,035	912	231	228	101	252	148	354	327	497	447	484	432	102
							-							
2026	1,163	1,005	308	305	126	320	185	427	411	589	531	586	526	127

Refer to Table 6-2 for a description of the scenarios.

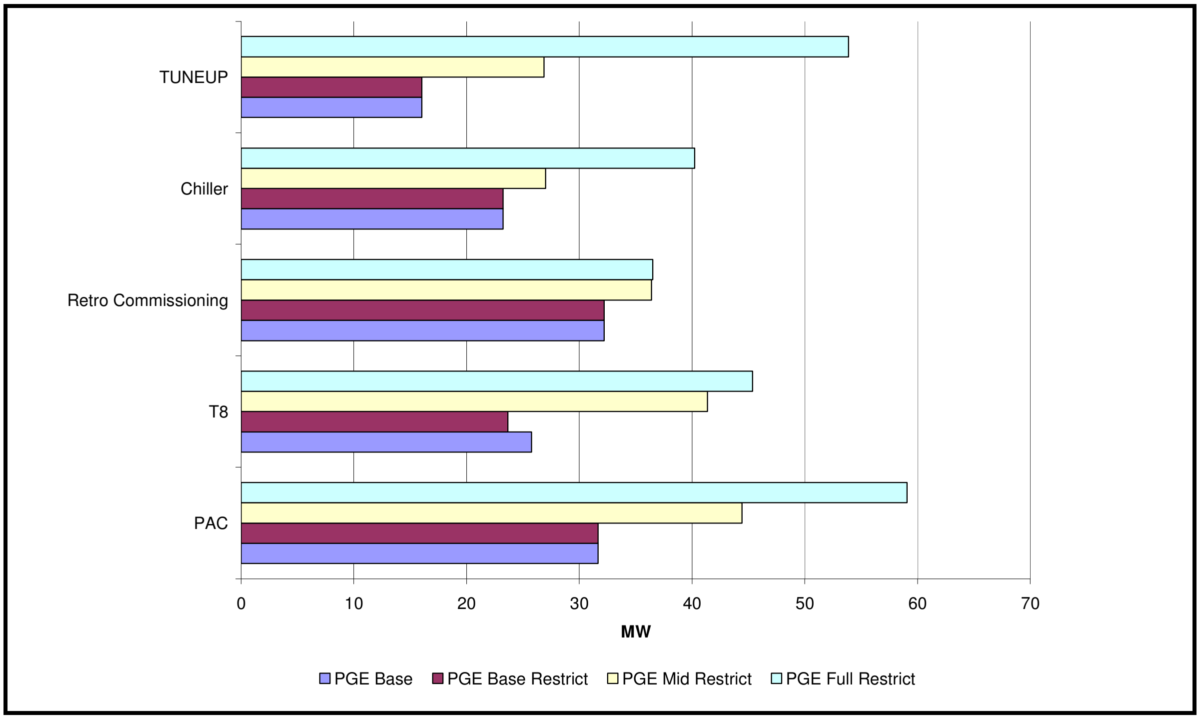
Figure 6-13: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Existing Commercial Buildings – 2007-2016 and 2026 (MW)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-14 illustrates the coincident peak demand savings potential from the top five demand savings measure groups. For PG&E's existing commercial sector, high efficiency packaged air conditioning units have the largest measure group potential, followed closely by the T8, retrocommissioning (for vents and chillers), high efficiency chillers, and tune-up measure groups. The measure groups listed in Figure 6-14 were ordered by their Mid Restricted scenario potential. The potential estimates for tune-ups is highly sensitive to increases in incentive from the Mid to the Full level, leading tune-ups to be the second highest demand savings group under the Full Restricted scenario.

Figure 6-14: PG&E Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Coincident Peak Demand Savings Measures – 2007-2016 (MW)



Refer to Table 6-2 for a description of the scenarios. The measure groups listed above have been ordered by their mid restrict potential.

SCE Potential Coincident Peak Demand Savings

Table 6-17 list the coincident peak demand savings potential from existing commercial buildings in SCE's service territory, while Figure 6-15 illustrates the savings estimates. Estimated gross market savings potential under the Base scenario are 393 MW from 2007 through 2016 and 522 MW from 2007 through 2026. The Base scenario estimates for 2007-2016 indicate that approximately 99% of SCE's existing commercial potential is in HVAC, lighting, and refrigeration. Approximately 56% of the Base scenario's coincident peak demand savings potential is derived from commercial HVAC, 34% from lighting, and 9% from refrigeration. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 577 MW for 2007-2016 and 680 MW for 2007-2026. Restricting the Mid scenario to those measures with a TRC > 0.85 (Mid Restricted scenario) leads to a potential savings estimate of 555 MW for 2007-2016 and 660 MW for 2007-2026. The slight reduction in savings between the Mid and Mid Restricted scenarios indicates that while most measures are cost-effective, increasing rebates will lead to an increase in customers' adoptions of non-cost-effective measures. Increasing incentives to Full incremental measure cost increases potential savings to 714 MW for 2007-2016 and 829 MW for 2007-2026. If SCE increases its incentives to

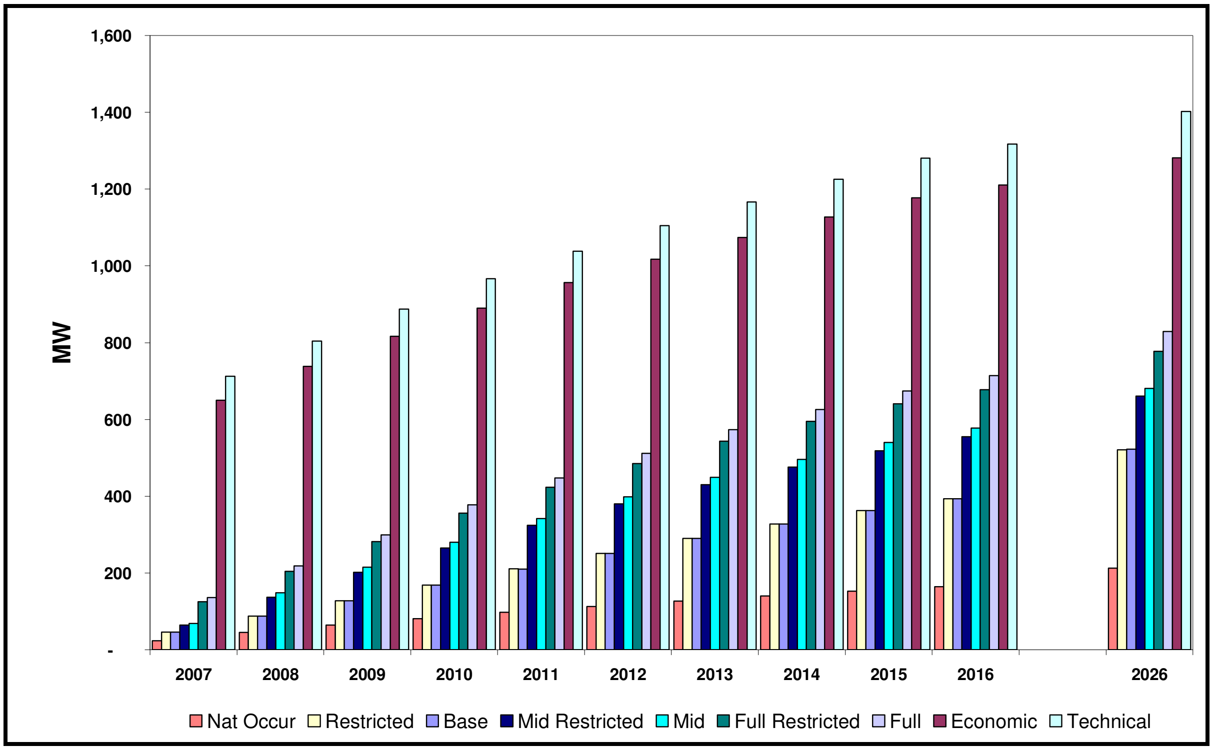
Full incremental costs, HVAC will account for about 50% of savings, lighting for 35% and refrigeration for 9%.

Table 6-17: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	712	650	45	46	24	48	28	68	64	136	124	71	67	24
2008	804	738	87	87	45	94	55	148	136	218	204	158	146	45
2009	887	816	127	127	63	140	81	215	201	299	282	251	235	64
2010	966	890	168	168	81	189	108	280	264	377	356	346	326	81
2011	1,038	956	210	210	97	238	134	341	324	447	423	423	400	98
2012	1,105	1,017	250	251	112	284	159	398	379	511	484	490	464	113
2013	1,167	1,074	290	290	126	329	183	449	429	572	543	553	525	128
2014	1,225	1,127	327	327	140	372	205	496	475	626	594	608	577	141
2015	1,280	1,177	362	362	152	408	227	540	518	674	640	657	624	154
2016	1,317	1,210	393	393	164	442	246	577	555	714	677	701	665	166
2026	1,402	1,281	522	521	212	549	327	680	660	829	777	831	779	213

Refer to Table 6-2 for a description of the scenarios.

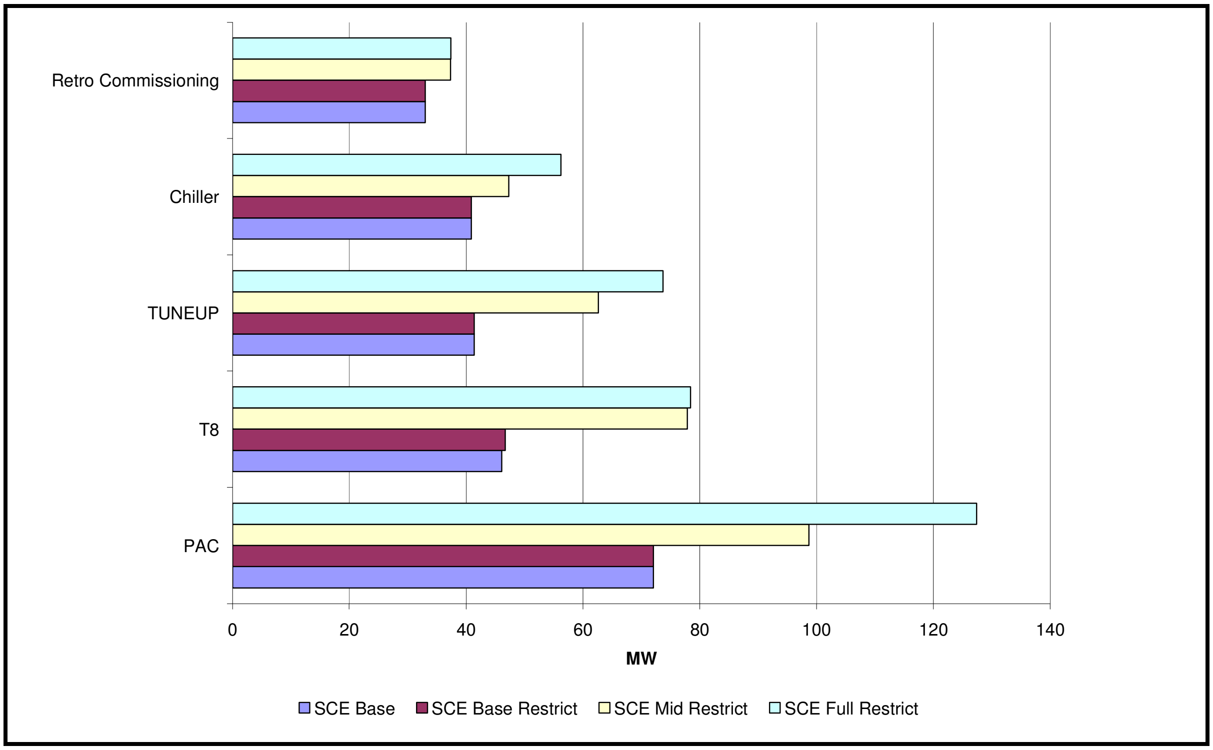
Figure 6-15: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Existing Commercial Buildings – 2007-2016 and 2026 (MW)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-16 illustrates the coincident peak demand savings potential from the top five demand savings measure groups. For SCE's existing commercial sector, packaged air conditioning units have the largest measure group potential, with this potential growing significantly under the Mid and Full scenarios relative to the Base scenario. The T8, tune-up, chiller, and retrocommissioning measure groups complete the top five demand savings groups. The presence of four HVAC technology groups in the top five measures is consistent with the finding that HVAC potential accounts for about 50-55% of SCE's existing commercial potential.

Figure 6-16: SCE Total Market Gross Coincident Peak Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 6-2 for a description of the scenarios.

SDG&E Potential Coincident Peak Demand Savings

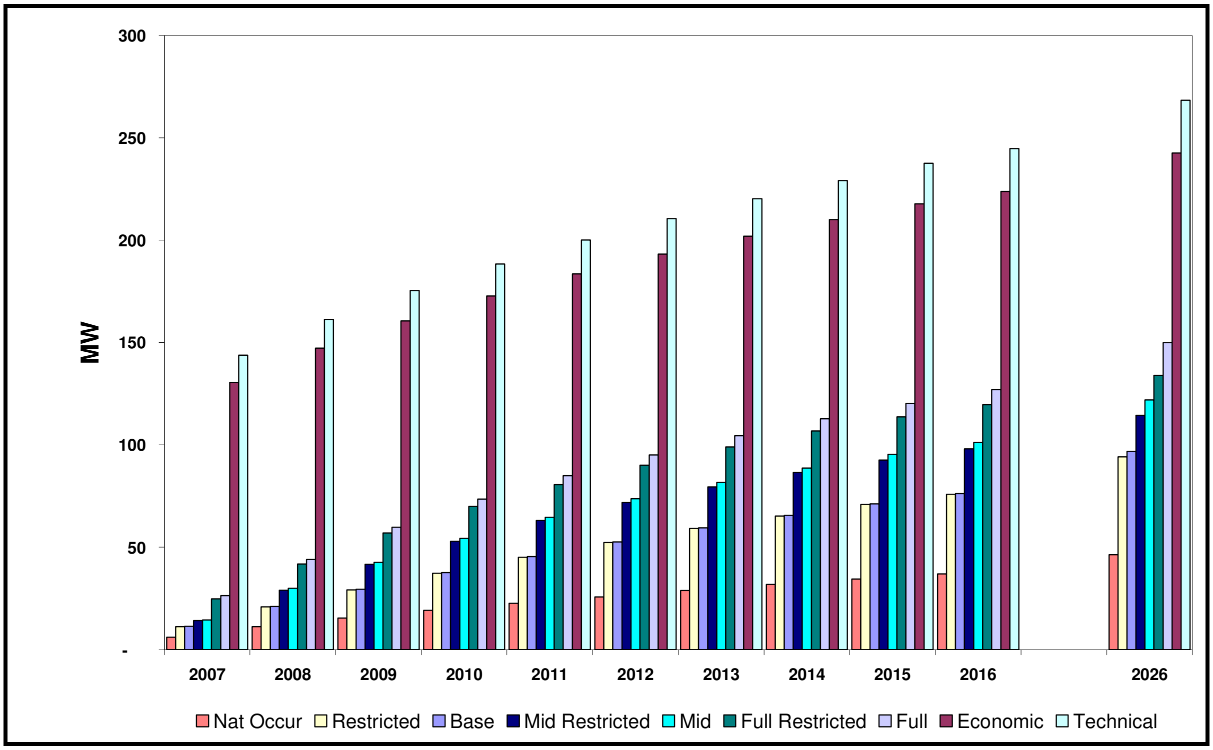
The results in Table 6-18 list the coincident peak demand savings potential from existing commercial buildings in SDG&E's service territory, while Figure 6-17 illustrates the demand savings estimates. Estimated gross market savings potential under Base scenario are 76 MW from 2007 through 2016 and 97 MW from 2007 through 2026. The Base scenario estimates for 2016 indicate that approximately 90% of SDG&E's existing commercial coincident peak demand potential is in lighting, HVAC, and refrigeration. Approximately 47% of the Base scenario's demand savings potential is derived from commercial lighting, 43% from HVAC, and 10% from refrigeration. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 101 MW for 2007-2016 and 122 MW for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 127 MW for 2007-2016 and 150 MW for 2007-2026. If SDG&E increases its incentives to Full incremental costs, lighting will account for about 47% of savings, HVAC for 38%, and refrigeration for 11%.

Table 6-18: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base - Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	144	130	11	11	6	12	7	14	14	26	25	15	15	6
2008	161	147	21	21	11	22	14	30	29	44	42	32	31	11
2009	175	161	29	29	15	32	20	43	42	60	57	50	48	16
2010	188	173	38	37	19	42	26	54	53	73	70	67	64	19
2011	200	184	45	45	23	51	31	65	63	85	81	80	76	23
2012	211	193	53	52	26	59	37	74	72	95	90	91	87	26
2013	220	202	59	59	29	66	42	82	79	104	99	101	96	29
2014	229	210	66	65	32	73	47	89	86	113	107	110	104	32
2015	238	218	71	71	35	79	51	95	93	120	114	117	111	35
2016	245	224	76	76	37	84	55	101	98	127	120	124	117	38
2026	268	243	97	94	46	97	69	122	114	150	134	150	134	47

Refer to Table 6-2 for a description of the scenarios.

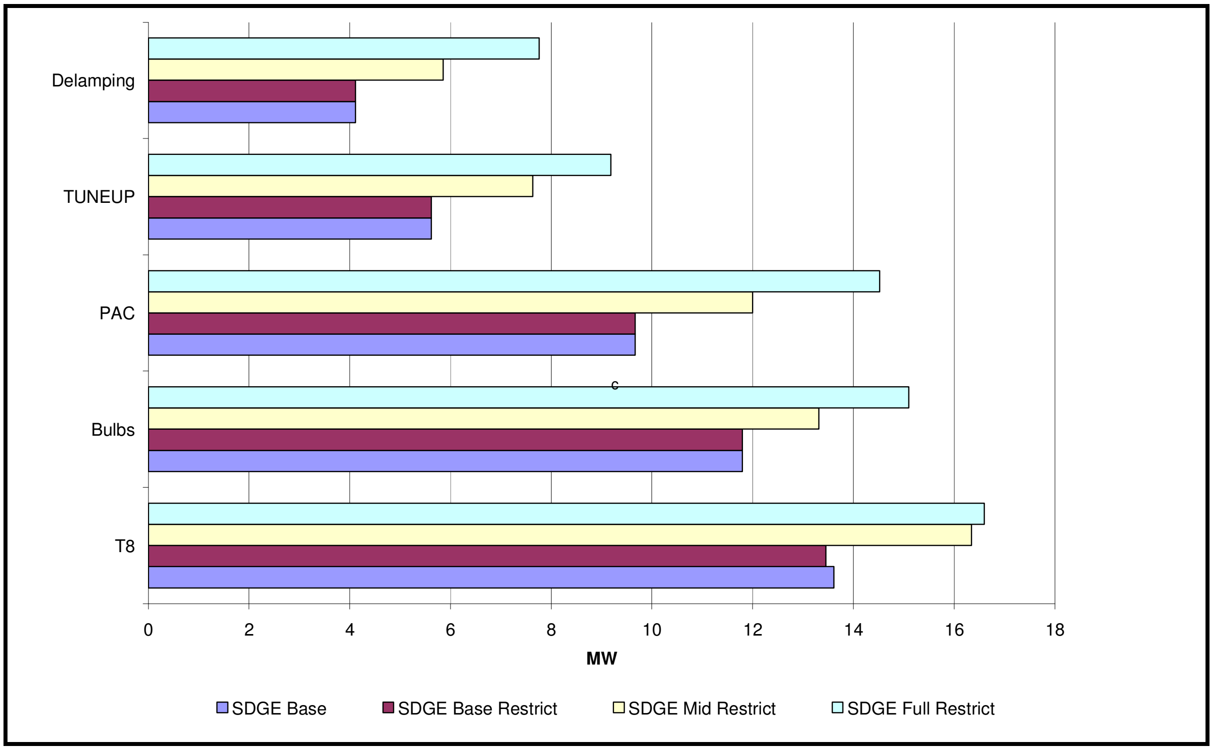
Figure 6-17: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Existing Commercial Buildings – 2007-2016 and 2026 (MW)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-18 illustrates the coincident peak demand savings potential from the top five demand savings measure groups. For SDG&E's existing commercial sector, grouping four-foot and eight-foot T8s into a single measure group results in T8s having the largest measure group potential, closely followed by high efficiency bulbs (grouping all screw-in CFLs and reflectors into a single measure group). The third highest measure group savings for SDG&E's commercial sector is packaged air conditioning units, followed by tune-ups and delamping. The presence of three lighting technology groups in the top five measures is consistent with the finding that lighting potential accounts for about 47% of SDG&E's existing commercial demand potential. The high number of lighting measure groups in SDG&E's top five demand measure grouping differentiates SDG&E's commercial program from those of PG&E and SCE. This difference is largely due to the relatively mild climate in SDG&E's service territory relative to PG&E and SCE's territories. The mild climate reduces the per unit savings impacts of installing high efficiency HVAC measures.

Figure 6-18: SDG&E's Total Market Gross Coincident Peak Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 6-2 for a description of the scenarios.

Utility Costs and Benefits from Electric Energy Efficiency

This subsection lists the present discounted value of costs and benefits and the program TRCs for the three electric IOUs for the commercial market potential scenarios. The results from four scenarios for each IOU are presented in Table 6-19 through Table 6-21. The estimates show that the three utility current electric commercial energy efficiency programs are cost-effective. SDG&E's and SCE's Base scenario-level estimated TRC are very similar at 1.76 and 1.71, respectively. PG&E's estimated Base TRC is 1.3. The Base Restricted TRCs for the three utilities are only slightly higher than their Base values. Restricting the commercial electric portfolio to measures with TRCs > 0.85 does not substantially reduce the TRC value at current (2006) incentive values. As incentives are increased, however, the TRC restrictions become more significant. The TRC for the Mid scenarios (not listed in the tables below) is 1.41 for SDG&E, 1.38 for SCE and 1.07 for PG&E. Increasing incentives leads to increasing adoptions of measures that are not cost effective. The TRCs for the Mid Restricted scenarios are 1.84 for SDG&E, 1.82 for SCE, and 1.59 for PG&E.

Table 6-19: Summary of PG&E's Electric Market Potential Results for Existing Commercial Buildings – 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	260	218	505	1,086
Net Measure Costs	436	310	608	954
Gross Program Costs	124	115	150	188
Net Electric Avoided Cost Benefits	731	674	1,204	1,820
Net Gas Avoided Cost Benefits	0	0	0	0
TRC	1.30	1.59	1.59	1.59

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

Table 6-20: Summary of SCE's Electric Market Potential Results for Existing Commercial Buildings – 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	402	365	815	1,522
Net Measure Costs	532	467	865	1,211
Gross Program Costs	147	142	185	221
Net Electric Avoided Cost Benefits	1,162	1,135	1,915	2,616
Net Gas Avoided Cost Benefits	0	0	0	0
TRC	1.71	1.86	1.82	1.83

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

Table 6-21: Summary of SDG&E's Electric Market Potential Results for Existing Commercial Buildings – 2007-2026

Costs and Benefits in $1,000,00	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	98	91	192	373
Net Measure Costs	129	111	200	293
Gross Program Costs	35	35	43	50
Net Electric Avoided Cost Benefits	289	280	446	624
Net Gas Avoided Cost Benefits	0	0	0	0
TRC	1.76	1.91	1.84	1.82

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

6.3 Gas Efficiency Potential

For the commercial natural gas potential analysis, 17 high efficiency commercial measures were analyzed. The measures are aggregated into three end uses: HVAC, food, and miscellaneous. The miscellaneous end use includes pool heaters, water heating boilers, tank water heaters, solar water heater backups, boiler controllers, and clothes washers.

Market Total Natural Gas Potential in Existing Commercial Buildings

Total IOU Commercial Market Potential

Figure 6-19 presents the total estimated gas usage and potential estimates from the analysis for the state gas IOUs of PG&E, SDG&E, and SCG.[15] The values are provided for the last year of the short-term analysis, 2007-2016.

As shown, total estimated consumption in 2016 is 2,390 million therms. The technical potential for 2007-2016 is 70 million therms and total estimated economic potential is 45 million therms. The Full market scenario from 2007-2016 is 36 million therms.[16] The technical potential is about 3% of expected commercial consumption, the economic potential is about 2%, and the Full incentive potential estimate is approximately 1.5% of estimated natural gas consumption. The Full scenario does not restrict measures by cost-effectiveness.

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[15] California Energy Commission. *2007 Final Natural Gas Market Assessment*. Tables J1, J2, and J3. December 2007.

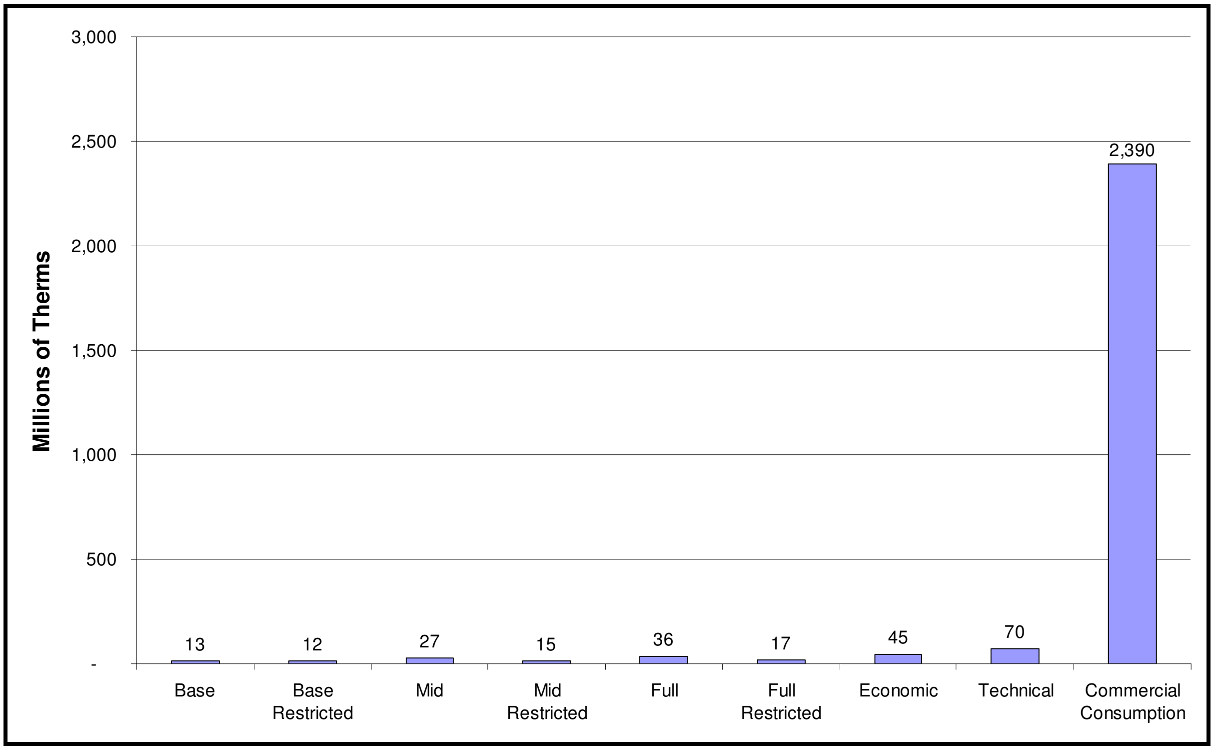
[16] In the Itron 2006 study, total natural gas technical potential was 109 million therms. The three HVAC measures that were eliminated from this study accounted for 38 million therms of the 2006 forecast, leaving the remaining estimate of technical potential approximately equivalent.

Limiting the measures in the Full scenario to those with a TRC $\geq$ 0.85 reduces the Full estimate of potential to 17 million therms or 0.7% of estimated consumption.

The commercial natural gas potential in this analysis is substantially less than the natural gas potential in the Itron 2006 study. The measure list and per unit assumed savings for many measures have been adjusted between the two analyses.[17] The study group for this study decided to eliminate three HVAC measures, which were estimated to have considerable savings in the 2006 analysis. Programmable thermostats were dropped due to the uncertainty surrounding their savings, pipe insulation was eliminated due to the belief that it was now standard practice, and boiler tune-ups were eliminated due to the current lack of IOU program activity for this measure. The elimination of these three HVAC measures has significant impact on the HVAC natural gas potential and needs to be remembered when comparing the results from this study and the 2006 study.

[17] The per unit savings for commercial clothes washers was reduced to be consistent with new standards which increased the base efficiency from an MEF of 1.04 to an MEF of 1.26. The per unit savings for water heating (both storage and instantaneous) was also reduced to be consistent with the 2005 DEER values. These adjustments led to substantially less clothes washer and water heater savings in this analysis when compared with the 2006 study.

Figure 6-19: Estimated Commercial IOU Gas Consumption in 2016, Technical, Economic, and Gross Market Potential for Existing Commercial Buildings – 2007-2016



The estimate of commercial gas consumption is from Tables J1-J3 of the 2007 Final Natural Gas Assessment, CEC Dec 2007. Refer to Table 6-2 for a description of the scenarios.

Table 6-22 presents the natural gas potential estimates by scenario for 2007-2016 and 2007-2026 across all three California IOUs (PG&E, SCG, and SDG&E). Total IOU market potential under the Base scenario is 13 million therms of gross natural gas potential for 2007-2016 and 21 million therms for 2007-2026. The net potential from the Base scenario is 4 million therms for 2007-2016 and 6 million therms for 2007-2026. These savings are the estimated energy savings potential if the IOUs continue their 2006 incentive levels and limit their program offerings to those measures incentivized in their 2004-2005 programs.[18] Increasing incentives to Full incremental costs and expanding the measure list to include a limited number of additional technologies increases the total gross market forecast to 36 million therms for 2007-2016 and 50 million therms for 2007-2026. The net potential estimates from the Full scenario are 26 million therms for 2007-2016 and 35 million therms

[18] The 2004-2005 energy efficiency programs included commercial thermostats. This measure contributed substantially to the claimed commercial programs' natural gas savings. There is substantial uncertainty surrounding the ability of these measures to reduce electric and/or natural gas consumption. This measure has been dropped from the 2006 commercial energy efficiency programs and therefore is not included in this analysis.

for 2007-2026. Limiting technologies in the Full scenario to those with a TRC > 0.85 reduces the potential estimates to 17 million therms of gross potential for 2007-2016 and 7 million therms of net potential for 2007-2016. If program incentives are set halfway between current incentives and full incremental costs (the Mid scenario) estimated gross natural gas gross potential savings are 27 million therms and net savings are 18 million therms for 2007-2016. Extending the forecast to 2007-2026, the Mid scenario estimated the gross potential at 38 millions therms and 23 million therms of net potential.

Table 6-22: Estimated Commercial IOU Total Market Potential by Scenario for Existing Commercial Buildings – 2007-2016 (Millions of Therms)

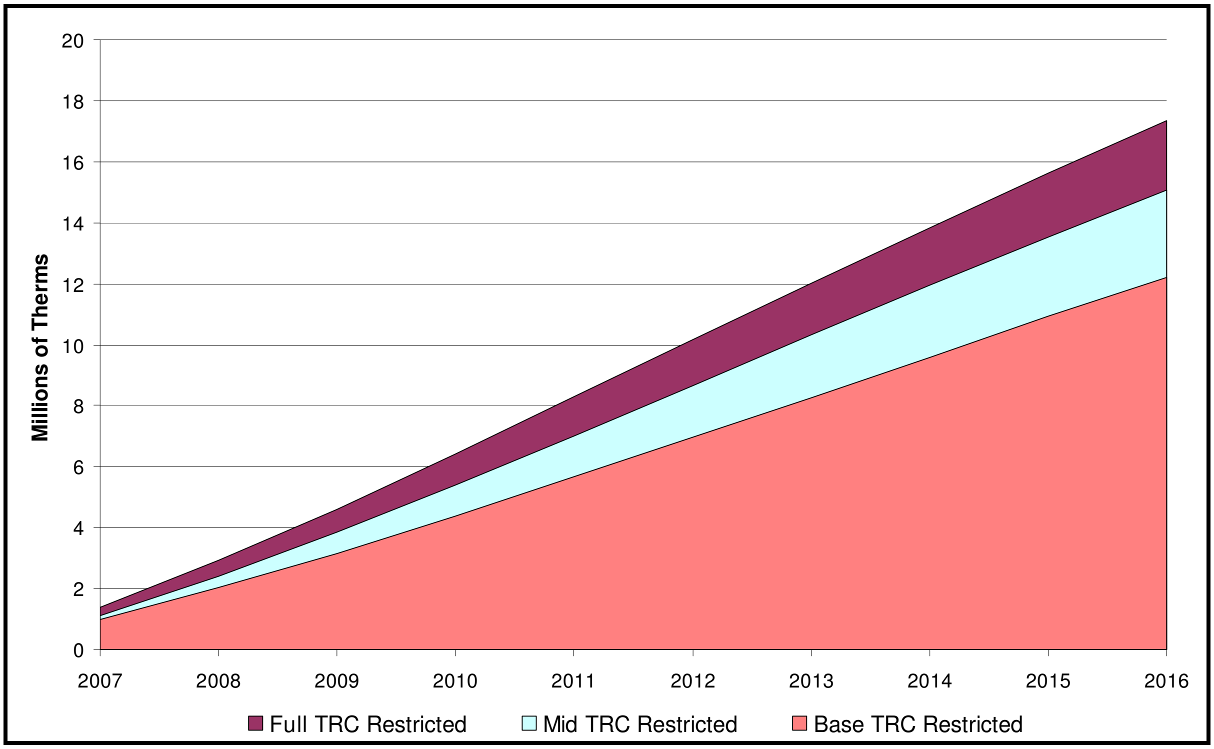
Funding Level	Market Estimates, 2016	Naturally Occurring, 2016	Market Estimates, 2026	Naturally Occurring, 2026
Base	13	9	21	15
Base Restricted	12	9	20	15
Mid	27	9	38	15
Mid Restricted	15	9	24	15
Full	36	10	50	15
Full Restricted	17	10	27	15
Full Gradual	35	10	50	15
Full Restrict Gradual	16	10	27	15

Refer to Table 6-2 for a description of the scenarios.

Table 6-22 also presents potential estimates for a scenario in which the incentive levels were gradually increased from current incentive levels (in 2006) to full incentive levels (by 2010). The results from this scenario indicate that the slower ramp-up of incentives, relative to the jump from 2006 current to 2007 full incentives, leads to a minor loss of potential relative to the Full and Full Restricted scenarios. Given the similarities in these forecasts, the remaining tables and figures will not present the potential estimates for the Full Gradual and the Full Restricted Gradual scenarios.

The results for the TRC Restricted gross market scenarios are illustrated in Figure 6-20. These graphs illustrate the yearly estimates of market potential for the TRC Restricted scenarios.

Figure 6-20: Estimated Commercial IOU Gross Total Energy Market Potential by TRC Restricted Funding Levels for Existing Residential Buildings – 2007-2016 (Millions of Therms)



Refer to Table 6-2 for a description of the scenarios.

Market and Naturally Occurring Potential with Higher Awareness

The natural gas potential model was evaluated under the assumption that the continued expansion of energy efficiency programs and the growing awareness about global warming would lead to a faster increase in the public's awareness and willingness to install energy efficiency measures. To model this possibility, the Base TRC Restricted Higher Awareness scenario assumes a faster growth rate for the awareness than the Base TRC Restricted scenario. In addition, this scenario assumes that the awareness and willingness of the naturally occurring estimate gross at a rate set equal to 75% of the growth rate of the program analysis.[19]

Table 6-23 lists the estimated natural gas savings for the Base Restricted and the Base Restricted with Higher Awareness scenarios. Comparing the 2007-2016 gross market estimate, assuming a higher growth rate of awareness increases the gross potential from 12 million therms to 13 million therms. The additional 1 million therms is an increase in

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[19] In all other scenarios, the awareness and willingness of the naturally occurring estimate is held fixed at the 2007 levels; it is not allowed to grow over time.

potential associated with high levels of knowledge, a substantial benefit to society from increased levels of information. Increasing awareness, however, also leads to an increase in the adoption of high efficiency devices occurring even if there are no energy efficiency rebate programs. The naturally occurring estimate is forecast to grow from 9 million therms to 11 million therms as awareness and willingness to install energy efficiency devices grows. This growth in naturally occurring, however, is dependent on the growth in awareness and willingness that is, at least in part, due to the continuous implementation of energy efficiency programs in California.

Table 6-23: Estimated Commercial IOU Total Market Potential for the Base Restricted and Base Restricted, Higher Awareness Scenarios – 2007-2016 and 2007-2026 (Millions of Therms)

Funding Level	Market Estimates, 2016	Naturally Occurring, 2016	Market Estimates, 2026	Naturally Occurring, 2026
Base Restricted	12	9	20	15
Base Restricted - Higher Awareness	13	11	20	17

Refer to Table 6-2 for a description of the scenarios.

Natural Gas Market Potential by End Use for Existing Commercial Buildings

Table 6-24 and Table 6-25 summarize the market potential results by end use and funding level from 2007 through 2016 and 2026, respectively. For comparison purposes, the end use level technical and economic potential are presented in Figure 6-21. Increasing funding for HVAC measures from the Base scenario to the Mid scenario, increase natural gas potential from 1 million therms to 4 million therms for 2007-2016 and from 3 to 6 million therms for 2007-2016. Increasing funding for miscellaneous measures from the Base to the Full scenario increases natural gas potential by 8 million therms from 2007 through 2016 and by 9 million therms if the analysis is continued from 2007 through 2026.[20] Increasing incentives for the food end use from the Base scenario level to the Full scenario, increases savings from 5 million therms to 16 million therms in 2016, and from 7 to 23 million therms if the analysis is allowed to accumulate through 2026.

[20] The HVAC potential is relatively low, when compared to the 2006 analysis, due to the elimination of thermostats, pipe insulation, and boiler tune-ups. The miscellaneous potential is low relative to the 2006 analysis because food measures have been separated into their own end use, clothes washer per unit savings have been adjusted to account for code changes, and the water heating savings have been reduced to be consistent with DEER 2005.

Table 6-24: Estimated Commercial IOU Total Gross Market and Naturally Occurring Natural Gas Potential by funding Level and End Use for Existing Commercial Buildings – 2007-2016 (Millions of Therms)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	1	1	1	3	2	4	3	1
Misc.	7	7	6	12	8	15	8	7
Food	5	4	3	12	5	16	6	3
Total	13	12	9	27	15	36	17	10

Refer to Table 6-2 for a description of the scenarios.

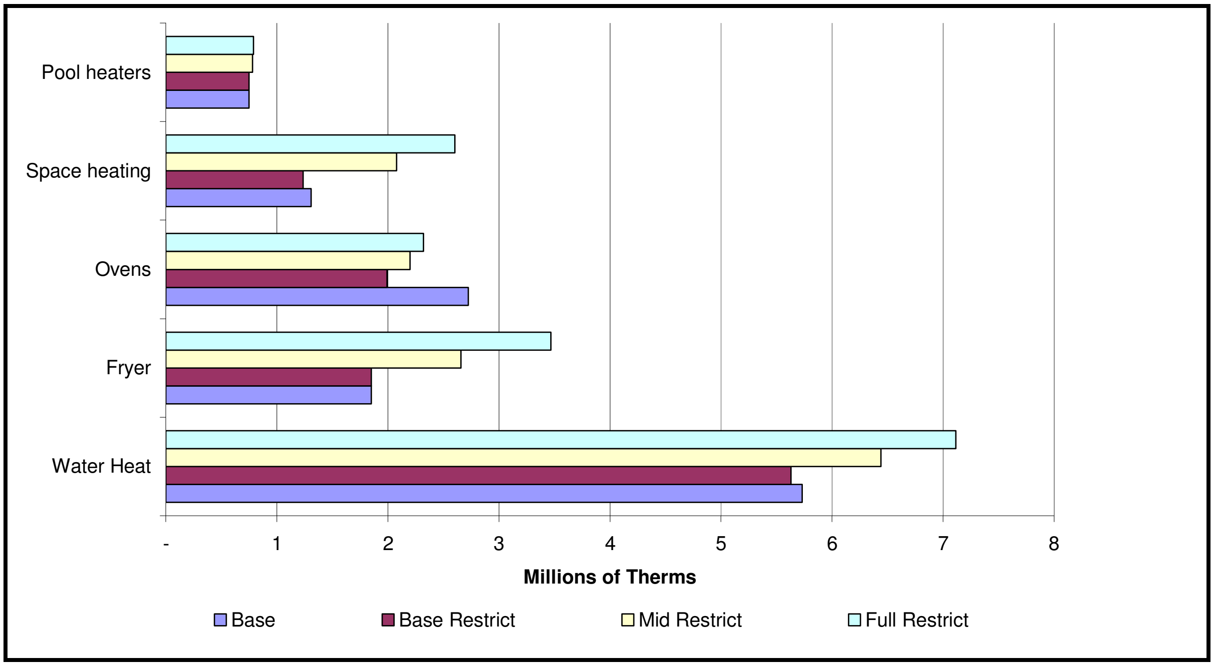
Table 6-25: Estimated Commercial IOU Total Gross Market and Naturally Occurring Natural Gas Potential by funding Level and End Use for Existing Commercial Buildings – 2007-2026 (Millions of Therms)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	3	3	1	6	4	8	5	1
Misc.	11	11	10	16	13	20	14	11
Food	7	6	3	17	7	23	8	3
Total	21	20	15	38	24	50	27	15

Refer to Table 6-2 for a description of the scenarios.

Figure 6-21 lists the total gross market potential for the top five natural gas saving measure groups in 2016. The measure group with the largest potential is water heating measures, including water heating boilers, tank water heaters, instantaneous water heaters, solar water heaters, and clothes washers. The measure group with the second highest natural gas potential is fryers and is limited to a single cooking measure. Closely following the energy savings potential of fryers is ovens, a measure group with two types of gas ovens. The fourth and fifth measure groups are heating and pool heaters, respectively. The heating measure group includes space heating boilers and furnaces.

Figure 6-21: Total California IOU Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 6-2 for a description of the scenarios.

Costs and Benefits from Gas Energy Efficiency

Table 6-26 lists the present discounted value of costs and benefits and the TRC for the commercial gas market potential estimates aggregated across all three California gas IOUs for four scenarios. The Base scenario commercial gas portfolio program for existing buildings is not cost-effective based on the TRC test. If the IOUs continue with their current programs, as estimated by the Base scenario, the aggregated TRC is 0.49. If the IOUs restrict the measures to those with a TRC > 0.85, the aggregated TRC increases to about 1.03. Restricting measures to those with a TRC > 0.85 will lead to a dramatic increase in cost-effectiveness as the measure costs fall significantly and the avoided cost benefits fall less dramatically.

Table 6-26: Summary of California IOU Commercial Gas Market Potential Estimates in Existing Commercial Buildings – 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	23	15	51	100
PDV Net Measure Costs	86	22	55	75
PDV Gross Program Costs	12	9	11	13
PDV Net Ele Avoided Cost Benefit	0	0	0	0
PDV Net Gas Avoided Cost Benefits	48	32	64	90
TRC	0.49	1.03	0.97	1.02

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

Utility-Level Commercial Gas Potential, Benefits, and Costs

In this section, market, technical, and economic potential are presented at the utility level. The utility-specific costs, savings, and TRC test results are listed below. Figure 6-22 through Figure 6-27 illustrate and Table 6-27 through Table 6-29 list the estimates of potential electric energy savings for the various market scenarios for PG&E, SCG, and SDG&E, respectively.

The yearly illustrations of technical and economic potential need to be analyzed carefully. For retrofit and conversion models, the technical potential assumes an instantaneous installation of energy efficiency measures wherever applicable and feasible. For replace-on-burnout models, the technical potential is phased in as the previous measures burn out. Economic potential is similar to technical, with the further consideration of costs. Both the technical and economic potential should be viewed as theoretical constructions that do not reflect the market barriers that must be overcome to achieve voluntary market adoptions. Given the definitions of economic and technical potential, the technical potential illustrated for each utility in 2007 demonstrates what the utility could achieve if it could force all households that could adopt the measure to adopt the measure. Increases in technical potential over time are due to population growth and the burnout of existing measures.

PG&E Potential Natural Gas Savings Forecasts for Existing Commercial Buildings

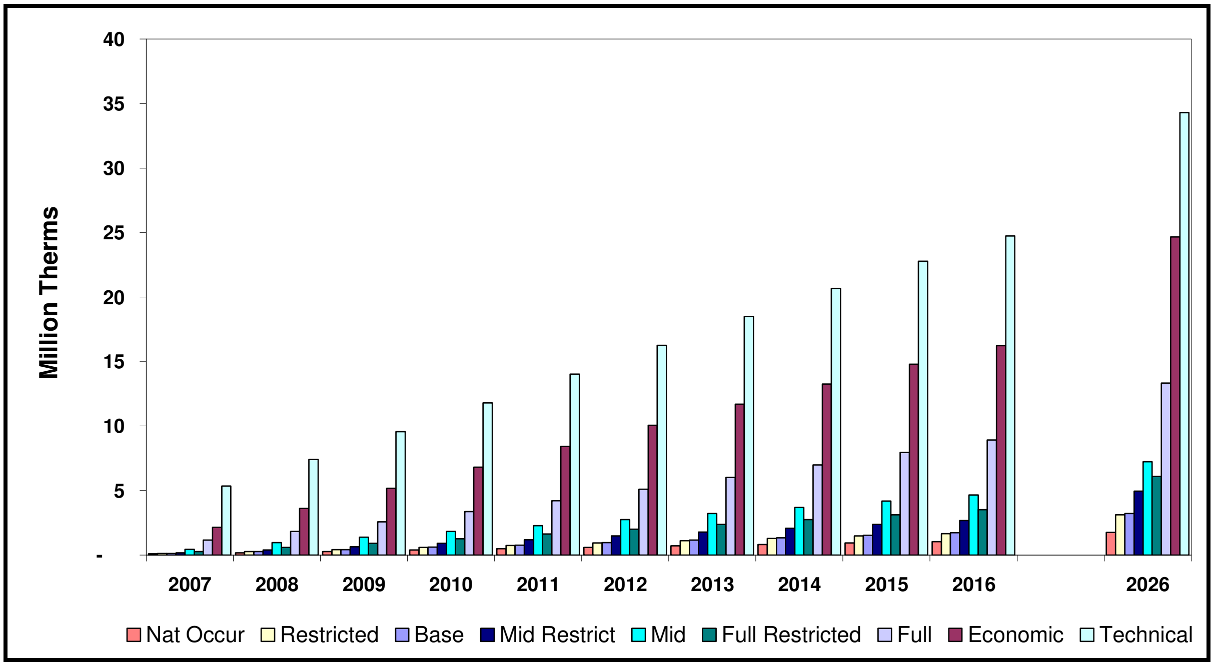
The results in Table 6-27**Error! Reference source not found.** list the natural gas savings potential from existing commercial buildings in PG&E's service territory, while Figure 6-22 illustrates the natural gas estimates. The estimated gross market savings potential under current incentives is 1.73 million therms from 2007 through 2016 and 3.22 million therms from 2007 through 2026, with about 58% of the savings from miscellaneous measures and 41% from HVAC. The Base scenario is calibrated to 2004-2005 program accomplishments, and estimates the potential if these programs continue. Currently, PG&E has a very limited commercial food program, limiting the estimates of the food end uses potential under the Base scenario. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 4.64 millions of therms for 2007-2016 and 7.24 million therms for 2007-2026. Increasing incentives to Full incremental measure cost increases the potential savings to 8.92 million therms for 2007-2016 and 13.33 for 2007-2026. The HVAC savings potential share under the Full scenario is reduced to 24%, while the miscellaneous share is 43% and the food share has increased to 33%.

Table 6-27: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	5.36	2.15	0.13	0.13	0.09	0.13	0.09	0.45	0.16	1.16	0.28	0.47	0.17	0.09
2008	7.41	3.63	0.28	0.26	0.18	0.27	0.19	0.97	0.39	1.84	0.58	1.01	0.40	0.19
2009	9.56	5.18	0.43	0.41	0.28	0.44	0.30	1.39	0.64	2.58	0.91	1.78	0.70	0.30
2010	11.79	6.81	0.60	0.58	0.38	0.62	0.43	1.83	0.91	3.37	1.26	2.66	1.06	0.42
2011	14.02	8.44	0.78	0.75	0.49	0.82	0.56	2.27	1.19	4.21	1.63	3.55	1.43	0.54
2012	16.26	10.07	0.96	0.93	0.60	1.02	0.70	2.74	1.48	5.10	2.00	4.47	1.80	0.67
2013	18.49	11.69	1.15	1.11	0.71	1.23	0.84	3.22	1.78	6.03	2.38	5.42	2.18	0.79
2014	20.68	13.26	1.34	1.29	0.82	1.45	0.98	3.70	2.08	6.99	2.75	6.39	2.56	0.91
2015	22.77	14.80	1.54	1.48	0.93	1.66	1.12	4.17	2.38	7.96	3.13	7.39	2.94	1.03
2016	24.75	16.23	1.73	1.66	1.03	1.88	1.26	4.64	2.68	8.92	3.50	8.39	3.32	1.15
2026	34.30	24.65	3.22	3.13	1.76	3.46	2.31	7.24	4.94	13.33	6.10	13.25	6.01	1.92

Refer to Table 6-2 for a description of the scenarios.

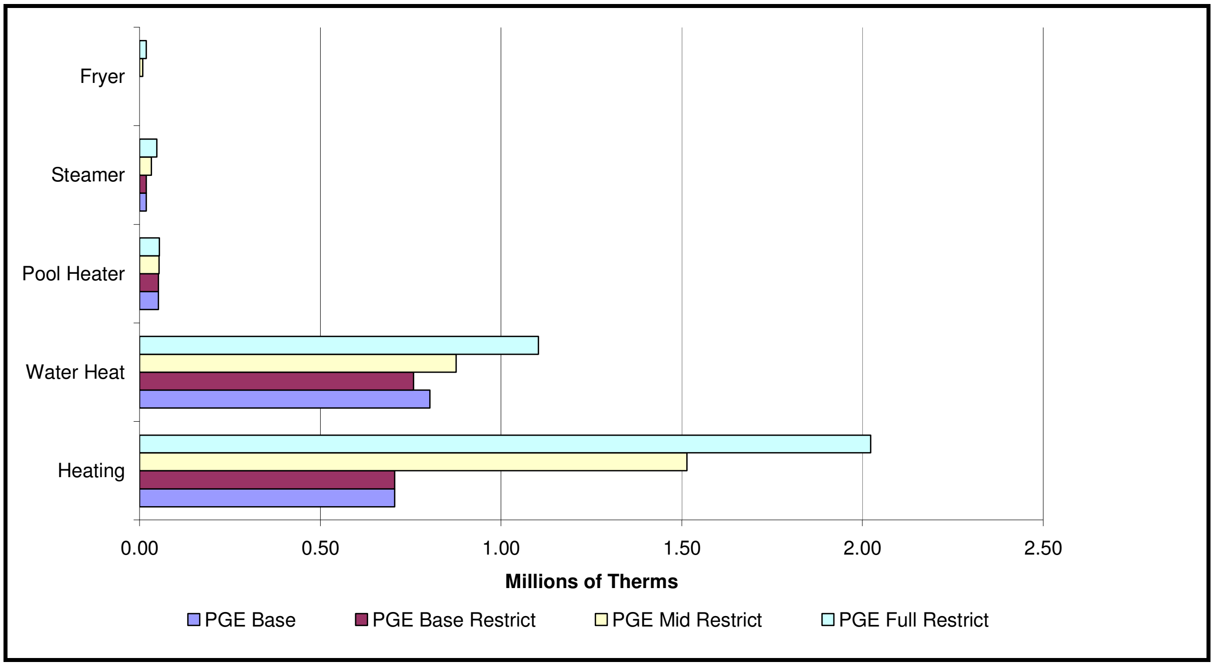
Figure 6-22: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Natural Gas Potential for Existing Commercial Buildings – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-23 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all heating measures into one measure group (space heating boilers and furnaces) illustrates the importance of this measure in PG&E's commercial energy efficiency natural gas program. Water heating measures closely follow heating measures in the quantity of remaining market energy efficiency potential. The remaining three top savings measure groups are pool heaters, steamers, and fryers.

Figure 6-23: PG&E Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 6-2 for a description of the scenarios.

SCG Potential Natural Gas Savings Forecasts for Existing Commercial Buildings

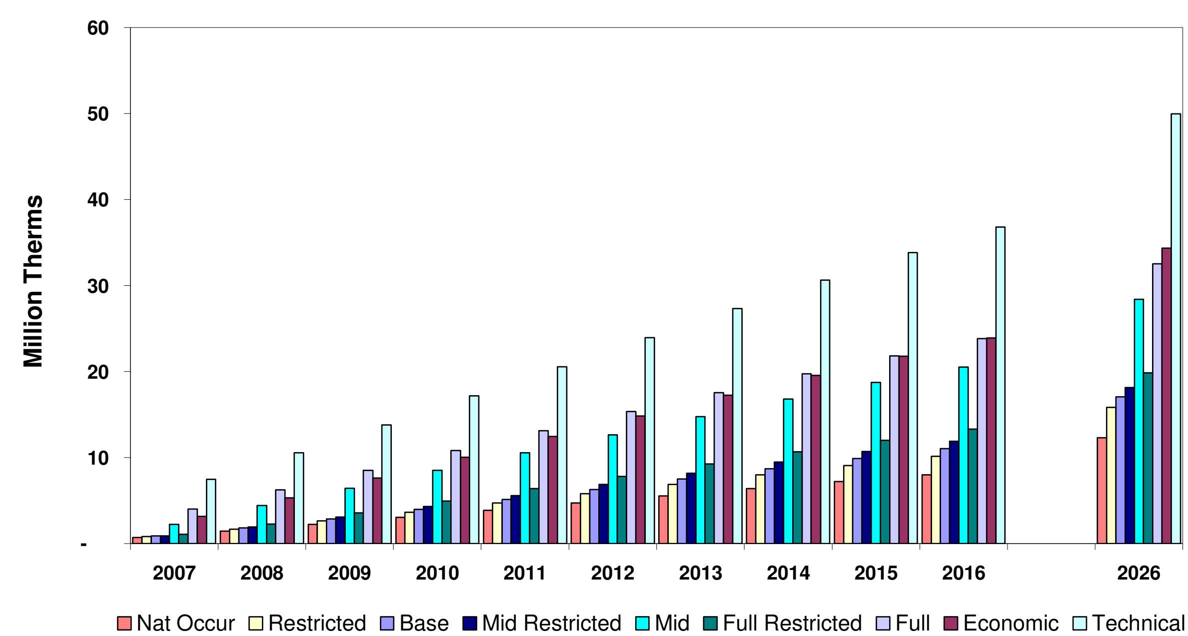
The results in Table 6-28 list the natural gas savings potential from existing commercial buildings in SCG's service territory, while Figure 6-24 illustrates the natural gas potential. The estimated gross market savings potential under current incentives is 11 million therms from 2007 through 2016 and 13 million therms from 2007 through 2026, with the savings split nearly evenly between miscellaneous and food measures and only very limited savings potential in HVAC. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to about 21 million therms for 2007-2016 and 26 million therms for 2007-2026. Increasing incentives to Full incremental measure cost increases the potential savings to 24 million therms for 2007-2016 and 33 for 2007-2026.

Table 6-28: SCG Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	7.45	3.14	0.88	0.81	0.70	0.83	0.74	2.22	0.89	4.01	1.06	2.28	0.91	0.73
2008	10.55	5.31	1.83	1.68	1.43	1.74	1.55	4.41	1.93	6.24	2.24	4.61	2.00	1.52
2009	13.79	7.61	2.86	2.63	2.21	2.76	2.43	6.45	3.07	8.50	3.55	7.38	3.25	2.37
2010	17.17	10.03	3.97	3.65	3.04	3.87	3.39	8.50	4.30	10.82	4.95	10.17	4.66	3.27
2011	20.55	12.44	5.12	4.71	3.87	5.02	4.39	10.55	5.57	13.12	6.39	12.53	6.11	4.17
2012	23.94	14.85	6.29	5.79	4.71	6.18	5.40	12.66	6.88	15.34	7.83	14.77	7.55	5.06
2013	27.33	17.24	7.49	6.88	5.56	7.34	6.40	14.75	8.19	17.55	9.26	17.00	8.98	5.94
2014	30.63	19.56	8.69	7.98	6.39	8.47	7.37	16.80	9.47	19.72	10.66	19.18	10.38	6.80
2015	33.82	21.79	9.90	9.09	7.22	9.56	8.33	18.74	10.72	21.84	12.02	21.32	11.74	7.63
2016	36.80	23.90	11.03	10.13	7.99	10.60	9.22	20.51	11.90	23.82	13.30	23.32	13.03	8.41
2026	49.96	34.34	17.06	15.84	12.31	16.01	14.02	28.40	18.13	32.52	19.83	32.41	19.79	12.68

Refer to Table 6-2 for a description of the scenarios.

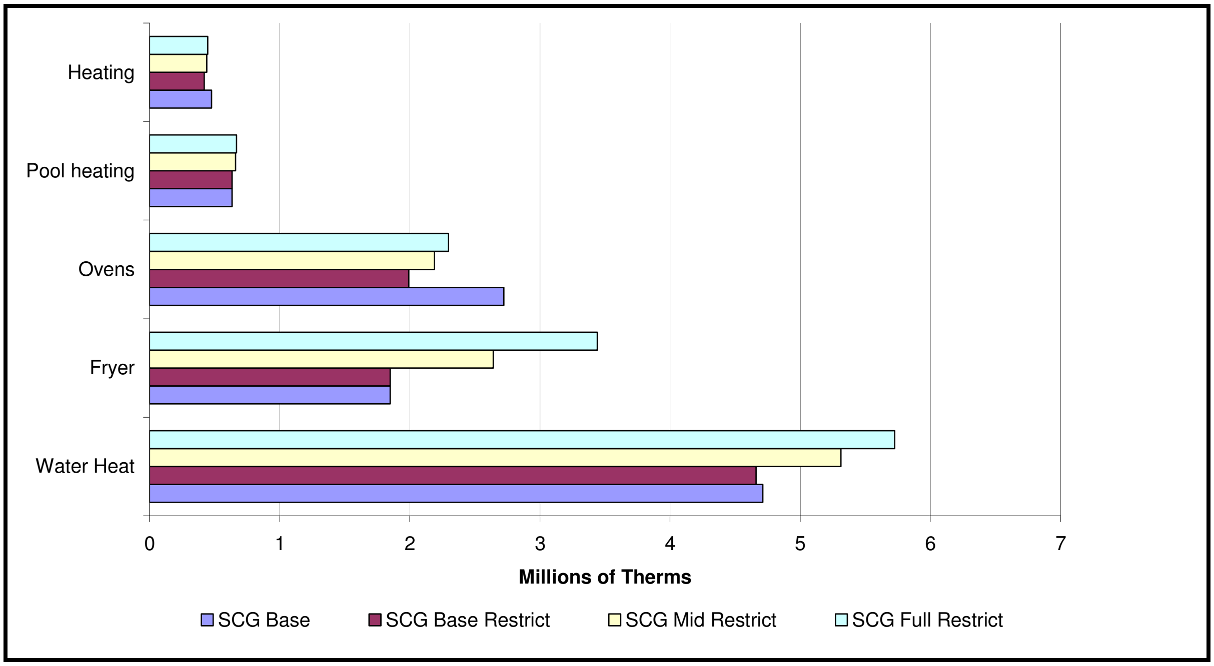
Figure 6-24: Estimated SCG Total Technical, Economic, Gross Market Gas and Naturally Occurring Potential for Existing Commercial Buildings – 2007-2016



Refer to Table 6-2 for a description of the scenarios.

Figure 6-25 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all water heating measures into one measure group (water heating boiler, tank water heaters, instantaneous water heaters, solar water heaters, and clothes washers) illustrates the importance of this measure group in SCG's commercial energy efficiency natural gas program. The second and third measure groups with the highest energy savings potential are fryers and ovens, the fourth is pool heaters, and the fifth is heating

Figure 6-25: SCG Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 6-2 for a description of the scenarios.

SDG&E Potential Gas Savings Forecasts for Existing Commercial Buildings

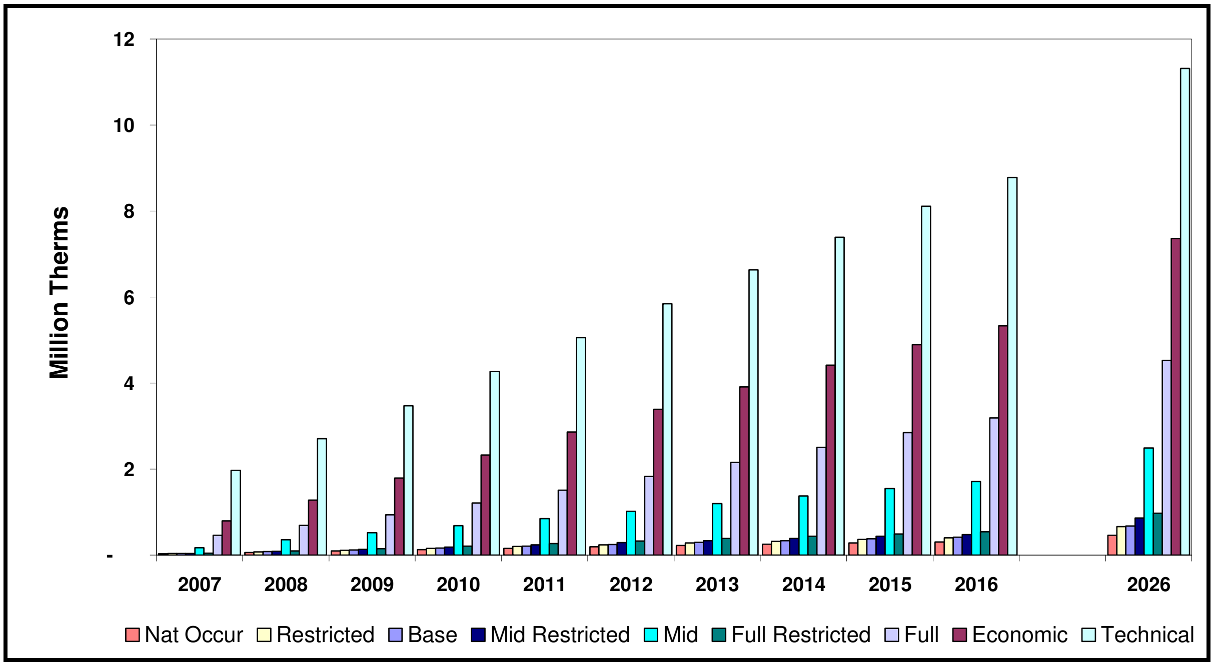
Table 6-1 lists the natural gas potential savings for SDG&E's existing residential sector by end use and scenario. At 2006 incentive levels, the natural gas potential savings is about 0.5 million therms for 2007-2016 and 0.7 million therms for 2007-2026. Increasing incentives to the average between the 2006 level and full incremental measure cost (Mid scenario) is estimated to increase natural gas savings to 1.7 million therms for 2007-2016 and 2.5 million therms for 2007-2026. Further increasing incentive to Full incremental measure costs increases potential savings to about 3.2 million therms for 2007-2016 and 4.5 million therms for 2007-2026. The food end use accounts for about 50% of the natural gas potential under the Full scenario, while miscellaneous accounts for 40% and HVAC about 10%.

Table 6-29: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Commercial Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	1.97	0.80	0.04	0.04	0.03	0.04	0.03	0.17	0.04	0.46	0.05	0.17	0.04	0.03
2008	2.71	1.28	0.08	0.07	0.06	0.08	0.06	0.36	0.08	0.69	0.10	0.38	0.09	0.07
2009	3.47	1.79	0.12	0.11	0.09	0.12	0.10	0.52	0.13	0.94	0.15	0.69	0.14	0.10
2010	4.27	2.33	0.16	0.16	0.13	0.17	0.14	0.68	0.18	1.21	0.21	1.00	0.20	0.14
2011	5.06	2.86	0.21	0.20	0.16	0.21	0.18	0.85	0.24	1.51	0.27	1.30	0.26	0.18
2012	5.85	3.39	0.25	0.24	0.19	0.26	0.22	1.02	0.29	1.83	0.33	1.62	0.32	0.21
2013	6.63	3.91	0.29	0.28	0.22	0.31	0.26	1.20	0.34	2.16	0.38	1.96	0.37	0.25
2014	7.39	4.41	0.34	0.32	0.25	0.35	0.29	1.37	0.39	2.50	0.44	2.30	0.43	0.28
2015	8.12	4.89	0.38	0.36	0.28	0.39	0.33	1.55	0.43	2.85	0.49	2.65	0.48	0.31
2016	8.78	5.34	0.42	0.40	0.31	0.43	0.36	1.71	0.48	3.19	0.54	3.00	0.53	0.33
2026	11.32	7.37	0.68	0.66	0.46	0.69	0.57	2.49	0.86	4.53	0.97	4.51	0.97	0.49

Refer to Table 6-2 for a description of the scenarios.

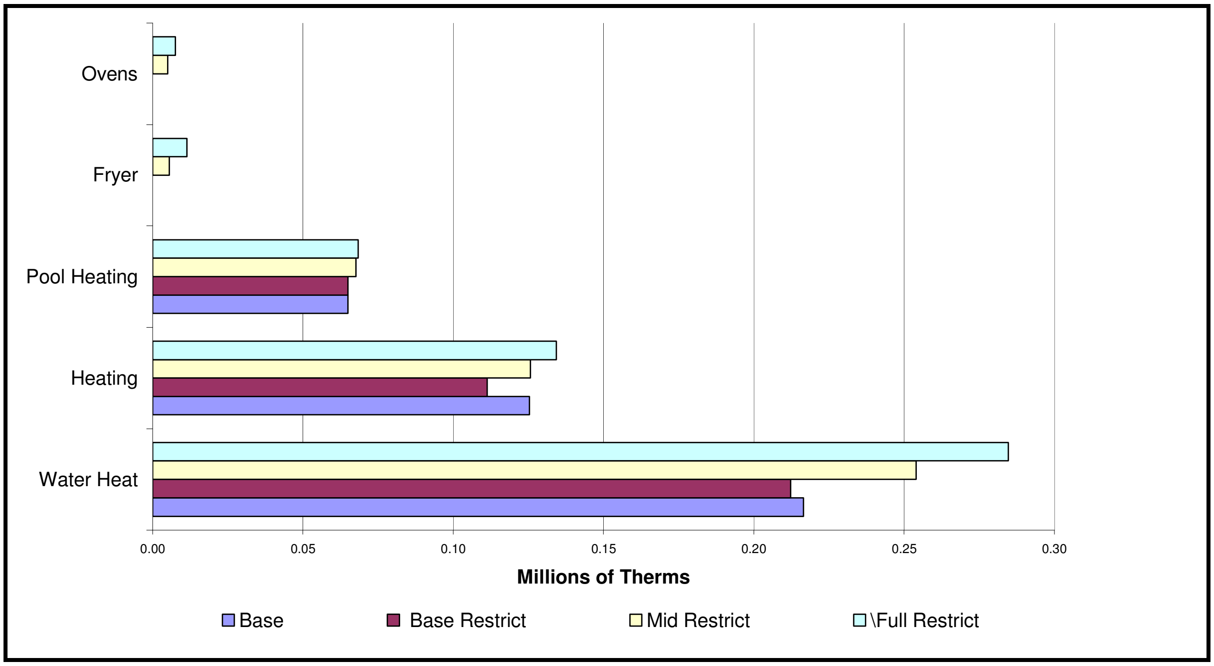
Figure 6-26: Estimated SDG&E Total Technical, Economic, Gross Market and Naturally Occurring Natural Gas Potential for Existing Commercial Buildings – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 6-2 for a description of the scenarios.

Figure 6-27 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all water heating measures into one measure group (water heating boiler, tank water heaters, instantaneous water heaters, solar water heaters, and clothes washers) illustrates the importance of this measure group in SDG&E's commercial energy efficiency natural gas program. The following top four saving measures include heating, pool heating, fryers, and ovens.

Figure 6-27: SDG&E Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 6-2 for a description of the scenarios.

Utility Specific Costs and Benefits from Gas Energy Efficiency

Table 6-30 through Table 6-32 present the IOU-specific present discounted value of costs and benefits and the TRCs for four scenarios in the existing commercial sector. As presented in Table 6-30 and Table 6-32, the commercial gas program is estimated to be cost-effective under the Base scenario for PG&E. The Base scenario estimate of the commercial gas TRC for SDG&E and SCG are 0.88 and 0.41, respectively. The SCG commercial gas program is estimated to be much larger than the programs for the other two IOUs and includes measures that are not present, or for which there are few adoptions, in the programs of the other IOUs. Increasing incentives and restricting the measures to those with a TRC > 0.85 would enable the IOUs to offer nearly cost-effective gas programs.

The TRC restrictions applied do not eliminate non-cost effective measures. Measures that are nearly cost effective will pass the TRC restriction. In addition, the TRC restrictions were applied in the beginning years of the forecast (2007-2010) and then intermittently throughout the forecast period (for example, 2015, 2020, 2025).[21] If a measure passed the TRC

[21] The intermittent nature of the program eligibility tests was necessary given the extended period of the forecast period (20 years). The ASSET software is not equipped to allow twenty separate testing periods. The failure of the program eligibility intermittent testing is due to the spike, followed by the long period of decline in the in the gas avoided costs.

restriction in 2010, the program restriction will continue the measure in the program through 2015, when the measure will be retested. If a measure did not pass the TRC test in 2010, the program restriction would be binding through 2015, when the measure would be re-evaluated for program eligibility. It appears that this form of program eligibility testing within the commercial gas model did not effectively eliminate all non-cost effective measures. Commercial tank water heaters have an average cost effectiveness less than 1 but greater than 0.85 in the early years of the forecast period. Later in the forecast period, however, these measures do not appear to be cost effective, but they are not eliminated from the restricted analysis due to the gaps in the program eligibility test. The cyclical nature of the cost effectiveness of tank water heaters is due to the early spike in gas avoided costs. Gas avoided costs spike in 2008 and then fall gradually, returning to their real 2008 value in 2034 for SDG&E's service territory.

Table 6-30: PG&E Commercial Gas Costs and Benefits in Existing Commercial Buildings – 2007-2026

Costs and benefits in $1,000,00	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	5	4	20	44
PDV Net Measure Costs	11	9	29	41
PDV Gross Program Costs	1	1	2	3
PDV Net Ele Avoided Cost Benefits	0	0	0	0
PDV Net Gas Avoided Cost Benefits	13	12	28	39
TRC	1.00	1.18	0.91	0.91

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

Table 6-31: SCG Commercial Gas Costs and Benefits in Existing Commercial Buildings – 2007-2026

Costs and benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	17	10	28	51
PDV Net Measure Costs	73	12	23	31
PDV Gross Program Costs	10	7	9	10
PDV Net Ele Avoided Cost Benefits	0	0	0	0
PDV Net Gas Avoided Cost Benefits	33	18	33	47
TRC	0.41	0.96	1.05	1.15

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

Table 6-32: SDG&E Commercial Gas Costs and Benefits in Existing Commercial Buildings – 2007-2026

Costs and benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	1.0	0.9	2.6	4.6
PDV Net Measure Costs	1.8	1.4	3.2	3.9
PDV Gross Program Costs	0.2	0.1	0.2	0.2
PDV Net Ele Avoided Cost Benefits	0.0	0.0	0.0	0.0
PDV Net Gas Avoided Cost Benefits	1.8	1.5	2.8	3.7
TRC	0.88	1.02	0.83	0.90

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

6.4 Costs and Benefits for Existing Commercial Buildings

The following subsection lists the costs and benefits associated with the existing commercial energy efficiency programs for the four California IOUs. The costs and benefits are listed first at the statewide level, aggregating the electric and the gas costs and benefits. The separate gas and electric numbers were listed in previous subsections.

Statewide Cost and Benefits for Existing Commercial Building

Table 6-33 presents the statewide present discounted value of costs and benefits for the existing commercial energy efficiency programs under the alternative funding levels and TRC restrictions. The table shows that the forecast of the TRC is greater than 1.0 for all scenarios. The Base scenario, which represents a continuation of the 2004-2005 measures and program incentive levels, has the highest non-restricted TRC. If the existing commercial measures covered by the programs are restricted to measures with TRCs > 0.85, the program-level TRC is approximately 1.75 for the Base, Mid, and Full Restrict scenarios. The slight fall in the TRC between the Base Restricted scenario and the Full and Mid Restricted scenarios indicate that the higher incentive levels have led to the adoption of measures with a slightly lower TRC than in the Base Restricted scenario.

Table 6-33: Summary of California IOU Total IOU Statewide Costs and Benefits for the Existing Commercial Building Sector – 2007-2026

Costs and benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	782	689	1,563	3,081
PDV Net Measure Costs	1,182	911	1,728	2,532
PDV Gross Program Costs	318	300	389	471
PDV Net Electric Avoided Cost Benefits	2,181	2,089	3,565	5,060
PDV Net Gas Avoided Cost Benefits	48	32	64	90
TRC	1.49	1.75	1.71	1.71

Refer to Table 6-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs is the present discounted value of non-incentive program costs.

6.5 Key Existing Commercial Results and Future Research Recommendations

Summary of Key Results for Existing Commercial Buildings

The statewide market potential for electric energy efficiency at the currently funded level (Base scenario) is 3,357 gross GWh for 2007-2016 and 4,189 GWh for 2007-2026. The net Base scenario potential is 1,871 GWh over a 10-year period and 2,404 GWh over the 20-year forecast period. Restricting measures to those with a TRC > 0.85 within the Base scenario leads to a very slight reduction in the Base Restricted scenario (potential of 3,321 GWh for 2007-2016 and 4,138 GWh for 2007-2026). Increasing incentives to a level equal to the mid-point between current incentives and full incremental costs (Mid scenario) is estimated to lead to energy savings of 4,961 GWh from 2007 through 2016 and 5,656 from 2007 through

2026. Further ramping up incentives to cover full incremental measure costs increases gross electric energy potential to 6,552 GWh for 2007-2016 and 7,304 for 2007-2026.

The Base scenario gross market potential estimates for 2007-2016 are 24% of the technical potential and 27% of the economic potential. Extending the forecast to 2007-2026, the Base scenario captures 29% of the technical potential and 33% of the economic potential. The full incremental cost scenario gross market potential estimates for 2007-2016 are 46% of the technical potential and 52% of the economic potential. For 2007-2026, the Full scenario estimates are 51% of the technical and 58% of the economic estimates. These forecasts imply that, even with increasing rebates, market barriers exist that will limit the ability of the IOUs to achieve higher levels of potential savings. Market barriers that the utilities must overcome include, but are not limited to, customer awareness of the energy efficiency measures, customer willingness to install a new type of technology, and vendors' awareness of the measures and their willingness to recommend and install the measures. When comparing the technical and economic potential to the market estimates, it is important to remember the theoretical nature of these estimates. Technical potential is a calculation of the potential associated with the implementation of all feasible and applicable technologies, regardless of market barriers or cost-effectiveness. Economic potential is the calculation of the cost-effective technical potential.

The net-to-gross ratio for the Base incentive scenario is 56% for 2007-2016 and 57% for 2007-2026. The net-to-gross ratio for the Full scenario is 77% for 2007-2016 and 76% for 2007-2026. These estimates of the net-to-gross ratio, however, assume that the base knowledge and willingness of the general population does not change over the forecast period. It is likely, however, that the continuous running of energy efficiency programs by the IOUs and the growing concern about global warming will increase the knowledge and the willingness of the general population to install high efficiency measures. The increase in knowledge and willingness is also likely to lead to an increase in the naturally occurring adoption of high efficiency measures. To simulate this possibility, the team estimated the Base Restricted scenario with a higher level of awareness for the general population. The estimated savings from the Base Restricted scenario is 4,138 GWh for 2007-2016 and the naturally occurring estimate is 1,785, leading to a net savings for 2007-2026 of 2,353 GWh. The estimated savings from the Base Restricted with Higher Awareness in 4,317 GWh for 2007-2026 and the Naturally Occurring estimate is 2,740 GWh, leading to a net savings of 1,577 GWh. The net-to-gross ratio for the Base Restricted scenario for 2007-2026 is 57% while the net-to-gross ratio for the Base Restricted with Higher Awareness scenario is 37%. The estimates from the Higher Awareness scenario indicate that higher levels of awareness will increase the total gross energy efficiency savings for society while reducing the net savings achieved by the utilities. The reduction in net savings, which is tied to the higher awareness, associated with continuous utility programs leads to additional questions concerning the appropriate measure of savings. These questions, and the answers to these questions, are outside the scope of this project.

The Base scenario gross market potential for coincident peak demand reduction is 700 MW over a 10-year period and 926 MW over a 20-year period. The net coincident peak demand potential from the Base scenario is 399 MW for 2007-2016 and 542 MW for 2007-2026. The gross base coincident peak demand potential is 27% of the estimated technical potential and 30% of estimated economic potential for 2007-2016, and 33% of technical potential and 36% of the economic potential for 2007-2026. The ratio of the net base market estimate to estimated technical potential is 15% of estimated technical potential and 17% of estimated economic potential for 2007-2016 while the market to technical ratio is 19% and the market to economic ratio is 21% for 2007-2026. It is important to remember, however, that when comparing net potential to economic and technical potential, additional market savings are occurring and benefiting society.

Increasing incentives to cover full incremental costs increases the gross coincident peak demand potential to 1,338 MW for 2007-2016 and 1,568 MW for 2007-2026. The net full coincident peak demand potential is 1,033 MW for 2007-2016 and 1,181 MW for 2007-2026. The Full market scenario estimate of gross coincident peak demand potential is 52% of estimated technical potential and 59% of estimated economic potential for 2007-2016. Continuing the forecast for 2007-2026 increases the ratio of full market potential to technical potential to 55% and the ratio of full market to economic potential to 62%.

The market potential for gross gas efficiency at the currently funded level (Base scenario) was 13 million therms over a 10-year period and 21 million therms over a 20-year period. The net base potential estimate was 4 million therms over a 10-year period and 6 million therms over a 20-year forecast. The gross base market potential is 19% of estimated technical potential and 29% of estimated economic potential through 2026. Extending the forecast from 2007 to 2026, the base market potential is 22% of technical potential and 32% of economic potential. Ramping up incentives to cover full incremental costs increased the estimates of gross savings to 36 million therms for 2007-2016 and 50 million therms for 2007-2026. The Full market scenario estimate of potential is 51% of estimated technical potential and 80% of estimated economic potential for 2007-2016, and 52% of estimated technical potential and 76% of estimated economic potential for 2007-2026.

Key Considerations for Interpreting Results

The input data for commercial measure technology density and base share are derived from CEUS, an extensive on-site survey of California commercial buildings. The on-site survey began in 2002 and ended in 2005. The use of these data helps to ensure that the input data on the technology density and fuel saturations represent current distributions. The information on the base share of standard and high efficiency measures represents the most recent and best data available. On-site surveys of high efficiency measures, however, can be limited by the surveyors' ability to gather efficiency data. If equipment is placed in inaccessible locations or if the nameplate information is not available, it may not be possible to determine if the equipment is high efficiency or base equipment. If it was not possible to determine efficiency levels, the measures are assumed to be at the base efficiency level. In the future, the high and low efficiency share should be updated using information on the number of high efficiency measures rebated.

Table 6-34: Key Considerations and Uncertainties in the Existing Commercial Sector

End Use	Key Considerations
HVAC	1) **Standards**: New standards for air conditioners were incorporated into the analysis. The start date of the analysis was 2005, when SEER 10 central air conditioners were base technology. In 2007, SEER 13 was the base technology. The change in the base SEER level reduces the forecast incremental savings associated with a SEER 15 high efficiency measure. The model was calibrated to utility program rebates for 13 and 15 SEER air conditioners. While ASSET is designed to automatically incorporate the base technology change, the change in base technology increases the uncertainty associated with the potential estimates. Until additional behavior is observed, it is uncertain how consumers will modify their purchases due to the changes in standards.
	2) **Uncertainty in Cost and Savings**: There were several cooling measures with a high degree of uncertainty in their assumed costs and savings. These include cool roofs, window film, DX tune-ups, and retrocommissioning (RCx). At this time, the cost and savings of these measures are highly uncertain. Each of these measures could be classified as a secondary heating and/or cooling measure. The savings associated with these measures is going to be very dependent on the baseline condition of the existing heating and cooling equipment. DX tune-ups and RCx are not currently in DEER and the savings used in the model were derived from utility workpapers, PAC discussions, and professional judgment. RCx is also highly judgmental in nature; every project is unique making the determination of average per unit savings difficult. Many of the discrete measures included in actual RCx packages are separately modeled within the study. The incremental savings and cost assumptions used within the potential model attempted to eliminate the incremental savings and costs associated with measures already modeled within the analysis.

Table 6-34 (cont'd): Key Considerations and Uncertainties in the Existing Commercial Sector

End Use	Key Considerations
Lighting	1) **Conversion of T12 to T8s**: The lighting potential results are very dependent on the assumptions made concerning the availability of different types of T8s. The previous Itron study modeled T12s converting to first-generation T8s. This study modeled T12s converting to first- and higher generation T8s. The model, however, does not allow first-generation T8s to convert to higher generation T8s. At the time of the study, the utility programs do not support this type of bulb conversion.
	2) **CFL screw-ins and fixtures**: There are substantial potential savings in CFL bulbs and fixtures. The allocation of the potential between screw-ins and fixtures was randomly assigned. The differential costs associated with these measures, however, is significant. At this time, however, it is difficult to determine weather an existing incandescent light will be replaced with a bulb or a fixture.
	3) **CFL Exit lighting**: The savings potential in exit lighting should be viewed with caution. The Itron team believes that the estimated savings potential may be too high. Review of the inputs, however, could find no errors. The group was concerned with the assumption that the utilities will re-incent the measure at the end of it expected useful life. If the incentives are discontinued, the savings potential could be substantially less than estimated.
	4) **Plug Load Motion Sensors**: This measure has significant technical potential; however, sensors on plug loads currently have a very low saturation and are not well understood or accepted by the public. The actual value of savings is very dependent on the equipment applied to the sensor.
	5) **Delamping**: Delamping was modeled as a 4 lamp 4ft T12 fixture delamping to a 2 lamp 4 ft T8 and a 2 lamp 8 ft T12 delamping to a 1 lamp 8ft T8. Delamping from a T12 to a first generation T8 increased the incremental savings relative to the 2006 study, which simply assumed a reduction in T12 lamps with the addition of specular reflectors. Restricting the 4ft delamping measure to fixtures with 4 lamps reduces the potential relative to the 2006 study, which incorporated 3 lamp fixtures in the delamping analysis. The 3 lamp T12s were analyzed in the T12 to T8 measure group for this study.

Table 6-34 (cont'd): Key Considerations and Uncertainties in the Existing Commercial Sector

End Use	Key Considerations
Refrigeration	1) **Complexity and measure saturation uncertainty**: Refrigeration measures encompass both self-contained and remote (built-up) refrigeration systems. For self-contained units, CEUS focused primarily on the type (frozen food, deli, etc.) and capacity-related information and did not ask about energy-efficiency options, so high-efficiency saturations were assumed. For remote refrigeration systems, detailed information–including energy efficiency options–was gathered. However, the complexity of these systems, the variation in actual operation, and the simplified methods that are used for estimating savings for these highly interactive measures lead to a high level of uncertainty.
	2) **Strip curtains**: Currently available working papers for strip curtains are extremely outdated with cost and savings estimates from the early 1990s, which lead to extremely large estimates of savings. Anecdotal evidence also indicates that this measure may be used in ways that limit its effectiveness. Given the on-going research related to this measure, preliminary evidence indicated that the workbook claimed incremental savings were too high. The PAC chooses to limit the incremental savings for this measure given the uncertainty associated with our current understanding.
Office Equipment	1) **Uncertainty of Savings and Measure Saturation**: The model included an 80 plus power supply for computers and a high efficiency copier. The measure saturation associated with these measures is highly uncertain. It is also unclear if these measures need to be included in a potential analysis, or if the highly competitive office equipment business will automatically incorporate the assumed gains in efficiency.
Food	1) **Uncertainty of Savings and Costs**: Several food measures were added to the analysis. The incremental cost and savings are highly uncertain for these measures.
Water Heating	1) **Uncertainty of Solar Water Heating Costs and Savings**: While there currently is significant interest in the savings potential associated with solar water heating, there is very little scientific research on appropriate savings assumptions. This measure is not currently in the DEER database or the utility workbooks. The assumed savings used in this analysis were 1.5 times the savings associated with instantaneous water heaters. Additional research is needed to help determine the appropriate level of savings.
	2) **Standards and Clothes Washers**: The model incorporated recent code changes that apply to clothes washers. These changes increase the base technologies MEF to 1.26 and reduce the allowed water usage. These changes reduce the incremental savings from this measure. It is likely, however, that this measure will be subject to additional code adjustments in the future that were not incorporated into the analysis.

Table 6-34 lists some issues to consider when evaluating the potential savings produced by this analysis. The savings assumptions for some commercial high efficiency measures have a high degree of uncertainty. The savings from programmable thermostats are highly uncertain, leading to this measure being dropped from the IOU programs and this analysis. The savings from HVAC tune-up or refrigerant recharging are also highly uncertain. Tune-ups or refrigerant recharge, however, have not been dropped from the program and were included in the analysis with a more conservative estimate of savings. Other measures with uncertain savings levels include strip curtains, door gaskets, solar water heating backup, daylighting, variable frequency drives, HVAC fan motors, and retrocommissioning. The potential savings estimates from these measures need to be viewed with caution. Future potential studies would benefit from further research on the savings impacts of these measures.

7

Energy Efficiency Potential in Existing Industrial Buildings

This section presents the estimates of industrial energy efficiency potential in existing industrial buildings. Estimates of potential are presented for the period 2007 through 2016, and for 2007 through 2026. Market potential is presented for nine scenarios. The scenarios assume alternative levels of measure incentives, cost-effectiveness tests, and measure awareness. All market results are presented as both gross and net total savings associated with cumulative adoptions over the estimation period.[1] An estimate of industrial consumption, technical potential, and economic potential is presented for comparison purposes.

7.1 Overview

A total of 161 high efficiency industrial measures were analyzed, including 125 electric and 36 gas measures. These measures are all commercially available. In the presentation of results below, measures are aggregated into 11 electric end uses and three gas end uses. Table 7-1 lists the individual measures that correspond to each end use and fuel type in the analysis. All the measures listed in Table 7-1 were analyzed in all scenarios. Measures are organized around base case technologies.[2] For measures modeled as replace-on-burnout, the base case is the minimum energy efficiency standard. For measures modeled as retrofit, the base case is the existing technologies found in California industrial establishments.

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1 The energy savings potential presented in the Itron 2006 forecast were gross savings. The 2006 study did not contain a baseline or naturally occurring estimate. The KEMA 2002/2003 forecasts were reported as net savings with an estimate of naturally occurring savings.

2 A full listing of commercial measures with their base technologies is available in Appendix A.

Table 7-1: Industrial Measure Descriptions

End Use	Measure Description	Fuel Type
CompAir	Compressed_Air-OM	Electric
CompAir	Compressed_Air_Controls	Electric
CompAir	Compressed_Air_System_Optimization	Electric
CompAir	Compressed_AirSizing	Electric
CompAir	Comp_Air_Replace_1-5_HP_motor	Electric
CompAir	Comp_Air_ASD_(1-5_hp)	Electric
CompAir	Comp_Air_Motor_practices-1_(1-5_HP)	Electric
CompAir	Comp_Air_Replace_6-100_HP_motor	Electric
CompAir	Comp_Air_ASD_(6-100_hp)	Electric
CompAir	Comp_Air_Motor_practices-1_(6-100_HP)	Electric
CompAir	Comp_Air_Replace_100+_HP_motor	Electric
CompAir	Comp_Air_ASD_(100+_hp)	Electric
CompAir	Comp_Air_Motor_practices-1_(100+_HP)	Electric
CompAir	Power_recovery	Electric
CompAir	Refinery_Controls	Electric
CompAir	Energy_Star_Transformers_Comp_Air	Electric
Fan	Fans_OM	Electric
Fan	Fans_Controls	Electric
Fan	Fans_System_Optimization	Electric
Fan	FansImprove_components	Electric
Fan	Fans_Replace_1-5_HP_motor	Electric
Fan	Fans_ASD_(1-5_hp)	Electric
Fan	Fans_Motor_practices-1_(1-5_HP)	Electric
Fan	Fans_Replace_6-100_HP_motor	Electric
Fan	Fans_ASD_(6-100_hp)	Electric
Fan	Fans_Motor_practices-1_(6-100_HP)	Electric
Fan	Fans_Replace_100+_HP_motor	Electric
Fan	Fans_ASD_(100+_hp)	Electric
Fan	Fans_Motor_practices-1_(100+_HP)	Electric
Fan	Optimize_drying_process	Electric
Fan	Power_recovery	Electric
Fan	Refinery_Controls	Electric
Fan	Energy_Star_Transformers_Fan	Electric
Pump	Pumps_OM	Electric
Pump	Pumps_Controls	Electric
Pump	Pumps_System_Optimization	Electric
Pump	Pumps_Sizing	Electric
Pump	Pumps_Replace_1-5_HP_motor	Electric
Pump	Pumps_ASD_(1-5_hp)	Electric
Pump	Pumps_Motor_practices-1_(1-5_HP)	Electric
Pump	Pumps_Replace_6-100_HP_motor	Electric
Pump	Pumps_ASD_(6-100_hp)	Electric

Table 7-1 (cont'd.): Industrial Measure Descriptions

End Use	Measure Description	Fuel Type
Pump	Pumps_Motor_practices-1_(6-100_HP)	Electric
Pump	Pumps_Replace_100+_HP_motor	Electric
Pump	Pumps_ASD_(100+_hp)	Electric
Pump	Pumps_Motor_practices-1_(100+_HP)	Electric
Pump	Power_recovery	Electric
Pump	Refinery_Controls	Electric
Pump	Energy_Star_Transformers_Pumps	Electric
Pump	Bakery_Process_(Mixing)_OM	Electric
Pump	OM_drives_spinning_machines	Electric
Pump	Air_conveying_systems	Electric
Pump	Replace_V-Belts	Electric
IndLight	RET_2L4_Premium_T8_1EB	Electric
IndLight	CFL_Hardwired_Modular_36W	Electric
IndLight	Metal_Halide_50W	Electric
IndLight	Occupancy_Sensor_4L4_Fluorescent_Fixtures	Electric
IndLight	Energy_Star_Transformers_Lighting	Electric
IndOther	Replace_V-belts	Electric
IndOther	Membranes_for_wastewater	Electric
IndOther	Energy_Star_Transformers_Other	Electric
Drive	Drives_EE_motor	Electric
Drive	Gap_Forming_papermachine	Electric
Drive	High_Consistency_forming	Electric
Drive	Optimization_control_PM	Electric
Drive	Efficient_practices_printing_press	Electric
Drive	Efficient_Printing_press_(fewer_cylinders)	Electric
Drive	Light_cylinders	Electric
Drive	Efficient_drives	Electric
Drive	Clean_Room_Controls	Electric
Drive	Clean_Room_New_Designs	Electric
Drive	Drives_Process_Controls_(batch_+_site)	Electric
Drive	Process_Drives_ASD	Electric
Drive	OM_Extruders_Injection_Moulding	Electric
Drive	Extruders_injection_Moulding-multipump	Electric
Drive	Direct_drive_Extruders	Electric
Drive	Injection_Moulding_Impulse_Cooling	Electric
Drive	Injection_Moulding_Direct_drive	Electric
Drive	Efficient_grinding	Electric
Drive	Process_control	Electric
Drive	Process_optimization	Electric

Table 7-1 (cont'd.): Industrial Measure Descriptions

End Use	Measure Description	Fuel Type
Drive	Drives_Process_Control	Electric
Drive	Efficient_drives_rolling	Electric
Drive	Drives_Optimization_process_(MT)	Electric
Drive	Drives_Scheduling	Electric
Drive	Machinery	Electric
Drive	Efficient_Machinery	Electric
Drive	Energy_Star_Transformers_Drives	Electric
IndHeat	Bakery_Process	Electric
IndHeat	Drying_(UV_IR)	Electric
IndHeat	Heat_Pumps_Drying	Electric
IndHeat	Top-heating_(glass)	Electric
IndHeat	Efficient_electric_melting	Electric
IndHeat	Intelligent_extruder_(DOE)	Electric
IndHeat	Near_Net_Shape_Casting	Electric
IndHeat	Heating_Process_Control	Electric
IndHeat	Efficient_Curing_ovens	Electric
IndHeat	Heating_Optimization_process_(MT)	Electric
IndHeat	Heating_Scheduling	Electric
IndHeat	Energy_Star_Transformers_Heating	Electric
IndRef	Efficient_Refrigeration_Operations	Electric
IndRef	Optimization_Refrigeration	Electric
IndRef	Energy_Star_Transformers	Electric
IndProcess	Other_Process_Controls_(batch_+_site)	Electric
IndProcess	Efficient_desalter	Electric
IndProcess	New_transformers_welding	Electric
IndProcess	Efficient_processes_(welding_etc.)	Electric
IndProcess	Process_control	Electric
IndProcess	Power_recovery	Electric
IndProcess	Refinery_Controls	Electric
IndProcess	Energy_Star_Transformers_Process	Electric
IndCool	Centrifugal_Chiller_0.51_kW_ton_500_tons	Electric
IndCool	Window_Film_Chiller	Electric
IndCool	EMS_Chiller_	Electric
IndCool	Cool_Roof_Chiller	Electric
IndCool	Chiller_Tune_Up_Diagnostics	Electric
IndCool	Cooling_Circ._Pumps_VSD_	Electric
IndCool	Energy_Star_Transformers	Electric
IndCool	DX_Packaged_System_EER=10.9_10_tons	Electric
IndCool	DX_Tune_Up__Advanced_Diagnostics	Electric

Table 7-1 (cont'd.): Industrial Measure Descriptions

End Use	Measure Description	Fuel Type
IndCool	Window_Film_DX	Electric
IndCool	Evaporative_Pre-Cooler	Electric
IndCool	Prog._Thermostat_DX	Electric
IndCool	Cool_Roof_DX	Electric
IndCool	Energy_Star_Transformers_Cooling	Electric
Boiler	Improved_process_control	Gas
Boiler	Maintain_boilers	Gas
Boiler	Flue_gas_heat_recovery_economizer	Gas
Boiler	Blowdown_steam_heat_recovery	Gas
Boiler	Upgrade_burner_efficiency	Gas
Boiler	Water_treatment	Gas
Boiler	Load_control	Gas
Boiler	Improved_insulation	Gas
Boiler	Steam_trap_maintenance	Gas
Boiler	Automatic_steam_trap_monitoring	Gas
Boiler	Leak_repair	Gas
Boiler	Condensate_return	Gas
HVAC	Boiler_95	Gas
HVAC	Improve_ceiling_insulation	Gas
HVAC	Stack_heat_exchanger	Gas
HVAC	Duct_insulation	Gas
HVAC	EMS_install	Gas
HVAC	EMS_optimization	Gas
Process	Process_Controls_&_Management	Gas
Process	Heat_Recovery	Gas
Process	Efficient_burners	Gas
Process	Process_integration	Gas
Process	Efficient_drying	Gas
Process	Closed_hood	Gas
Process	Extended_nip_press	Gas
Process	Improved_separation_processes	Gas
Process	Thermal_oxidizers	Gas
Process	Flare_gas_controls_and_recovery	Gas
Process	Fouling_control	Gas
Process	Furnace_HE	Gas
Process	Oxyfuel	Gas
Process	Batch_cullet_preheating	Gas
Process	Preventative_maintenance	Gas
Process	Combustion_controls	Gas
Process	Optimize_furnace_operations	Gas
Process	Insulation/reduce_heat_losses	Gas

The analysis was conducted for 16 industrial business segments (SIC codes 20-39 with 21, 31, and 39 grouped together), 21 electric climate zones, and 23 natural gas climate zones (16 CEC Title 24 zones further divided into unique utility service areas).[3] In addition, the analysis of market potential considered nine scenarios. The scenario names and a short description are in Table 7-3.

Table 7-2: Industrial Business Segments

SEGMENT	SEGMENT NAME
SIC20	Food & Kindred Products
SIC22_23	Textiles/Apparel
SIC24_25	Lumber/Furniture
SIC26	Paper & Allied Products
SIC27	Printing & Publishing
SIC28	Chemicals & Allied Products/Industrial Gasses/Plastics
SIC29	Petroleum Refining and Al Other Industrial
SIC30	Rubber/Plastics
SIC32	Stone/Clay/Glass
SIC33	Primary Metals
SIC34	Fabricated Metals
SIC35	Industrial Machinery
SIC36	Electronics
SIC37	Transportation Equipment
SIC38	Instruments
SIC39_21_31	Miscellaneous

[3] The inputs from the industrial analysis were derived from those used in the Itron 2006 study. The industrial sector analysis in the 2006 study was estimated using the ASSYST model and analysis was completed under a separate contract by KEMA-Xenergy. This study has chosen to use the SIC code mapping employed in the 2006 study to ensure consistency of the input data.

Table 7-3: Scenario Descriptions

Scenario Name	Scenario Description
Base Incentive	Includes measures incentivized in the 2004-2005 program year with incentives that were available in 2006.
Mid Incentive	Includes all measures analyzed in the study with incentives half way between those that were available in 2006 and full incremental costs.
Full Incentive	Includes all measures analyzed with incentives set to full incremental costs.
Base Incentive TRC Restricted	Current incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Mid Incentive TRC Restricted	Mid incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Incentive TRC Restricted	Full incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Gradual	Includes all measures analyzed with incentives increasing from 2006 levels to full incremental costs in 2010.
Full Gradual TRC Restricted	Full gradual scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Base TRC Restricted Higher Awareness	The current incentive TRC restricted scenario with a higher level of awareness for both the program and the naturally occurring analysis.

7.2 Electric Efficiency Potential in Existing Industrial Buildings

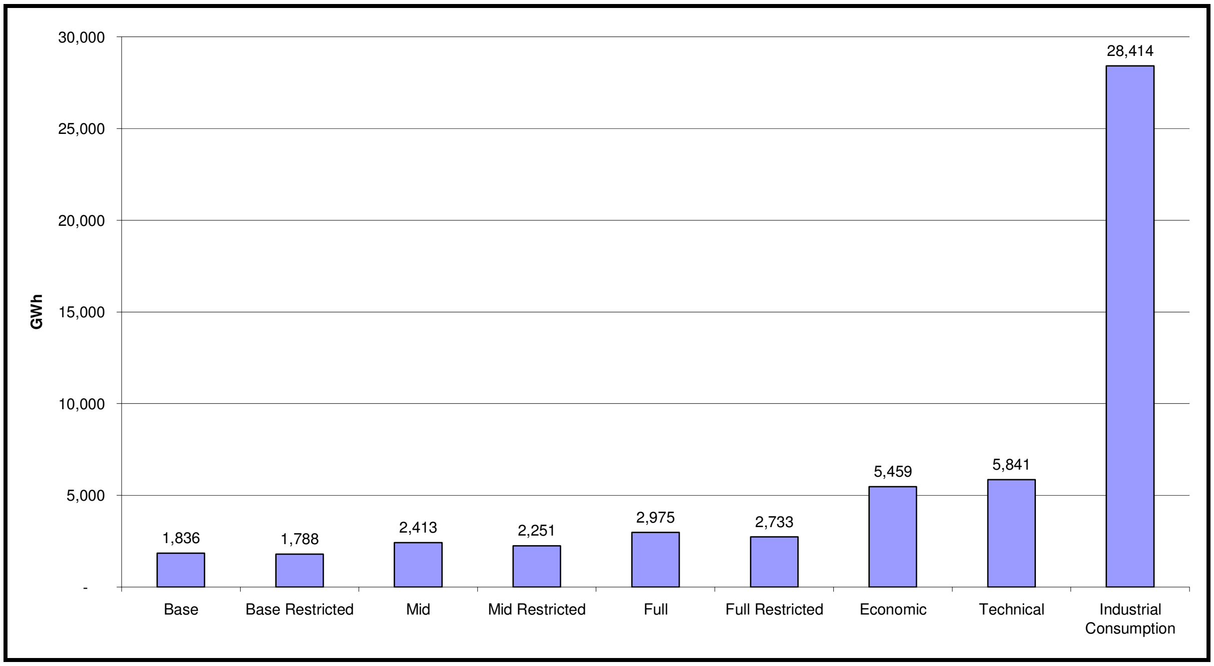
7.2.1 Industrial Market Potential for Energy Efficiency

In this subsection, the results of the analysis of the potential for existing industrial enterprises are presented under the alternative market scenarios. Figure 7-1 and Figure 7-2 present the total estimated market, technical, and economic electric energy and demand savings potential resulting from the analysis for the three state electric IOUs: PG&E, SCE, and SDG&E.[4] Also shown in these figures is the forecasted electricity use and demand for these utilities, as estimated by the CEC.[5] The values are provided for 2016, the last year of the short-run analysis.

4 The energy savings potential presented in this report are at the generation level.

5 California Energy Commission. *California Energy Demand 2008-2018: Staff Energy Demand Forecast.* June 2005.

Figure 7-1: Forecasted California IOU Industrial Electricity Usage in 2016 and Gross Market, Economic, and Technical Potential for Existing Industrial Buildings – 2007-2016 (GWh)



The forecast of industrial consumption uses data from the *California Energy Demand 2008-2018 Staff Revised Forecast* (November 2007). The industrial consumption numbers are derived from a combination of data from Form 1.1b and Form 1.1c. The 2016 industrial consumption numbers are multiplied by the ratio of IOU-specific consumption relative to the total statewide consumption (ratio = .75546). Refer to Table 7-3 for a description of the scenarios.

As shown in Figure 7-1, the total CEC-estimated industrial electric consumption for 2016 is 28,414 GWh. Estimated technical potential for energy savings from 2007 to 2016 is 5,841 GWh and total estimated electric economic potential is 5,459 GWh. The total gross Full incentive potential for 2007-2016 is 2,975 GWh, and current incentive or the Base forecast is 1,836 GWh.[6] The technical potential is about 21% of expected consumptions, the economic potential is about 20%, while the full incentive potential estimate is approximately 10% of expected electric energy consumption. Figure 7-2 shows total estimated industrial coincident peak demand of 5,841 MW. Estimated technical potential for coincident peak demand reduction for 2007-2016 is 944 MW and total estimated economic potential 878 MW. The total gross coincident peak demand potential for 2007-2016 under the Full scenario of 485 MW. The technical potential is about 16% of the expected coincident peak demand in 2016. Economic potential is about 16% and full incentive potential is approximately 8% of coincident peak demand in 2016.

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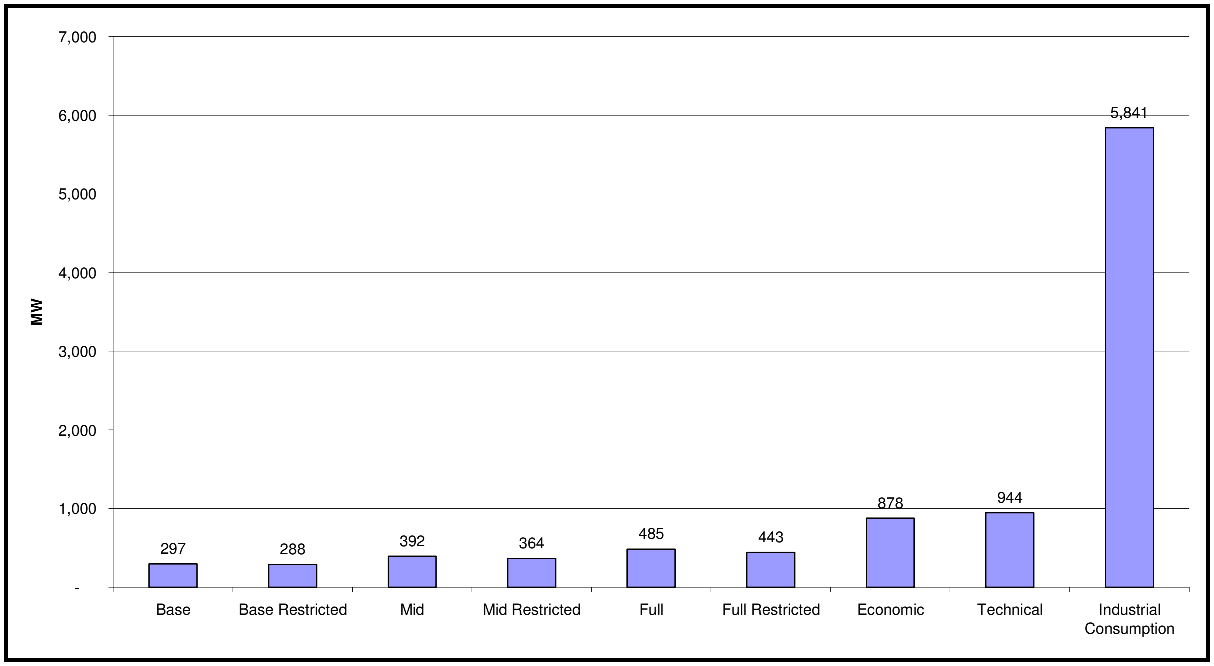
6 The industrial forecast of market, technical, and economic potential uses ASSET's autorep feature for all high efficiency measures. The autorep feature assumes that all high efficiency technologies are automatically re-adopted without an incentive. The re-adoption savings will appear in both the market and the naturally occurring potential, leaving the net savings from these adoptions equal to zero. The autorep feature was used to facilitate comparisons to the ASSYST analysis and to more closely reflect the SPC program implementation policy that does not generally incentivize the re-installation of measures.

Figure 7-2: Forecasted California IOU Industrial Electricity Coincident Peak Demand in 2016 and Gross Market, Economic, and Technical Coincident Peak Demand Potential for Existing Industrial Buildings – 2007-2016 (MW)



The forecast of industrial consumption uses data from the *California Energy Demand 2008-2018 Staff Revised Forecast* (November 2007). The industrial coincident peak demand numbers are derived from a combination of data from Form 1.3 and Form 1.4b. The 2016 industrial coincident peak demand numbers are multiplied by the ratio of IOU-specific coincident peak demand relative to the total statewide coincident peak demand (ratio = .74993). Refer to Table 7-3 for a description of the scenarios.

The total existing industrial market electric potential by scenario, across all three California IOUs, is listed in Table 7-4. Total IOU market potential under the Base scenario is 1,836 GWh of gross energy savings for 2007-2016 and 3,242 GWh through 2026. The net Base potential is 858 GWh for 2007-2016 and 1,539 GWh through 2026. These savings are the estimated energy savings potential if the IOUs continue the 2004-2005 programs. Increasing incentives to Full incremental costs increases the total gross market potential to 2,975 GWh for 2007-2016 and 4,527 GWh for 2007-2026. The Full net potential is 1,997 GWh for 2007-2016 and 2,824 GWh for 2007-2026. If program incentives were set halfway between current incentives and full incremental costs (the Mid scenario), estimate gross energy savings potential is 2,413 for 2007-2016 and net energy savings potential is 1,435 GWh for 2007-2016.

Limiting measures to those that are cost-effective makes only a modest reduction in savings in the Base Restrict scenario (48 GWh or 2% reduction) for 2007-2016, but leads to a slightly larger reduction in the Mid Restrict (162 GWh or 6%) and Full Restrict (242 GWh or 7%) scenarios for 2007-2016. Increasing incentives above their Base level leads to only small increases in the adoption of non-cost-effective measures within the existing industrial sector.

Total IOU market coincident peak demand potential is also listed in Table 7-4. The total IOU gross existing industrial market coincident peak demand potential under the Base scenario is 297 MW for 2007-2016 and 524 MW for 2007-2026. The Base net potential is 141 MW for 2007-2016 and 254 MW for 2007-2026. The Base gross and net savings potential implies a net-to-gross (NTG) ratio of 46% in 2016. The estimated NTG ratio is significantly lower than those ratios estimated in the KEMA industrial forecast of potential, which was included in the Itron 2006 study and KEMA's 2002/2003 analysis. The lower estimate, however, is consistent with more recent information which indicates that industrial customers are increasingly aware of cost-effective energy saving devices and that these customers are willing to install measures without a rebate if the measures are cost-effective for their businesses.

Increasing incentives to the halfway point between current and full incremental cost incentives increases the estimate of gross coincident peak demand potential to 392 MW for 2007-2016 and 639 MW for 2007-2026, and the Mid net estimate to 236 MW for 2007-2016 and 467 MW for 2007-2026. Further increasing incentives to Full incremental measure cost increases gross industrial coincident peak demand potential to 485 MW for 2007-2016 and net potential to 329 MW. Restricting incentivized measures to those that are cost-effective reduces net Base coincident demand potential to 132 MW for 2007-2016, the Mid incentive net coincident demand potential to 208 MW, and the Full incentive net coincident demand potential to 297 MW.

Table 7-4: Estimated California IOU Total Market and Naturally Occurring Potential by Scenario for Existing Industrial Buildings – 2007-2016 and 2007-2026(GWh and MW)

Scenario	Gross Energy (GWh, 2016)	Naturally Occurring Energy (GWh, 2016)	Coin. Peak Demand (MW, 2016)	Naturally Occurring Coin. Peak Demand (MW, 2016)	Gross Energy (GWh, 2026)	Naturally Occurring Energy (GWh, 2026)	Coin. Peak Demand (MW, 2026)	Naturally Occurring Coin. Peak Demand (MW, 2026)
Base	1,836	978	297	156	3,242	1,703	524	272
Base Restricted	1,788	978	288	156	3,163	1,703	511	272
Mid	2,413	978	392	156	3,937	1,703	639	272
Mid Restricted	2,251	978	364	156	3,741	1,703	605	272
Full	2,975	978	485	156	4,527	1,703	736	272
Full Restricted	2,733	978	443	156	4,265	1,703	690	272
Full Gradual	2,844	978	464	156	4,462	1,703	726	272
Full Restrict Gradual	2,616	978	424	156	4,205	1,703	680	272

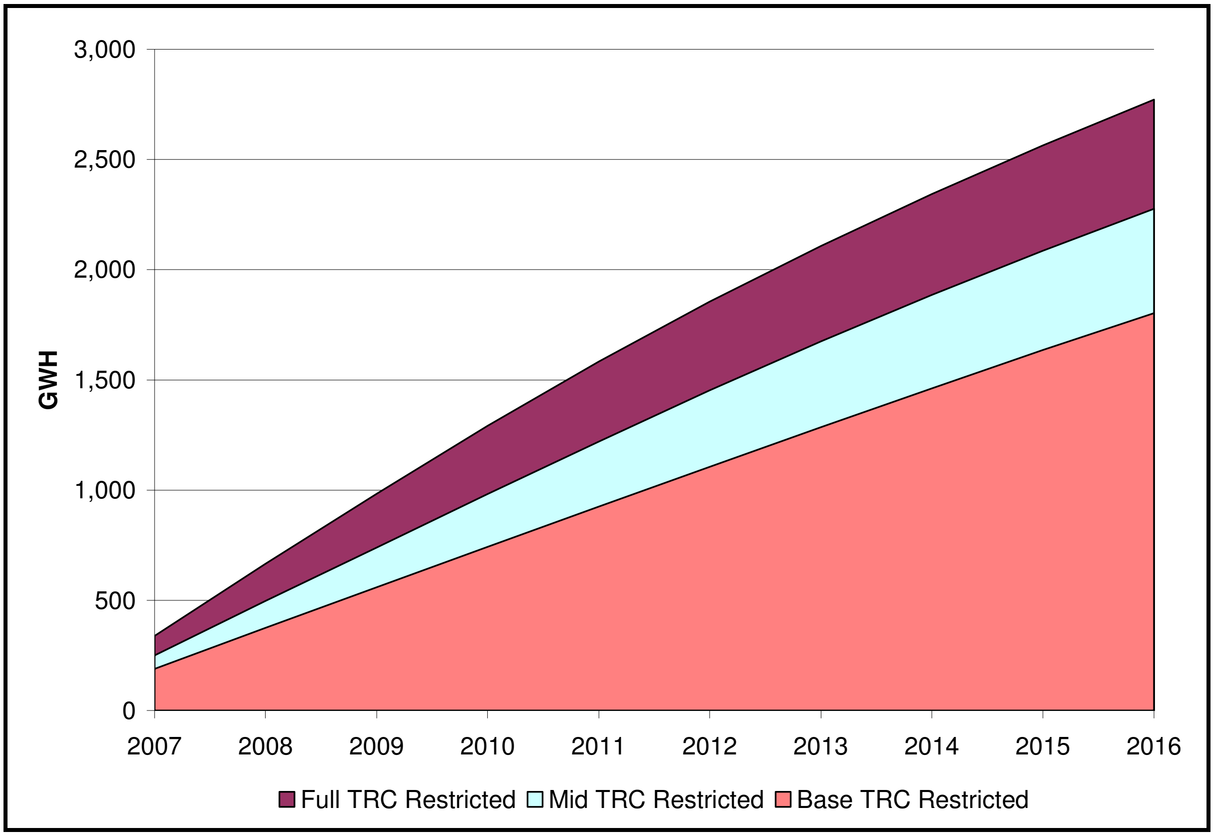
Refer to Table 7-3 for a description of the scenarios.

Table 7-4 also presents potential estimates for a scenario in which the incentives levels were gradually increased from current incentive levels (in 2006) to full incentive levels (by 2010). The results from this scenario (Full Gradual and the Full Restrict Gradual) indicate that the slower ramp-up of incentives, when compared to the instantaneous jump from current incentives in 2006 to full incentives in 2007, leads to only a minor loss in potential relative to the Full scenario.

The results for the TRC Restricted gross market scenarios are illustrated in Figure 7-3 and Figure 7-4. These graphs illustrate the yearly estimate of TRC restricted market potential from cumulative adoptions from 2007 to 2016.[7]

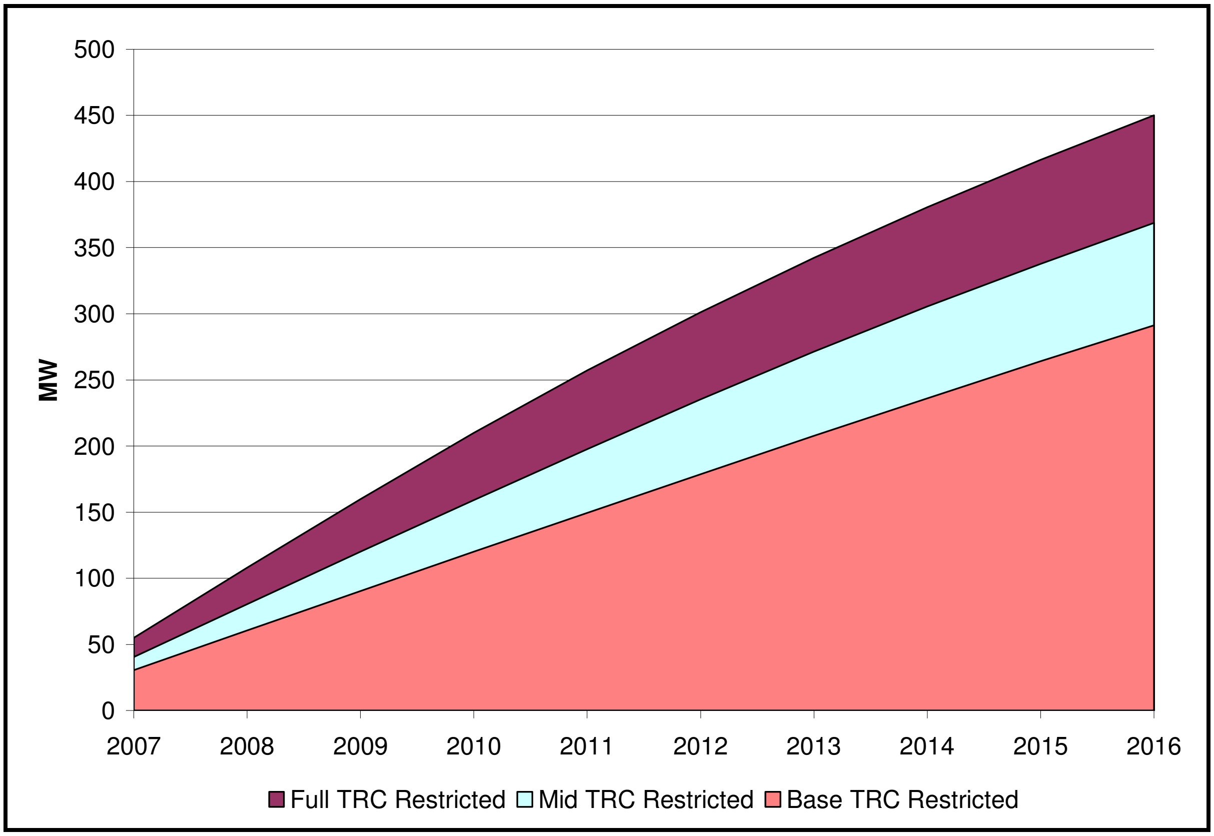
[7] The results presented in these figures are gross market savings estimates. The savings estimates have not been reduced by the naturally occurring estimate of savings.

Figure 7-3: Estimated California IOU Gross Total Energy Market Potential by TRC Restricted Funding Levels for Existing Industrial Buildings – 2007-2016 (GWh)



Refer to Table 7-3 for a description of the scenarios.

Figure 7-4: Estimated California IOU Gross Total Coincident Peak Demand Market Potential by TRC Restricted Funding Levels for Existing Industrial Buildings – 2007-2016 (MW)



Refer to Table 7-3 for a description of the scenarios.

Market and Naturally Occurring Potential with Higher Awareness

Voluntary energy efficiency programs have been used to encourage Californians to adopt efficiency technologies for approximately three decades. During this period, their basic knowledge of energy efficiency measures and their willingness to install these measures has grown. The ongoing emphasis on expanding energy efficiency savings, and the growing public concern about global warming, may lead to a faster future growth in the awareness and willingness of consumers to adopt energy efficiency devices. In particular, it may lead to an increase in the awareness of efficiency measures and willingness of customers to adopt these measures without receiving rebates. To model this possibility, the Base TRC Restricted Higher Awareness scenario assumes a faster growth rate for the awareness than in the Base TRC Restricted scenario. In addition, this scenario assumes that the awareness and willingness of the naturally occurring estimate grows at a rate set equal to 75% of the growth rate of the program analysis.[8]

Table 7-5 lists the estimated electric savings for the Base TRC Restricted with Higher Awareness scenario. Comparing the 2007-2016 market energy potential with the Base TRC Restricted estimates presented in Table 7-4, the gross market energy savings with higher awareness increased by 110 GWh or about 6%, while the naturally occurring energy savings increased by 202 GWh or 17%. The large increase in the naturally occurring estimate leads to a reduction in the net-to-gross ratio. The net-to-gross ratio for the Base TRC Restricted scenario is about 46% in 2016, while the net-to-gross for the Base TRC Restricted Higher Awareness scenario is approximately 36%.

Table 7-5: Estimated California IOU Total Market Potential for the Base, TRC Restricted with Higher Awareness for Existing Industrial Buildings – 2007-2016 and 2007-2026 (GWh and MW)

	Gross Base TRC Restricted Higher Awareness 2016	Naturally Occurring Base TRC Restricted Higher Awareness, 2016	Gross Base TRC Restricted Higher Awareness, 2026	Naturally Occurring Base TRC Restricted Higher Awareness, 2026
GWh	1,898	1,180	3,315	2,098
MW	306	187	536	334

Refer to Table 7-3 for a description of the scenarios.

Market Potential by End Use for Existing Industrial Buildings

Table 7-6 and Table 7-7 summarize the energy market potential estimates by funding level and end use for 2007-2016 and 2007-2026, respectively. Table 7-8 and Table 7-9 present similar results for coincident peak demand reduction. Increasing funding for all end uses from current funding levels to full incremental cost increases gross energy savings by 61% through 2016 and about 40% through 2026. Increasing funding for industrial programs from the Base level funding to the Full incremental cost level increases potential for compressed air measures by 25%, pumps by 36% and lighting measures by 94% through 2016. Increasing incentives from the Base level to Full incremental cost incentives increases the estimates of energy potential for fans by 82%, cooling measures by 228%, and refrigeration measures by 30% through 2016.

8 In all other scenarios, the awareness and willingness of the naturally occurring estimate is held fixed; it does not grow. For the Base TRC Restricted Higher Awareness scenario, the growing awareness and willingness for the naturally occurring analysis is intended to reflect the possible influence of market effects and growing awareness of global warming on the probability of adoption outside the program. The awareness and willingness of the naturally occurring estimate is never allowed to exceed 95%. The awareness and willingness of the program estimate commonly reaches 100% prior to the end of the forecast period.

Table 7-6: Estimated California IOU Total Gross Market and Naturally Occurring Energy Potential by Funding Level and End Use for Existing Industrial Buildings – 2007-2016 (GWh)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
Compressed Air	358	355	267	407	398	447	435	267
Fans	154	153	60	209	206	279	271	60
Drives	107	99	60	165	141	212	184	60
Pump	695	694	310	816	815	948	945	310
Lighting	368	360	199	544	526	712	693	199
Other	0.51	0.51	0.27	0.81	0.81	1.20	1.20	0.27
Cooling	59	32	23	151	43	230	59	23
Process	10	10	7	14	14	18	18	7
Heating	35	35	21	48	48	63	63	21
Refrigeration	49	49	31	59	59	64	64	31
Total	1,836	1,788	978	2,413	2,251	2,975	2,733	978

Refer to Table 7-3 for a description of the scenarios.

Table 7-7: Estimated California IOU Total Gross Market and Naturally Occurring Energy Potential by Funding Level and End Use for Existing Industrial Buildings – 2007-2026 (GWh)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
Compressed Air	629	624	446	681	670	725	710	446
Fans	291	290	111	377	372	478	464	111
Drives	189	178	108	253	233	295	280	108
Pump	1,248	1,248	552	1,425	1,423	1,608	1,602	552
Lighting	619	608	340	796	779	913	896	340
Other	0.98	0.98	0.51	1.44	1.44	1.95	1.95	0.51
Cooling	117	69	50	230	89	310	115	50
Process	20	20	12	25	25	31	31	12
Heating	61	61	38	79	79	93	93	38
Refrigeration	66	66	45	70	70	71	71	45
Total	3,242	3,163	1,703	3,937	3,741	4,527	4,265	1,703

Refer to Table 7-3 for a description of the scenarios

The distribution of market energy savings potential by end use indicates that the largest end use potential for the existing industrial sector is in the pumping end use, accounting for about 35% of energy saving potential. In addition, approximately 20% of the Base scenario's energy savings potential is in both lighting and compressed air measures.

Table 7-8: Estimated California IOU Total Gross Market and Naturally Occurring Coincident Peak Demand Potential by Funding Level and End Use for Existing Industrial Buildings – 2007-2016 (MW)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
Compressed Air	48	48	36	55	53	60	59	36
Fans	20	20	8	27	27	36	35	8
Drives	14	13	8	21	18	27	24	8
Pump	125	125	56	147	147	171	170	56
IndLight	66	65	36	98	95	128	125	36
IndOther	0.07	0.07	0.04	0.11	0.11	0.16	0.16	0.04
IndCooling	11	6	4	28	8	43	11	4
IndProcess	1	1	1	2	2	2	2	1
IndHeating	5	5	3	6	6	9	9	3
IndRefrigeration	7	7	4	8	8	9	9	4
Total	**297**	**288**	**156**	**392**	**364**	**485**	**443**	**156**

Refer to Table 7-3 for a description of the scenarios.

Table 7-9: Estimated California IOU Total Gross and Naturally Occurring and Market Coincident Peak Demand Potential by Funding Level and End Use for Existing Industrial Buildings – 2007-2026 (MW)

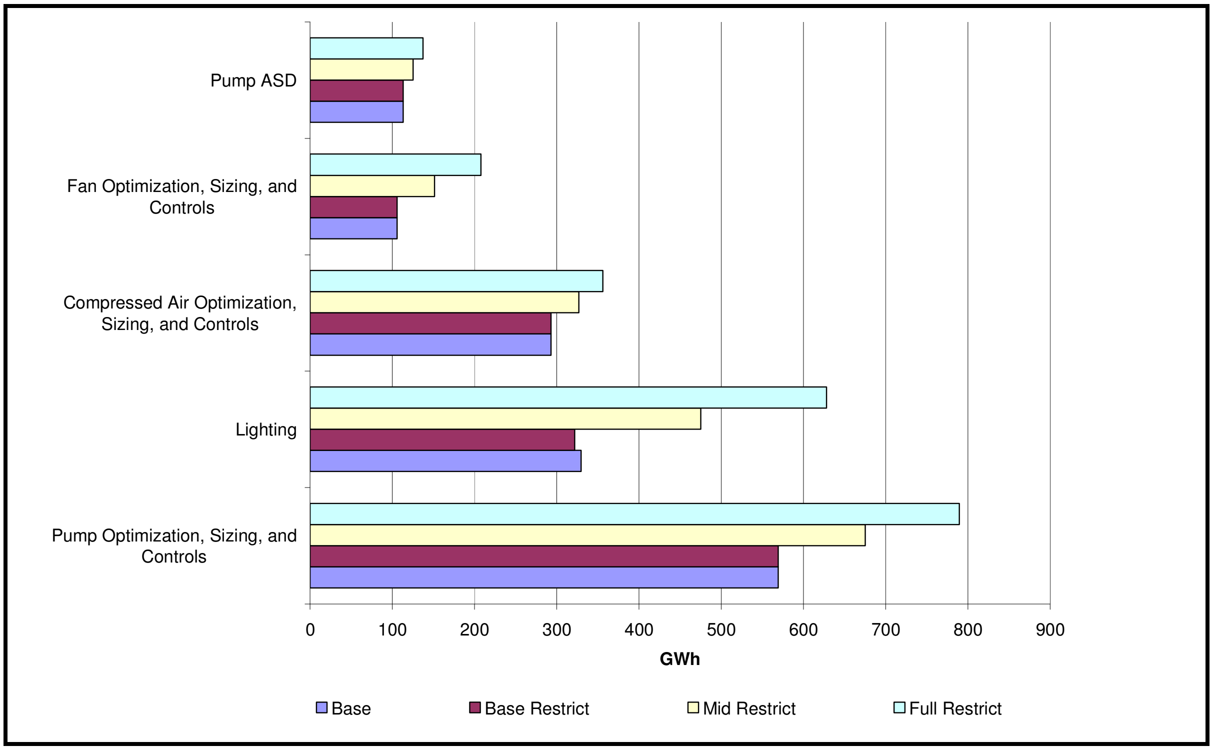
	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
Compressed Air	85	84	60	92	90	97	95	60
Fans	38	38	15	49	48	62	60	15
Drives	24	23	14	32	30	38	36	14
Pump	225	224	100	257	256	290	289	100
IndLight	111	109	61	143	140	164	162	61
IndOther	0.13	0.13	0.07	0.19	0.19	0.26	0.26	0.07
IndCooling	22	13	9	43	17	59	22	9
IndProcess	3	3	2	3	3	4	4	2
IndHeating	8	8	5	11	11	13	13	5
IndRefrigeration	9	9	6	9	9	9	9	6
Total	**524**	**511**	**272**	**639**	**605**	**736**	**690**	**272**

Refer to Table 7-3 for a description of the scenarios.

Figure 7-5 and Figure 7-6 present estimates of total market gross potential at the grouped measure level for the top five savings measures. The measure groups are ordered according to their potential from the Mid TRC Restricted market scenario. As shown in these figures, grouping all pump optimization, control, maintenance, and sizing measures into a single measure group results in this measure group having the highest energy and demand potential.

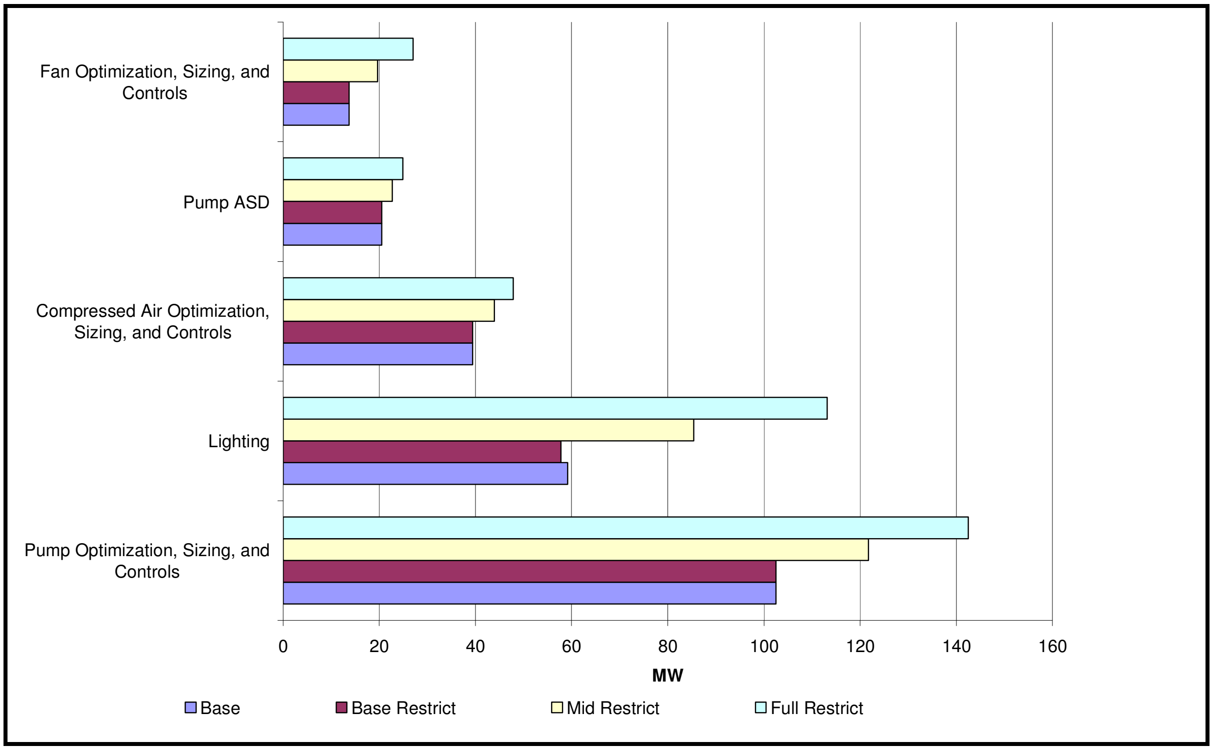
Grouping lighting measures other than sensors and controls into one measure group results in these measures contributing the second highest savings potential within the existing industrial sector. Compressed air and fan optimization, sizing, maintenance, and control are the third and fourth highest potential energy saving measure groups, followed by pump ASD measures.

Figure 7-5: Total California IOU Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 7-3 for a description of the scenarios.

Figure 7-6: Total California IOU Market Gross Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 7-3 for a description of the scenarios.

7.2.2 Electric Cost and Benefit Results for Existing Industrial Buildings

Table 7-10 presents a summary of the present discounted value of costs and savings and the benefit-to-cost ratios for four of the market potential funding scenarios.

Table 7-10: Summary of the California IOU Electric Market Potential Results by Scenario for Existing Industrial Buildings – 2007-2026

Cost and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	146	120	322	596
PDV Net Measure Costs	347	244	413	585
PDV Gross Program Costs	97	94	115	136
PDV Net Elec Avoided Cost Benefits	955	904	1,382	1,872
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	2.15	2.68	2.62	2.59

Refer to Table 7-3 for a description of the scenarios. PDV Net Measure Costs is the gross measure costs minus the naturally occurring measure costs. The PDV Gross Program Costs are the non-incentive program costs.

The results show that all Base funding results are cost-effective program based on the TRC test, with a benefit-cost ratio of 2.15. For the TRC Restricted scenarios, the TRC value is approximately 2.60.

7.2.3 Industrial Utility-Level Potential, Benefits, and Costs

In this section, market, technical and economic potential are presented at the utility level. The utility-specific costs, savings, and TRC test results are listed below. Figure 7-7 through Figure 7-18 illustrate and Table 7-11 through Table 7-16 list the estimates of potential electric energy savings for the various market scenarios for PG&E, SCE, and SDG&E, respectively.

The yearly illustrations of technical and economic potential need to be analyzed carefully. For retrofit and conversion models, the technical potential assumes an instantaneous installation of energy efficiency measures wherever applicable and feasible. For replace-on-burnout models, technical potential is phased in as the previous measures burn out. Economic potential is similar to technical, with the further consideration of costs. Both technical and economic potential should be viewed as theoretical constructions that do not reflect the market barriers to be overcome in order to achieve voluntary market adoptions. Given the definitions of economic and technical potential, the technical potential illustrated for each utility in 2007 illustrates what the utility could achieve if it could force all households that could adopt the measure to adopt the measure. Increases in technical potential over time are due to population growth and the burnout of existing measures.

PG&E Potential Energy Savings Forecasts for the Existing Industrial Sector

The results in Table 7-11 list the energy savings potential from the existing industrial sector in PG&E's service territory, while Figure 7-7 illustrates the savings estimates. Estimated gross market savings potential under current incentives are 765 GWh from 2007 through 2016 and 1,366 GWh from 2007 through 2026. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario), increases the estimate of savings to 1,005 GWh for 2007-2016 and 1,673 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 1,250 GWh for 2007-2016 and 1,941 GWh for 2007-2026. The potential results listed in Table 7-11 indicate that there is not a substantial reduction in energy savings potential when the measure lists are restricted to measures with a TRC > 0.85.

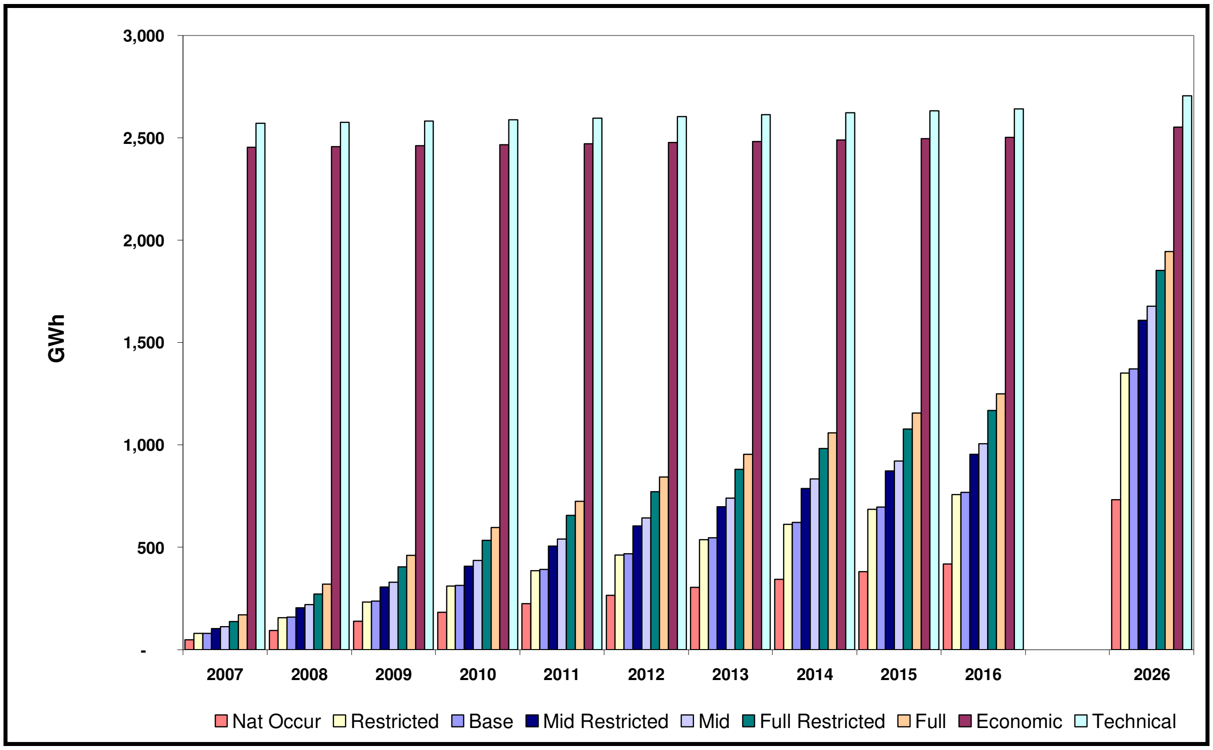
Figure 7-8 illustrates the energy savings potential from the top five energy savings measure groups. Grouping all pump optimization, sizing, control, and maintenance practices into one measure group leads to the highest measure group potential. Grouping light bulbs and fixtures into the lighting measure group results in this measure group having the second highest measure savings potential. Lighting and pump maintenance, sizing, control, and optimization potential is followed by the measure group potential in compressed air and fan maintenance, sizing, control, and optimization, and pump ASDs.

Table 7-11: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	2,535	2,398	79	78	47	80	50	111	102	171	136	94	90	47
2008	2,540	2,401	157	155	93	160	101	220	203	321	269	208	195	93
2009	2,546	2,405	235	232	138	242	152	328	303	463	400	333	307	138
2010	2,552	2,409	313	308	181	326	203	435	403	599	528	494	444	181
2011	2,560	2,414	390	384	223	411	256	540	502	727	650	636	573	223
2012	2,568	2,420	467	459	264	493	307	642	599	846	764	765	694	264
2013	2,577	2,426	543	535	303	573	358	739	692	957	871	884	806	303
2014	2,586	2,433	619	609	342	650	407	832	781	1,060	971	994	912	342
2015	2,596	2,439	693	681	379	725	454	920	865	1,158	1,066	1,097	1,011	379
2016	2,605	2,446	765	752	416	798	500	1,005	946	1,250	1,155	1,193	1,104	416
2026	2,669	2,496	1,366	1,343	727	1,406	895	1,673	1,595	1,941	1,831	1,912	1,804	727

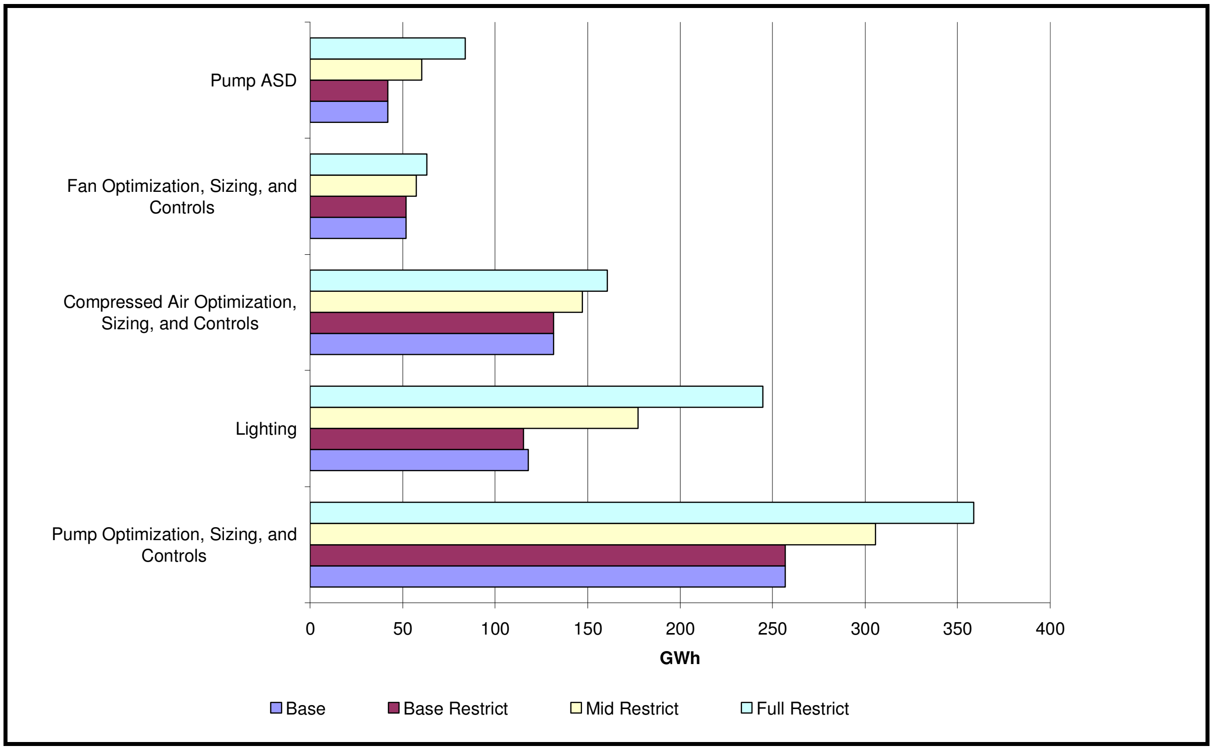
Refer to Table 7-3 for a description of the scenarios.

Figure 7-7: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Energy Potential for Existing Industrial Sector – 2007-2016 and 2026 (GWh)



Refer to Table 7-3 for a description of the scenarios.

Figure 7-8: PG&E Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 7-3 for a description of the scenarios.

SCE Potential Energy Savings Forecasts for the Existing Industrial Sector

The results in Table 7-12 list the energy savings potential in the existing industrial sector in SCE's service territory, while Figure 7-9 illustrates the savings estimates. Estimated gross market savings potential under current incentives are 954 GWh from 2007 through 2016 and 1,680 GWh from 2007 through 2026. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 1,262 GWh for 2007-2016 and 2,038 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 1,552 GWh for 2007-2016 and 2,335 GWh for 2007-2026.

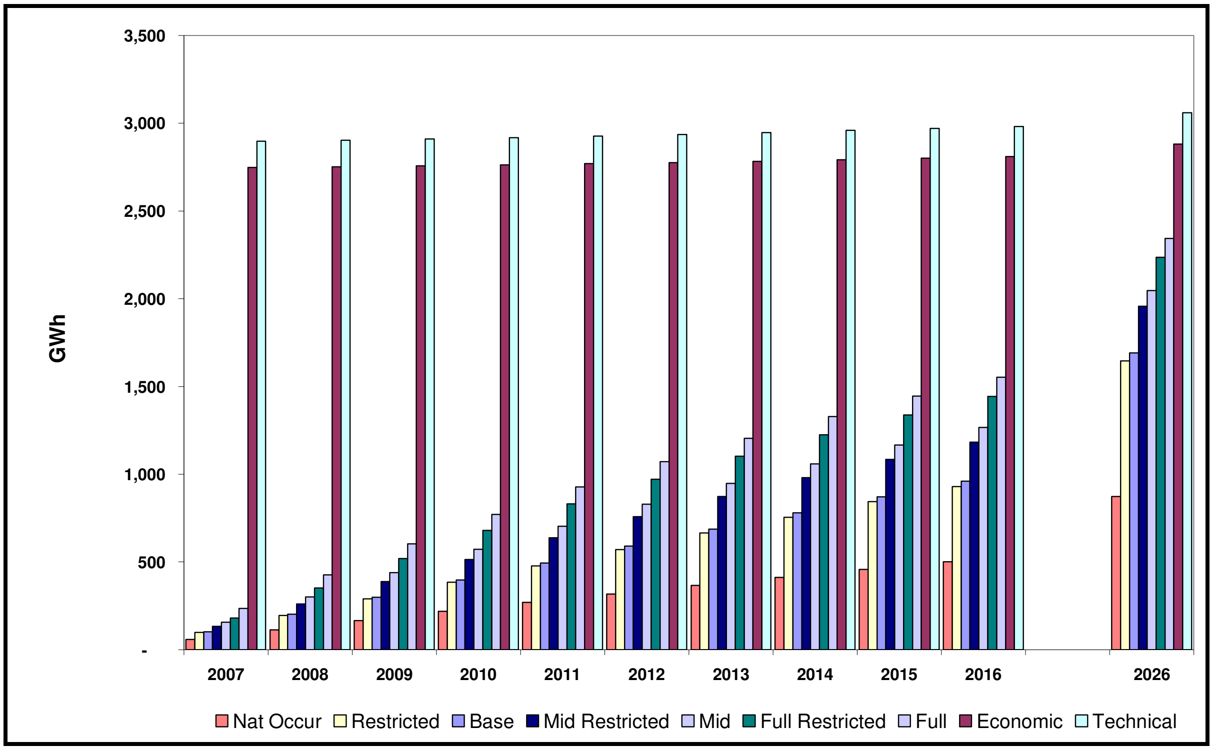
Figure 7-10 illustrates the top five energy saving measure groups in the SCE service territory. Grouping all pump optimization, maintenance, control, and sizing measures into a measure group leads to the top measure group potential. Following pumps are lighting, compressed air and fan optimization, maintenance, controls, sizing, and pump ASDs.

Table 7-12: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (GWh)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Naturally Occurring	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	2,847	2,669	100	96	56	99	60	155	129	237	176	125	113	56
2008	2,853	2,673	199	192	111	198	120	299	256	428	345	280	245	111
2009	2,859	2,678	297	286	164	299	181	437	381	606	508	442	385	164
2010	2,867	2,684	394	379	216	402	243	571	505	773	666	642	558	216
2011	2,876	2,690	491	472	266	506	305	700	627	930	816	817	718	266
2012	2,886	2,697	586	565	314	607	367	826	746	1,073	954	973	866	314
2013	2,897	2,705	681	656	362	705	427	944	859	1,206	1,083	1,116	1,003	362
2014	2,908	2,713	774	746	408	799	485	1,056	967	1,330	1,202	1,248	1,130	408
2015	2,919	2,722	866	835	452	890	541	1,162	1,069	1,445	1,314	1,370	1,248	452
2016	2,930	2,730	954	920	495	978	596	1,262	1,166	1,552	1,419	1,484	1,358	495
2026	3,009	2,800	1,680	1,628	865	1,708	1,064	2,038	1,931	2,335	2,199	2,302	2,169	865

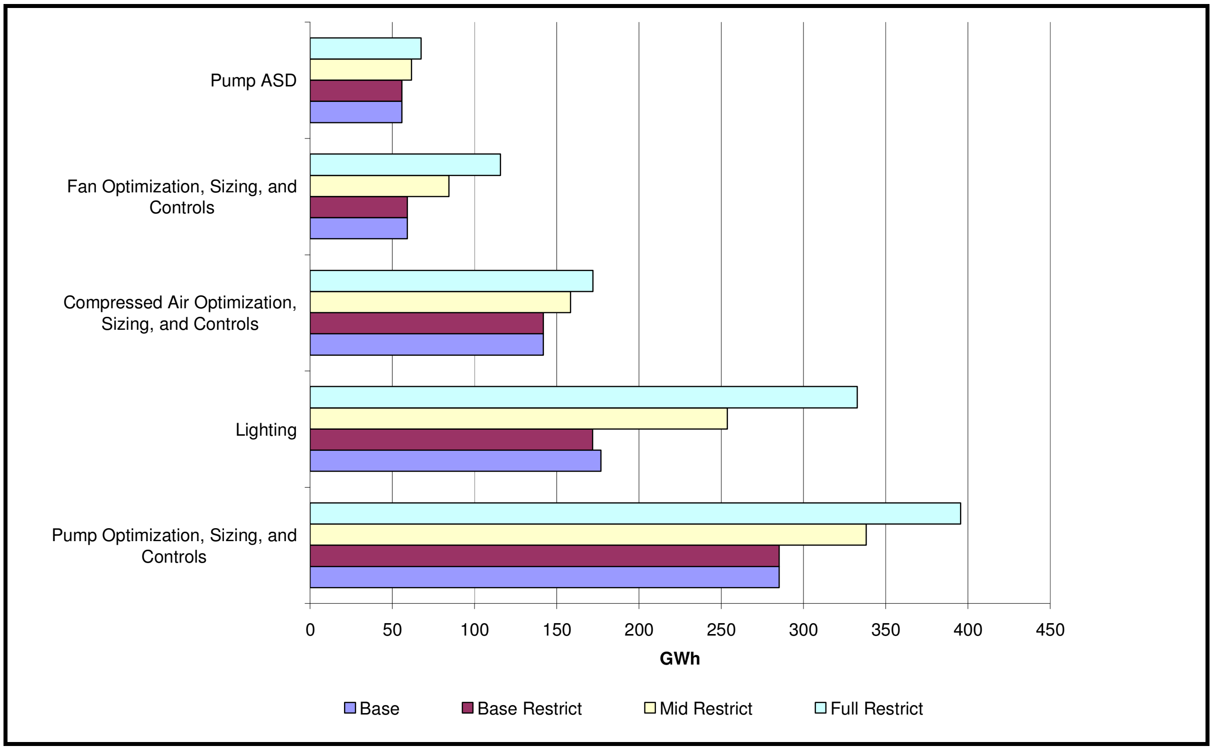
Refer to Table 7-3 for a description of the scenarios.

Figure 7-9: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Energy Potential for the Existing Industrial Sector – 2007-2016 and 2026 (GWh)



Refer to Table 7-3 for a description of the scenarios.

Figure 7-10: SCE Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 7-3 for a description of the scenarios.

SDG&E Potential Energy Savings Forecasts for the Existing Industrial Sector

The results listed in Table 7-13 present the energy savings from the existing industrial sector in SDG&E's service territory. Figure 7-11 illustrates SDG&E's energy savings by scenario. Estimated gross savings potential under the Base scenario are 118 GWh for 2007-2016 and 196 GWh for 2007-2026. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario), increases forecasted potential savings to 146 GWh for 2007-2016, a 24% increase in savings. In 2026, the Mid scenario's total gross market potential is 226 GWh. Further increasing incentives to Full incremental measure cost increases potential savings to 172 GWh for 2007-2016 and 250 GWh for 2007-2026.

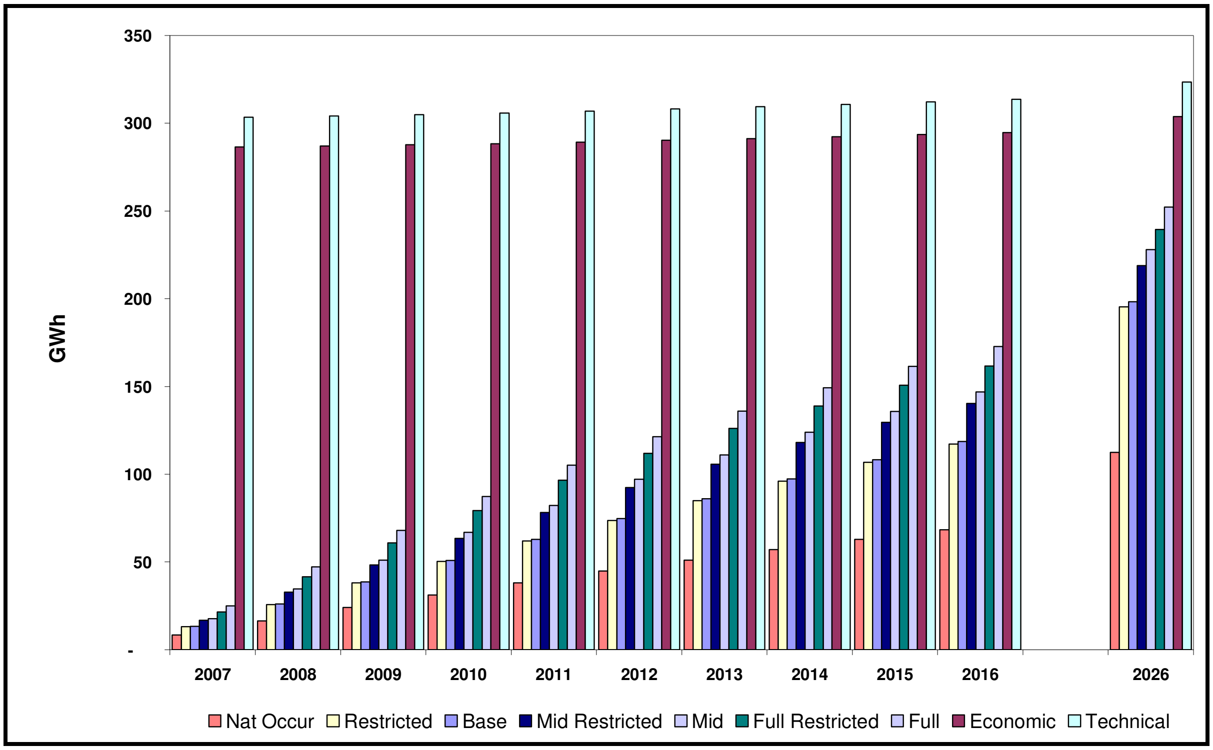
Table 7-13 lists the ratio of technical and economic potential to market potential estimates.

Table 7-13: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (GWh)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Base Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	296	274	13	13	8	13	9	18	17	25	21	15	15	8
2008	296	275	26	25	16	26	18	34	32	47	41	33	31	16
2009	297	275	38	38	24	39	26	51	48	68	60	52	49	24
2010	298	276	50	50	31	53	35	66	63	87	78	74	68	31
2011	299	277	62	61	38	66	44	82	77	105	95	94	86	38
2012	300	278	74	73	44	78	52	97	91	121	110	112	103	44
2013	302	279	85	84	50	90	60	110	104	136	124	128	117	50
2014	303	280	96	95	56	102	68	123	116	149	137	142	130	56
2015	304	281	107	106	62	112	76	135	128	161	148	155	143	62
2016	306	282	118	116	68	123	83	146	138	172	159	166	154	68
2026	316	291	196	193	111	201	139	226	215	250	235	248	232	111

Refer to Table 7-3 for a description of the scenarios.

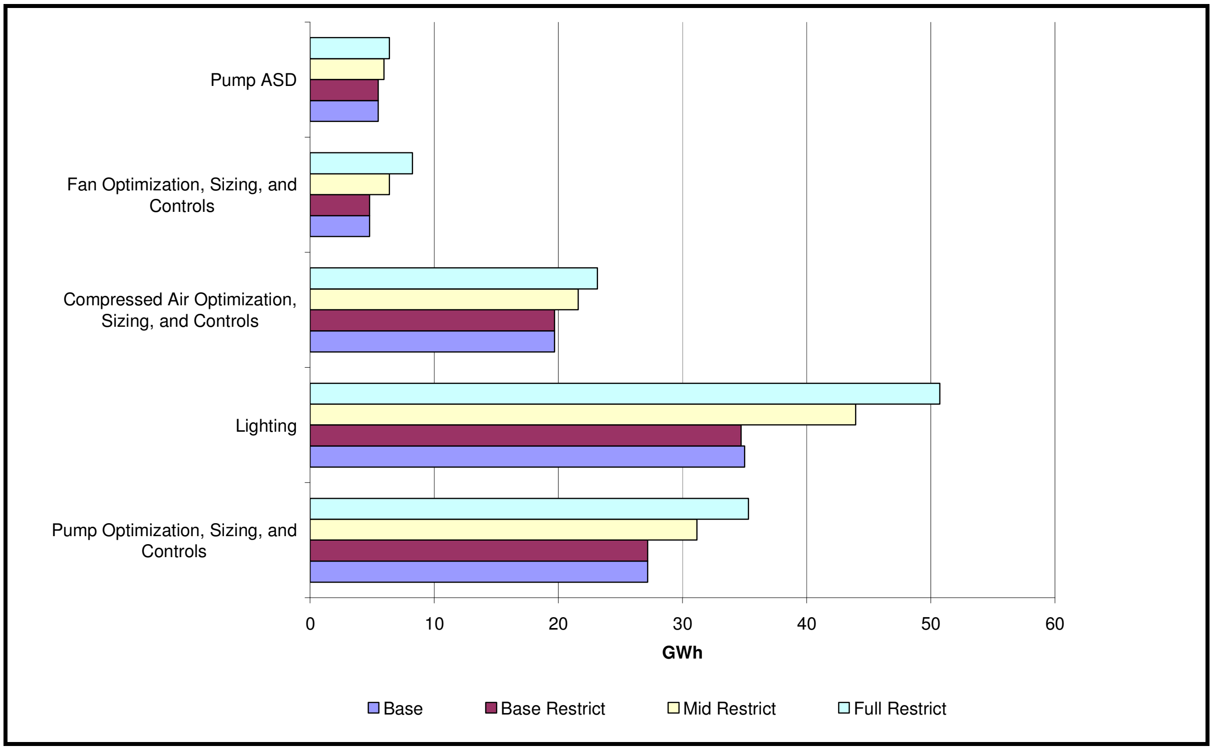
Figure 7-11: SDG&E Estimated Total Gross Technical, Economic, Market, and Naturally Occurring Energy Potential for the Existing Industrial Sector – 2007-2016 and 2026



Refer to Table 7-3 for a description of the scenarios.

Figure 7-12 illustrates the existing industrial market energy savings estimates from the top five measure savings groups in SDG&E's service territory. Grouping pump sizing, maintenance, optimization, and controls into a single measure group leads to the highest measure group potential within SDG&E's industrial sector. Lighting, compressed air and fan sizing maintenance, optimization, and controls, and pump ASDs complete the top five measure groups.

Figure 7-12: SDG&E Total Market Gross Energy Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (GWh)



Refer to Table 7-3 for a description of the scenarios.

PG&E Potential Demand Savings Forecasts for the Existing Industrial Sector

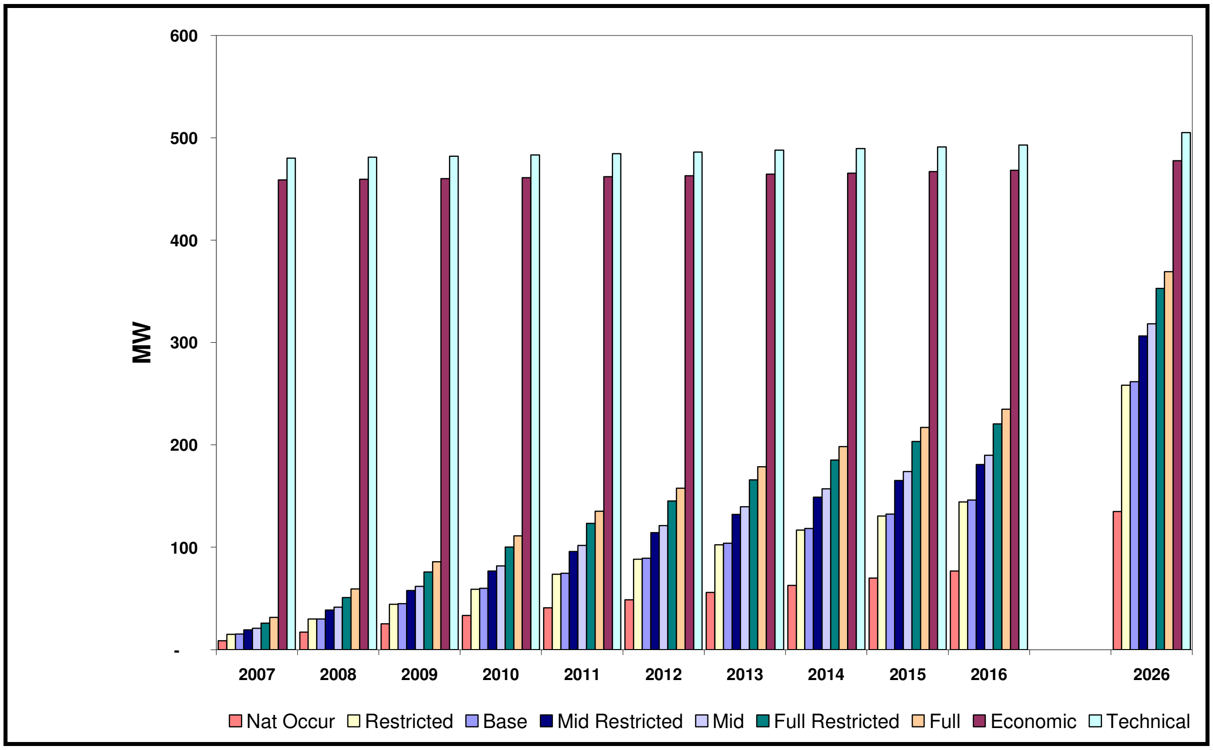
The results in Table 7-14 list the coincident peak demand savings from the existing industrial sector in PG&E's service territory, while Figure 7-13 illustrates these estimates. The estimated coincident peak demand savings potential under the Base scenario is 145 MW for 2007-2016 and 260 MW for 2007-2026. Restricting the measures to those with a TRC ≥0.85 leads to only a minor reduction in the Base scenario estimates (143 MW for 2007-2016 and 257 MW for 2007-2026). Increasing incentives to the average between current incentives and full incremental measure costs (the Mid scenario) increases the estimate of coincident peak demand savings to 190 MW for 2007-2016 and 318 MW for 2007-2026. The growth rate in the coincident peak demand estimates between the Base and the Mid scenarios is about 30%. Further increasing incentives from 2006 levels to Full incremental measure cost increases demand potential savings to 235 MW for 2007-2016 and 368 MW for 2007-2026.

Table 7-14: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (MW)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Base Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	473	448	15	15	9	15	9	21	19	32	25	18	17	9
2008	474	448	30	30	17	31	18	41	38	60	50	39	37	17
2009	475	449	45	44	25	46	28	62	57	86	75	62	58	25
2010	476	450	60	59	33	62	37	82	76	112	99	92	84	33
2011	478	451	74	73	41	78	47	102	95	136	122	119	108	41
2012	479	452	89	88	48	94	56	121	113	158	144	143	131	48
2013	481	453	103	102	55	109	65	139	131	179	164	165	152	55
2014	482	455	118	116	63	124	74	157	148	199	183	186	172	63
2015	484	456	132	130	69	139	83	174	164	217	201	206	191	69
2016	486	457	145	143	76	152	91	190	179	235	218	224	208	76
2026	498	467	260	257	134	270	164	318	304	368	349	363	343	134

Refer to Table 7-3 for a description of the scenarios.

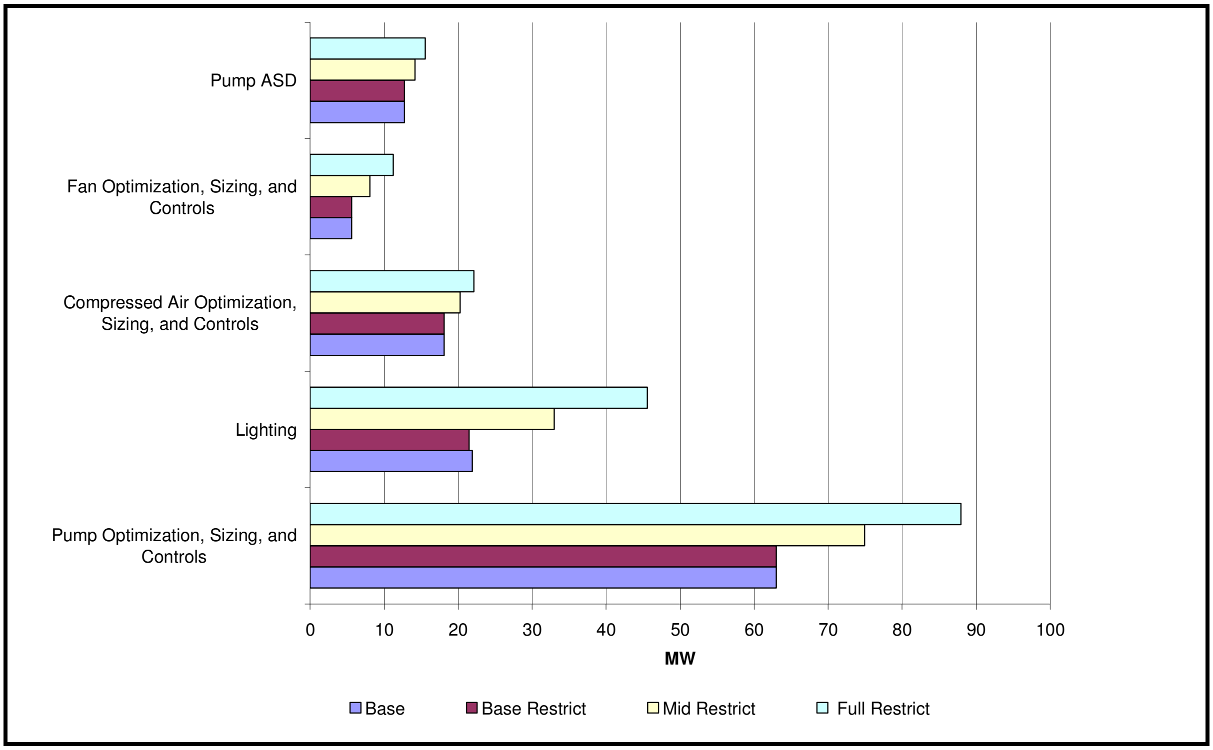
Figure 7-13: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for the Existing Industrial Sector – 2007-2016 and 2026 (MW)



Refer to Table 7-3 for a description of the scenarios.

Figure 7-14 illustrates the coincident peak demand savings potential from the top five measure groups. In PG&E's existing industrial sector, grouping pump optimization, sizing, maintenance, and controls into a single measure group leads to the highest coincident peak demand savings potential.

Figure 7-14: PG&E Total Market Gross Coincident Peak Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 7-3 for a description of the scenarios.

SCE Potential Demand Savings Forecasts for Existing Industrial Sector

The results in Table 7-15 list the peak demand savings from existing industries in SCE's service territory. The estimated demand savings potential under current incentives is 133 MW for 2007-2016 and 235 MW for 2007-2026. Increasing incentives to the average between current incentives and full incremental measure costs increases Mid scenario forecast savings to 180 MW for 2007-2016 and 288 MW for 2007-2026. Increasing incentives to Full incremental measure cost increases demand potential savings to 224 MW for 2007-2016 and 330 MW for 2007-2026

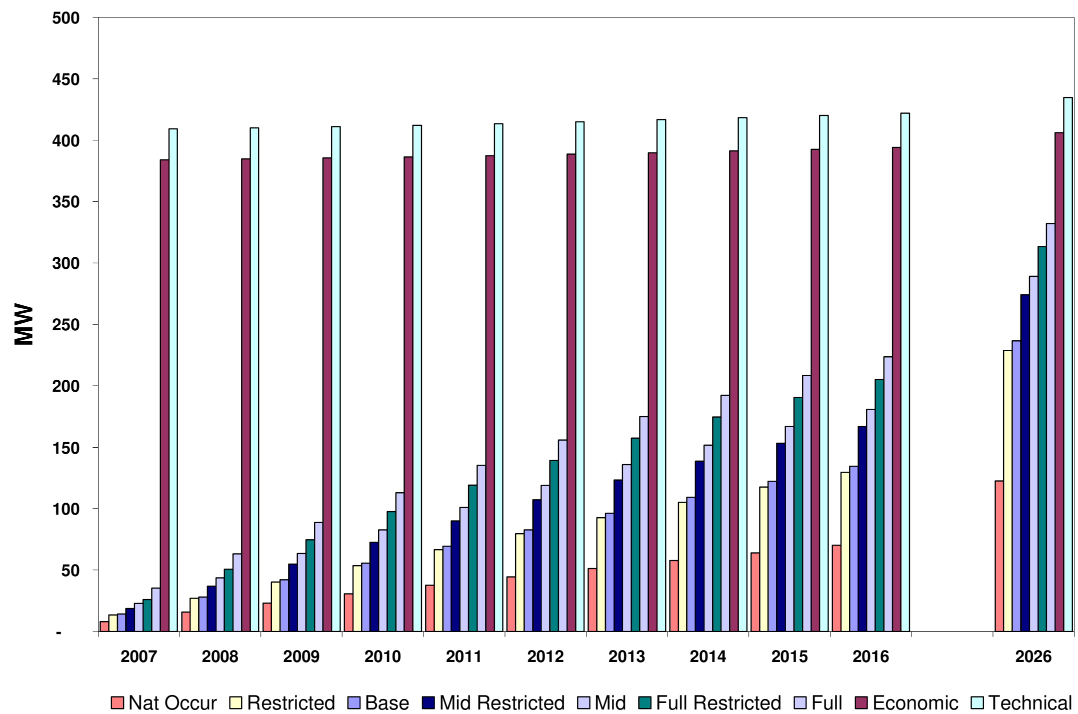
Table 7-15: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (MW)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Base Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	400	369	14	13	8	14	8	23	18	36	25	18	16	8
2008	401	370	28	27	16	27	17	44	36	64	49	40	34	16
2009	402	371	42	40	23	41	25	63	54	89	73	64	54	23
2010	403	372	55	53	30	56	34	82	71	113	95	93	79	30
2011	404	373	69	66	37	70	43	101	88	136	116	119	102	37
2012	406	374	82	78	44	84	51	119	105	156	136	141	123	44
2013	407	375	95	91	51	98	60	135	121	175	154	162	142	51
2014	409	377	108	104	57	111	68	151	136	192	171	180	160	57
2015	411	378	121	116	63	123	76	166	150	209	186	198	177	63
2016	413	379	133	128	69	136	84	180	164	224	201	214	192	69
2026	425	391	235	226	121	236	149	288	269	330	307	326	303	121

Refer to Table 7-3 for a description of the scenarios.

Figure 7-15 presents the potential coincident peak demand savings for the market scenarios and the economic and technical potential estimates for SCE.

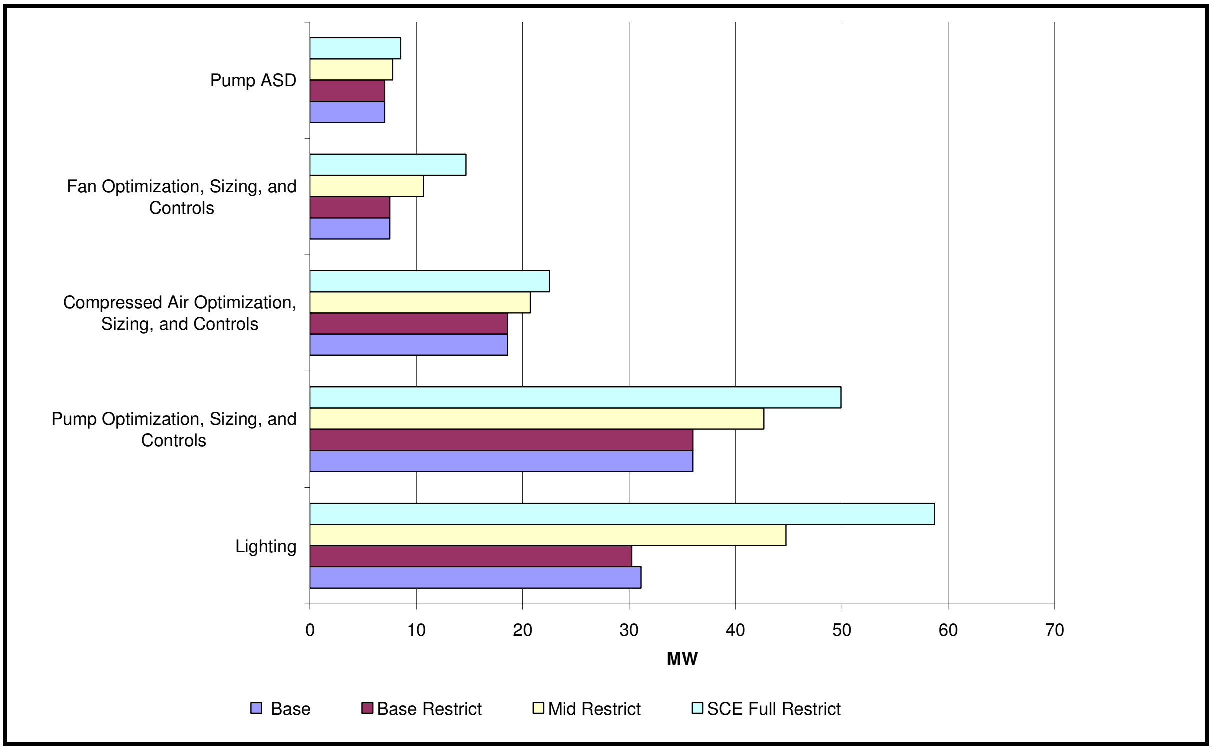
Figure 7-15: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Existing Industrial Sector – 2007-2016 and 2026 (MW)



Refer to Table 7-3 for a description of the scenarios.

Figure 7-16 lists the measure groups with the top five coincident peak demand savings potential. For SCE's industrial sector, the lighting measure group has the top coincident demand savings potential, closely followed by the pump optimization, controls, sizing, and maintenance measure group. Following the top two measure groups are compressed air and fan optimization, controls, sizing, and maintenance, and pump ASDs.

Figure 7-16: SCE Total Market Gross Coincident Peak Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 7-3 for a description of the scenarios.

<u>SDG&E Potential Demand Savings Forecasts for Existing Industrial Buildings</u>

The results in Table 7-16 list the coincident peak demand savings from existing industrial businesses in SDG&E's service territory. The estimated gross coincident peak demand savings potential under the Base scenario (2006 incentive levels) is 18 MW for 2007-2016 and 29 MW for 2007-2026 Increasing incentives to the average between current incentives and full incremental measure costs, increases the Mid scenario forecast coincident peak demand potential to 22 MW for 2007-2016 and 34 MW for 2007-2026. Increasing incentives to Full incremental measure cost increases demand potential savings to 26 MW for 2007-2016 and 38 MW for 2007-2026.

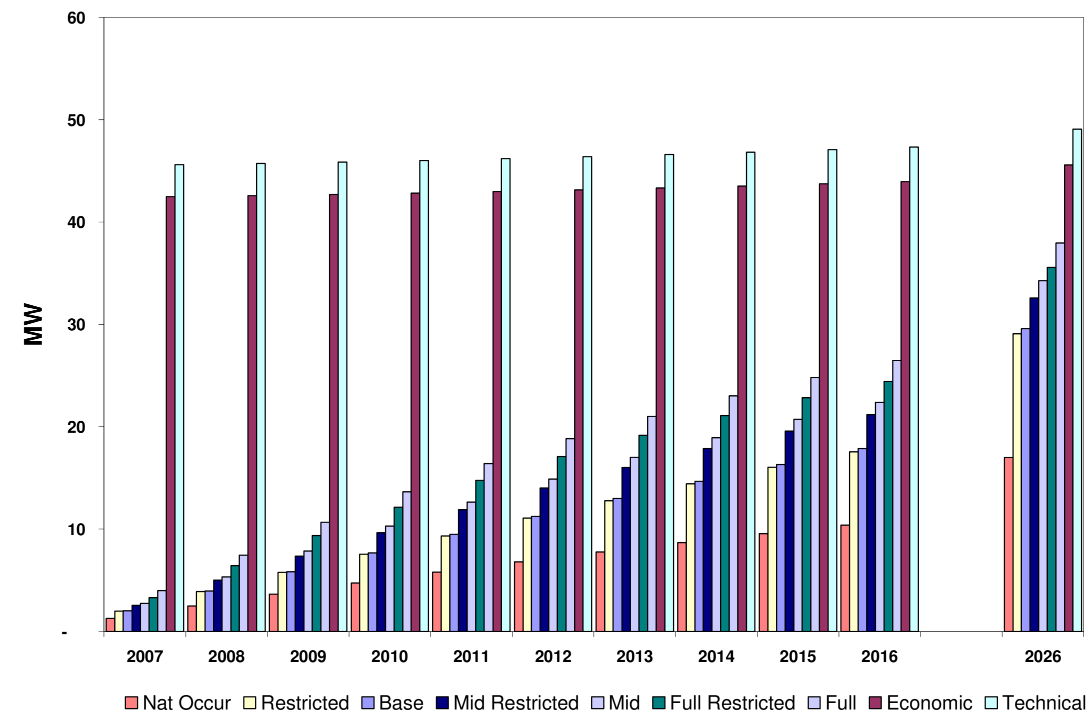
Table 7-16: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (MW)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Base with Higher Awareness	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	44	40	2	2	1	2	1	3	3	4	3	2	2	1
2008	44	40	4	4	2	4	3	5	5	7	6	5	5	2
2009	44	40	6	6	4	6	4	8	7	11	9	8	7	4
2010	45	40	8	7	5	8	5	10	10	14	12	12	10	5
2011	45	41	9	9	6	10	7	13	12	16	15	15	13	6
2012	45	41	11	11	7	12	8	15	14	19	17	17	16	7
2013	45	41	13	13	8	14	9	17	16	21	19	20	18	8
2014	45	41	14	14	9	15	10	19	18	23	21	22	20	9
2015	46	41	16	16	9	17	11	21	19	25	22	24	22	9
2016	46	42	18	17	10	18	13	22	21	26	24	25	23	10
2026	48	43	29	29	17	30	21	34	32	38	35	37	34	17

Refer to Table 7-3 for a description of the market funding scenarios.

Figure 7-17 illustrates SDG&E's potential coincident peak demand savings associated with technical, economic and the market scenarios.

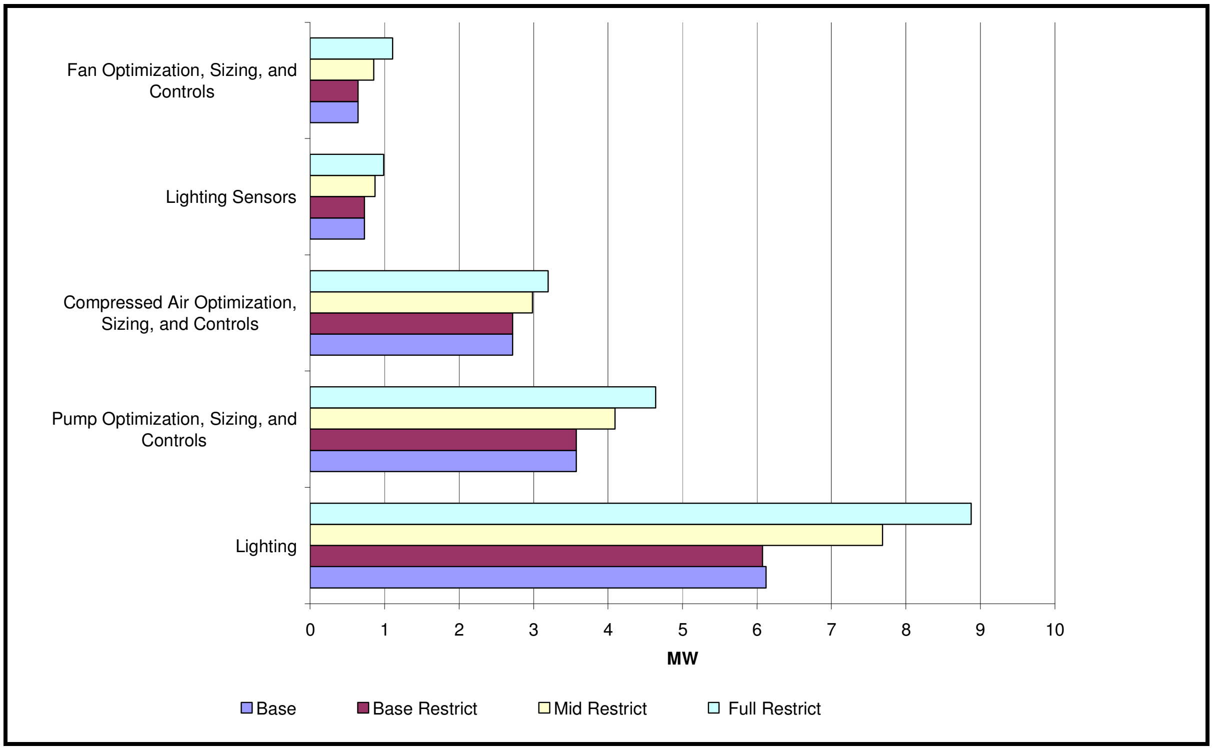
Figure 7-17: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Existing Industrial Buildings – 2007-2016, and 2026 (MW)



Refer to Table 7-3 for a description of the market funding scenarios.

Figure 7-18 illustrates the coincident peak demand potential from the top five savings measure groups. The lighting measure group is estimated to provide SDG&E with the largest peak demand potential, followed by the pump optimization, controls, sizing, and maintenance measure group. Compressed air optimization, controls, sizing, and maintenance, lighting sensors, and fan optimization, controls, sizing, and maintenance measure groups complete the list of the top five coincident demand savings measure groups.

Figure 7-18: SDG&E Total Market Gross Coincident Peak Demand Savings Potential by Measure Group and Scenario for the Top Five Demand Savings Measures – 2007-2016 (MW)



Refer to Table 7-3 for a description of the scenarios.

Utility-Specific Cost and Benefits for the Existing Industrial Sector

The utility-specific costs and benefits are presented in Table 7-17 through Table 7-19. The forecast shows that all three utilities offer cost-effective programs and that their programs would be cost-effective at both the Mid and Full incremental cost funding levels.

Table 7-17: Summary of PG&E Electric Market Potential Costs and Benefits by Scenario for Existing Industrial Buildings – 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	54	46	126	237
PDV Net Measure Costs	123	96	164	235
PDV Gross Program Costs	45	44	54	64
PDV Net Elec Avoided Cost Benefits	376	361	555	758
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	2.24	2.59	2.55	2.54

Refer to Table 7-3 for a description of the scenarios. The PDV of net measure costs is the gross measure costs minus the naturally occurring measure costs. The PDV of the gross program costs are the non-incentive program costs.

Table 7-18: Summary of SCE Electric Market Potential Costs and Benefits by Scenario for Existing Industrial Buildings – 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	82	64	174	322
PDV Net Measure Costs	204	133	226	319
PDV Gross Program Costs	48	46	56	67
PDV Net Elec Avoided Cost Benefits	518	484	745	1,008
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	2.06	2.71	2.64	2.61

Refer to Table 7-3 for a description of the scenarios. The PDV of net measure costs is the gross measure costs minus the naturally occurring measure costs. The PDV of the gross program costs are the non-incentive program costs.

Table 7-19: Summary of SDG&E Electric Market Potential Costs and Benefits by Scenario for Existing Industrial Buildings – 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	10	9	22	37
PDV Net Measure Costs	20	15	24	31
PDV Gross Program Costs	4	4	5	5
PDV Net Elec Avoided Cost Benefits	60	58	83	106
PDV Net Gas Avoided Cost Benefits	0	0	0	0
TRC	2.50	2.96	2.91	2.89

Refer to Table 7-3 for a description of the scenarios. The PDV of net measure costs is the gross measure costs minus the naturally occurring measure costs. The PDV of the gross program costs are the non-incentive program costs.

7.3 Gas Efficiency Potential in the Existing Industrial Sector

In the presentation of natural gas saving potential below, measures are aggregated into three end uses: HVAC, boiler, and process. This analysis uses most of the same inputs used in the industrial subsection of the Itron 2006 study that was completed by KEMA-Xenergy. The analyses differ in a number of ways; this analysis uses the ASSET model, while the 2006 analysis used the ASSYST model; the current study presents results for 2007-2016 and 2007-2026, while the 2006 analysis presented results from 2005-2016; and the current study uses IOU-specific TOU periods.

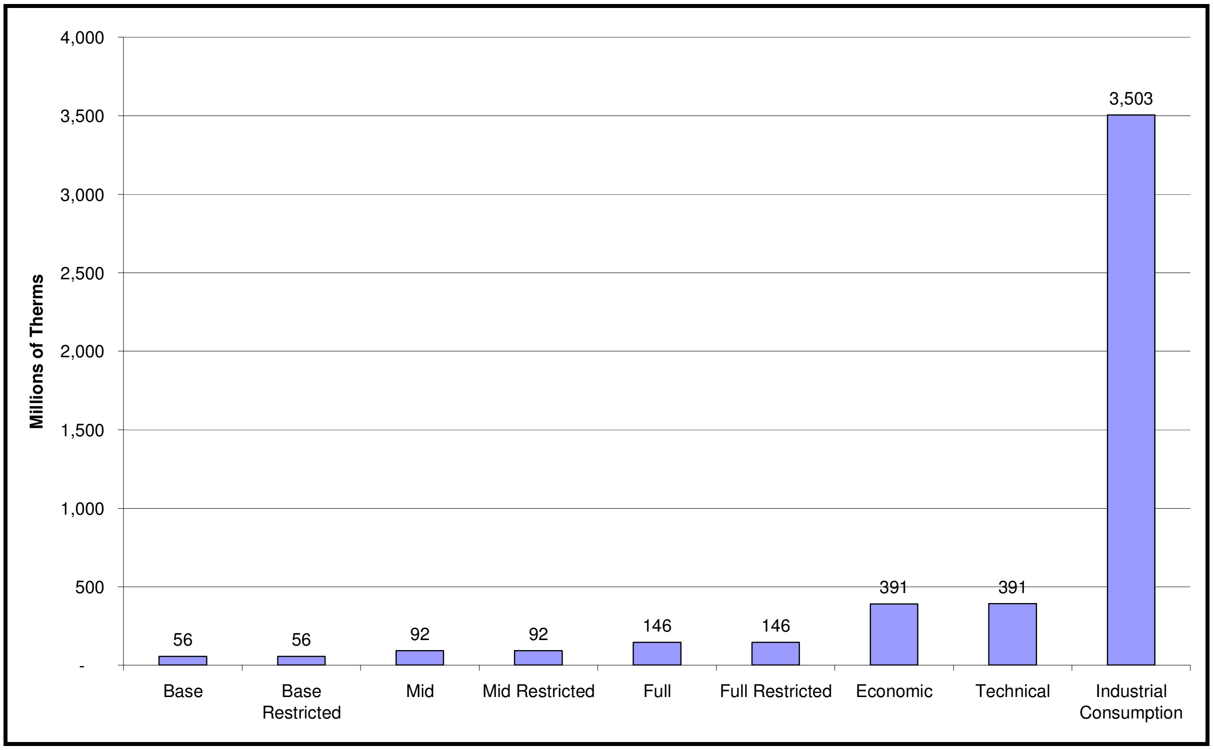
Total IOU Industrial Market Potential

Figure 7-19 presents the total estimated gas usage and potential estimates from the analysis for the California gas IOUs of PG&E, SDG&E, and SCG.[9] The values are provided for 2016, the last year of the short-term analysis.

As shown, total estimated consumption is 3,503 million therms. The technical potential is 391 million therms for 2007-2016 and total estimated economic potential is 391 million therms. The Full scenario estimate for 2007-2016 is 146 million therms. The technical and economic potential are about 11% of expected industrial consumption and the full incentive potential estimate is approximately 4% of estimated natural gas consumption.

9 CEC December 2007, 2007 Final Natural Gas Market Assessment, Tables J1, J2, and J3.

Figure 7-19: Estimated California IOU Gas Consumption in 2016, Technical, Economic, and Gross Market Potential for the Existing Industrial Sector – 2007-2016



Refer to Table 7-3 for a description of the scenarios.

Table 7-20 presented natural gas potential estimates by scenario for 2007-2016 and 2007-2026 across all three IOUs. Total IOU market potential under the Base scenario is 56 million therms of gross natural gas potential for 2007-2016 and 119 million therms for 2007-2026. The net Base scenario potential for 2007-2016 is 23 million therms, while the net Base scenario potential for 2007-2026 is 59 million therms. These savings are the estimated energy savings potential if the IOUs continue their 2006 incentive levels. Increasing incentives to Full incremental costs increases the total gross market forecast to 146 million therms for 2007-2016 and the net potential estimates to 113 million therms for 2007-2016.

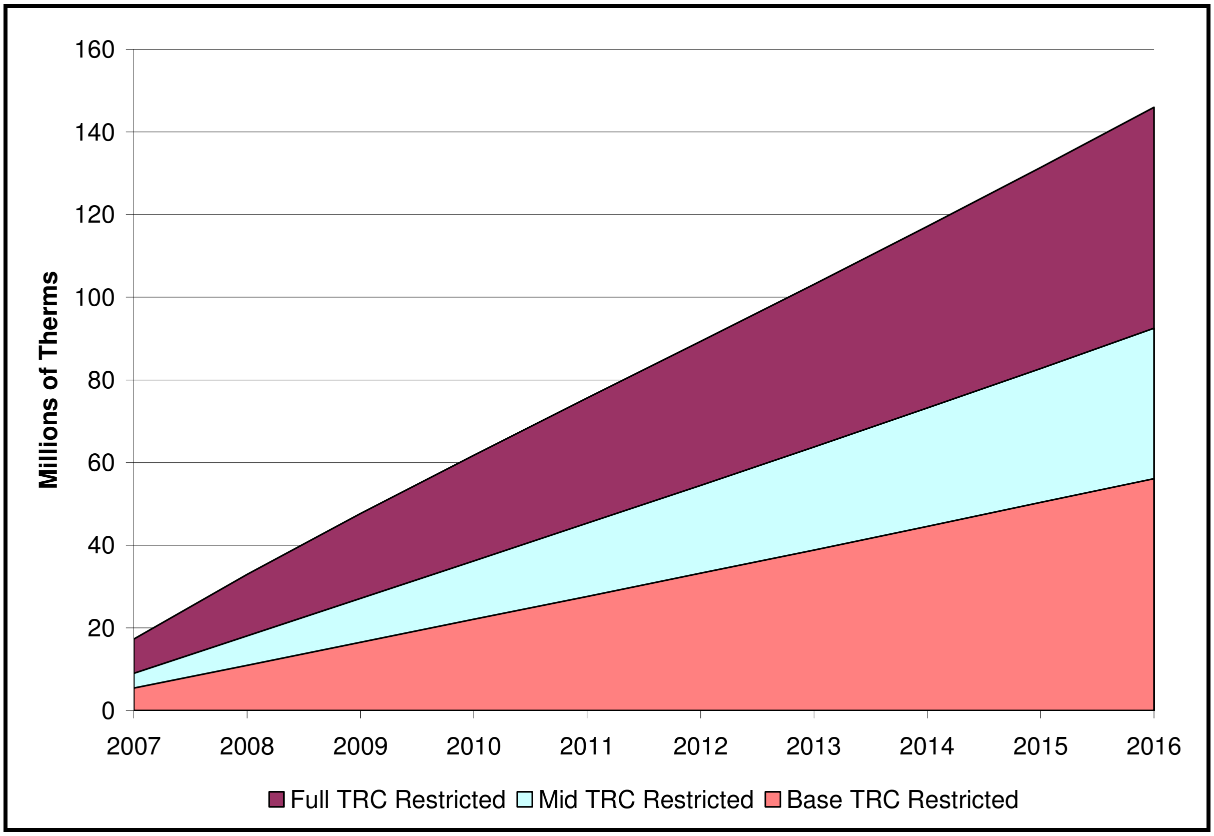
Table 7-20: Estimated Total Gross Market and Naturally Occurring Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2007-2026 (Millions of Therms)

Funding Level	Market Potential, 2016	Naturally Occurring, 2016	Market Potential, 2026	Naturally Occurring, 2026
Base	56	33	119	60
Base Restricted	56	33	119	60
Mid	92	33	187	60
Mid Restricted	92	33	187	60
Full	146	33	245	60
Full Restricted	146	33	245	60
Full Gradual	139	33	242	60
Full Restrict Gradual	139	33	242	60

Refer to Table 7-3 for a description of the scenarios.

The results for the TRC Restricted gross market scenarios are illustrated in Figure 7-20. These graphs illustrate the yearly estimates of market potential for the TRC Restricted scenarios.

Figure 7-20: Estimated California IOU Gross Total Energy Market Potential, TRC Restricted Funding Levels for the Existing Industrial Sector – 2007-2016 (Millions of Therms)



Refer to Table 7-3 for a description of the scenarios.

Market and Naturally Occurring Potential with Higher Awareness

The natural gas potential model was evaluated under the assumption that the continued expansion of energy efficiency programs and the growing awareness about global warming would lead to a faster increase in the public's awareness and willingness to install energy efficiency measures. To model this possibility, the Base TRC Restricted Higher Awareness scenario assumes a faster growth rate for the awareness than in the Base TRC Restricted scenario. In addition, this scenario assumes that the awareness and willingness of the naturally occurring estimate gross at a rate set equal to 75% of the growth rate of the program analysis.[10]

Table 7-21 lists the estimated natural gas savings for the Base Restricted and the Base Restricted with Higher Awareness scenarios. Comparing the 2007-2016 gross market estimate, assuming a higher growth rate of awareness increases the gross potential from 56

[10] In all other scenarios, the awareness and willingness of the naturally occurring estimate is held fixed at the 2007 levels; it is not allowed to grow over time.

million therms to 65 million therms. The additional 9 million therms is an increase in potential associated with high levels of knowledge, a substantial benefit to society. Increasing awareness, however, also leads to a large increase in the adoption of high efficiency devices occurring even if there are no energy efficiency rebate programs. The naturally occurring estimate is forecast to grow from 33 million therms to 43 million therms for 2007-2016 as awareness and willingness to install energy efficiency devices grows. This growth in naturally occurring, however, is dependent on the growth in awareness and willingness that is, at least in part, due to the continuous implementation of energy efficiency programs in California.

Table 7-21: Estimated California IOU Total Gross Market and Naturally Occurring Potential for the Base Restricted and Base Restricted, Higher Awareness Scenarios – 2007-2016 and 2007-2026 (Millions of Therms)

Funding Level	Market Potential, 2016	Naturally Occurring, 2016	Market Potential, 2026	Naturally Occurring, 2026
Base Restricted	56	33	119	60
Base Restricted - Higher Awareness	65	43	137	95

Refer to Table 7-3 for a description of the scenarios.

<u>Natural Gas Market Potential by End Use for the Existing Industrial Sector</u>

Table 7-22 and Table 7-23 summarize the market potential results by end use and funding level. Increasing funding for HVAC measures from the Base scenario to the Mid scenario increases natural gas potential from 1 million therms to 3 million therms from 2007 through 2016, while increasing funding for boiler measures increases natural gas potential from 42 million therms to 58 million and increasing funding for process measures increases potential from 13 million therms to 31 million therms from 2007 through 2016. All of these increases in savings potential are associated with cost-effective measures given that all of the industrial gas measures passed the TRC > 0.85 restriction.

Table 7-22: Estimated California IOU Total Gross Market and Naturally Occurring Natural Gas Potential by funding Level and End Use for the Existing Industrial Sector – 2007-2016 (Millions of Therms)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	1	1	0	3	3	7	7	0
Boiler	42	42	27	58	58	79	79	27
Process	13	13	6	31	31	60	60	6
Total	**56**	**56**	**33**	**92**	**92**	**146**	**146**	**33**

Refer to Table 7-3 for a description of the scenarios.

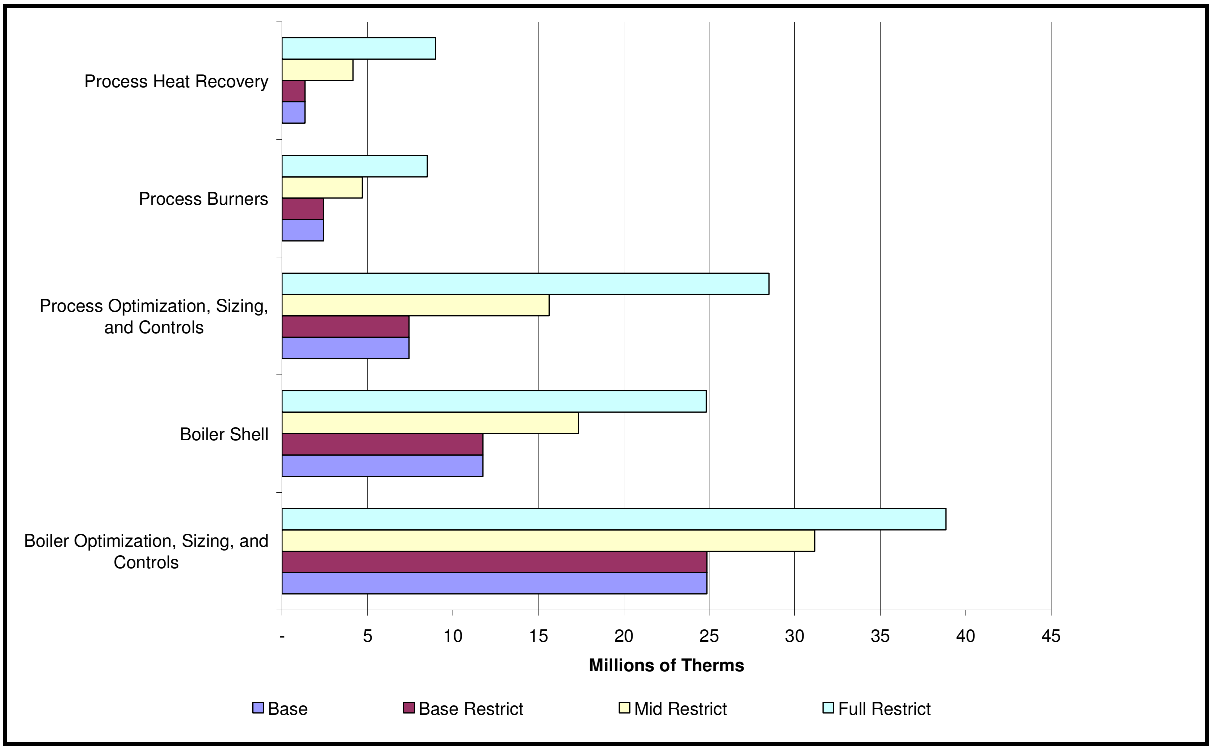
Table 7-23: Estimated California IOU Total Gross Market and Naturally Occurring Natural Gas Potential by funding Level and End Use for the Existing Industrial Sector – 2007-2026 (Millions of Therms)

	Base	Base Restricted	Base Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full Naturally Occurring
HVAC	2	2	1	6	6	10	10	1
Boiler	88	88	49	119	119	145	145	49
Process	29	29	10	62	62	90	90	10
Total	**119**	**119**	**60**	**187**	**187**	**245**	**245**	**60**

Refer to Table 7-3 for a description of the scenarios.

Figure 7-21 lists the total gross market potential for the top five natural gas saving measure groups. The measure group with the largest potential is boiler optimization, controls, sizing, and maintenance. The measure group with the second highest natural gas potential is boiler shell measures, which includes insulation and ducts. The third highest efficiency measure group is process optimization, controls, sizing, and maintenance, followed by process burners and process heat recovery.

Figure 7-21: Total California IOU Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Energy Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 7-3 for a description of the scenarios.

7.3.2 Gas Cost and Benefit Results for Existing Industrial Buildings

Table 7-24 presents a summary of the industrial gas market potential estimates for three of the market funding levels with costs, benefits, and TRC ratios included. As shown at the statewide level, the portfolio of gas programs is cost-effective based on the results of the TRC test.

Table 7-24: Summary of California IOU Gas Market Potential Results by Scenario for Existing Industrial Buildings 2007-2026

Costs and benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	31	31	136	319
PDV Net Measure Costs	69	69	201	351
PDV Gross Program Costs	43	43	68	95
PDV Net Electric Avoided Cost Benefits	0	0	0	0
PDV Net Gas Avoided Cost Benefits	367	367	875	1,430
TRC	3.30	3.30	3.25	3.20

Refer to Table 7-3 for a description of the scenarios. PDV Net Measure Costs is the present discounted value of the gross measure costs minus the naturally occurring measure costs. The PDV of gross program costs are the non-incentive program costs.

7.3.3 Utility-Level Industrial Gas Potential, Benefits and Costs

In this section, market, technical and economic potential are presented at the utility level. The utility-specific costs, savings, and TRC test results are listed below. Figure 7-22 through Figure 7-27 illustrate and Table 7-25 through Table 7-27 list the estimates of potential electric energy savings for the various market scenarios for PG&E, SCG, and SDG&E, respectively.

The yearly illustrations of technical and economic potential need to be analyzed carefully. For retrofit and conversion models, the technical potential assumes an instantaneous installation of energy efficiency measures wherever applicable and feasible. For replace-on-burnout models, the technical potential is phased in as the previous measures burn out. Economic potential is similar to technical, with the further consideration of costs. Both the technical and economic potential should be view as theoretical constructions that do not reflect the market barriers that must be overcome to achieve voluntary market adoptions. Given the definitions of economic and technical potential, the technical potential illustrated for each utility in 2007 illustrates what the utility could achieve if it could force all households that could adopt the measure to adopt the measure. Increases in technical potential over time are due to population growth and the burnout of existing measures.

<u>PG&E Potential Natural Gas Savings Forecasts for the Existing Industrial Sector</u>

The results in Table 7-25 list the natural gas savings potential from the existing industrial sector in PG&E's service territory, while Figure 7-22 illustrates the natural gas estimates. Estimated gross market savings potential under current incentives are 29 million therms from 2007-2016 and 61 million therms from 2007-2026. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario) increases the estimate of savings to 49 millions of therms for 2007-2016 and 96 million therms in for 2007-2026. Increasing incentives to Full incremental measure cost increases the potential savings to 76 million therms for 2007-2016 and 122 for 2007-2026.

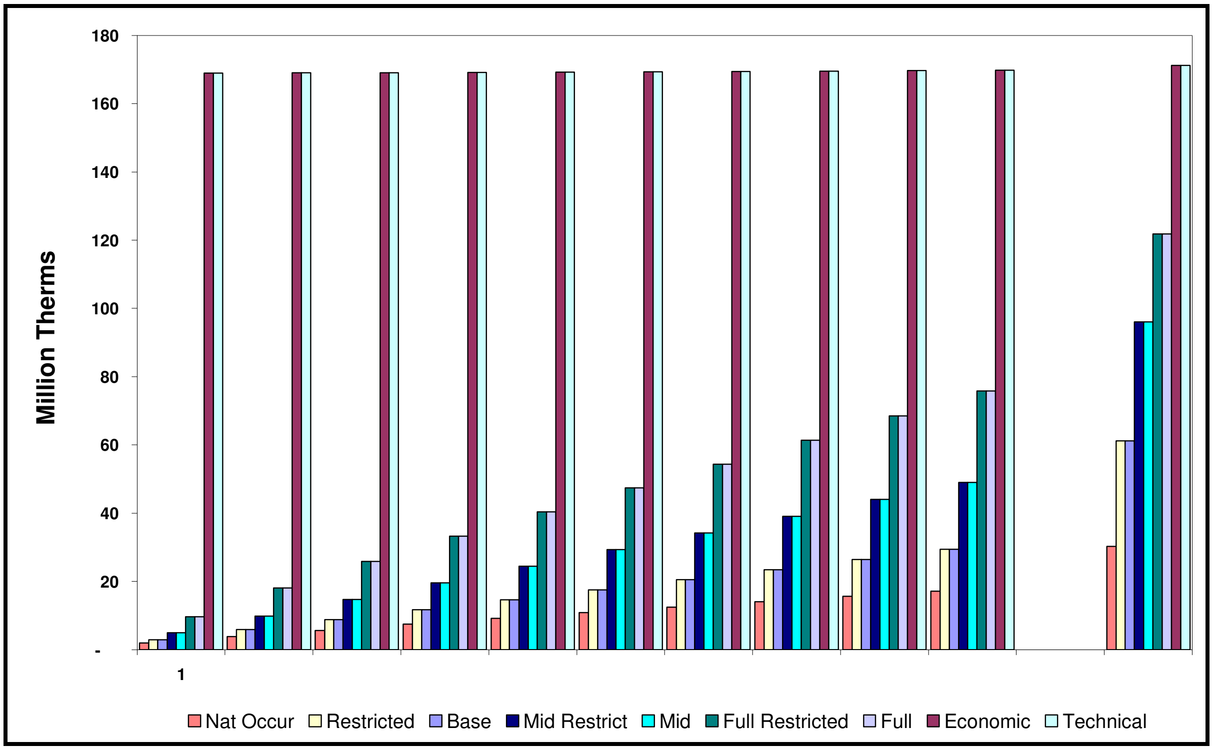
Figure 7-22 illustrates the yearly natural gas potential savings, by scenario.

Table 7-25: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	169	169	3	3	2	3	2	5	5	10	10	4	4	2
2008	169	169	6	6	4	6	4	10	10	18	18	9	9	4
2009	169	169	9	9	6	9	6	15	15	26	26	15	15	6
2010	169	169	12	12	7	12	8	20	20	33	33	25	25	7
2011	169	169	15	15	9	15	11	24	24	40	40	33	33	9
2012	169	169	18	18	11	19	13	29	29	47	47	42	42	11
2013	169	169	20	20	12	22	15	34	34	54	54	49	49	12
2014	170	170	23	23	14	26	17	39	39	61	61	57	57	14
2015	170	170	26	26	16	30	20	44	44	68	68	65	65	16
2016	170	170	29	29	17	34	22	49	49	76	76	73	73	17
2026	171	171	61	61	30	70	48	96	96	122	122	121	121	30

Refer to Table 7-3 for a description of the scenarios.

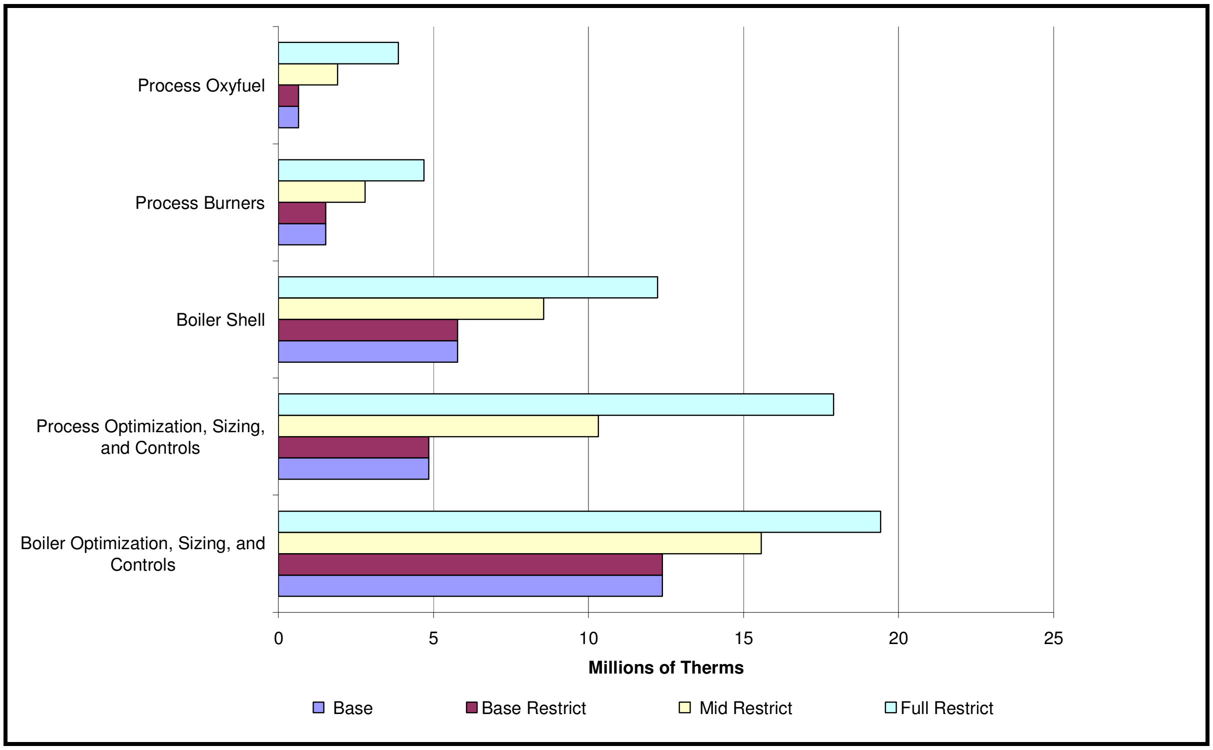
Figure 7-22: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Natural Gas Potential for the Existing Industrial Sector – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 7-3 for a description of the scenarios.

Figure 7-23 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all boiler optimization, control, sizing, and maintenance measures into one measure group illustrates the importance of this measure group in PG&E's industrial energy efficiency natural gas program. Process optimization, control, sizing, and maintenance measures closely follow boilers measures in the quantity of remaining market energy efficiency potential. The remaining three top savings measure groups are boiler shell measures (insulation and ducts), process burners, and process oxyfuel.

Figure 7-23: PG&E Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 7-3 for a description of the scenarios.

SCG Potential Natural Gas Savings Forecasts for the Existing Industrial Sector

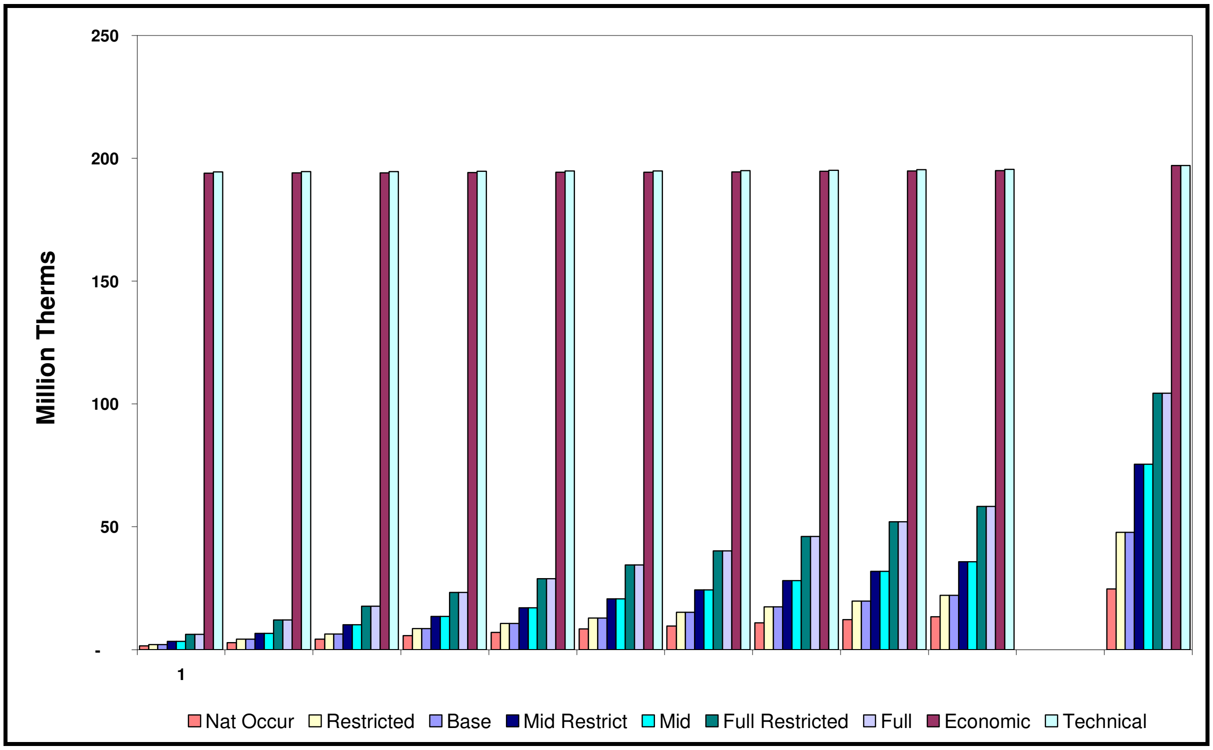
The results in Table 7-26 list the natural gas savings potential from the existing industrial sector in SCG's service territory, while Figure 7-24 illustrates the natural gas potential. Estimated gross market savings potential under current incentives are 22 million therms from 2007-2016 and 48 million therms from 2007-2026. Increasing incentives to the average between current incentives and full incremental measure costs (Mid scenario), increases the estimate of savings to 36 million therms for 2007-2016 and 75 million therms for 2007-2026. Increasing incentives to Full incremental measure cost increases the potential savings to 58 million therms for 2007-2016 and 104 million therms for 2007-2026. Figure 7-24 illustrates the yearly natural gas potential savings, by scenario.

Table 7-26: SCG Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	194	194	2	2	1	2	2	3	3	6	6	3	3	1
2008	194	194	4	4	3	4	3	7	7	12	12	6	6	3
2009	195	194	6	6	4	7	5	10	10	18	18	10	10	4
2010	195	194	9	9	6	9	6	14	14	23	23	17	17	6
2011	195	194	11	11	7	11	8	17	17	29	29	23	23	7
2012	195	194	13	13	8	14	10	21	21	34	34	29	29	8
2013	195	194	15	15	10	17	12	24	24	40	40	36	36	10
2014	195	195	17	17	11	19	13	28	28	46	46	42	42	11
2015	195	195	20	20	12	22	15	32	32	52	52	48	48	12
2016	195	195	22	22	13	25	17	36	36	58	58	55	55	13
2026	197	197	48	48	25	55	39	75	75	104	104	103	103	25

Refer to Table 7-3 for a description of the scenarios.

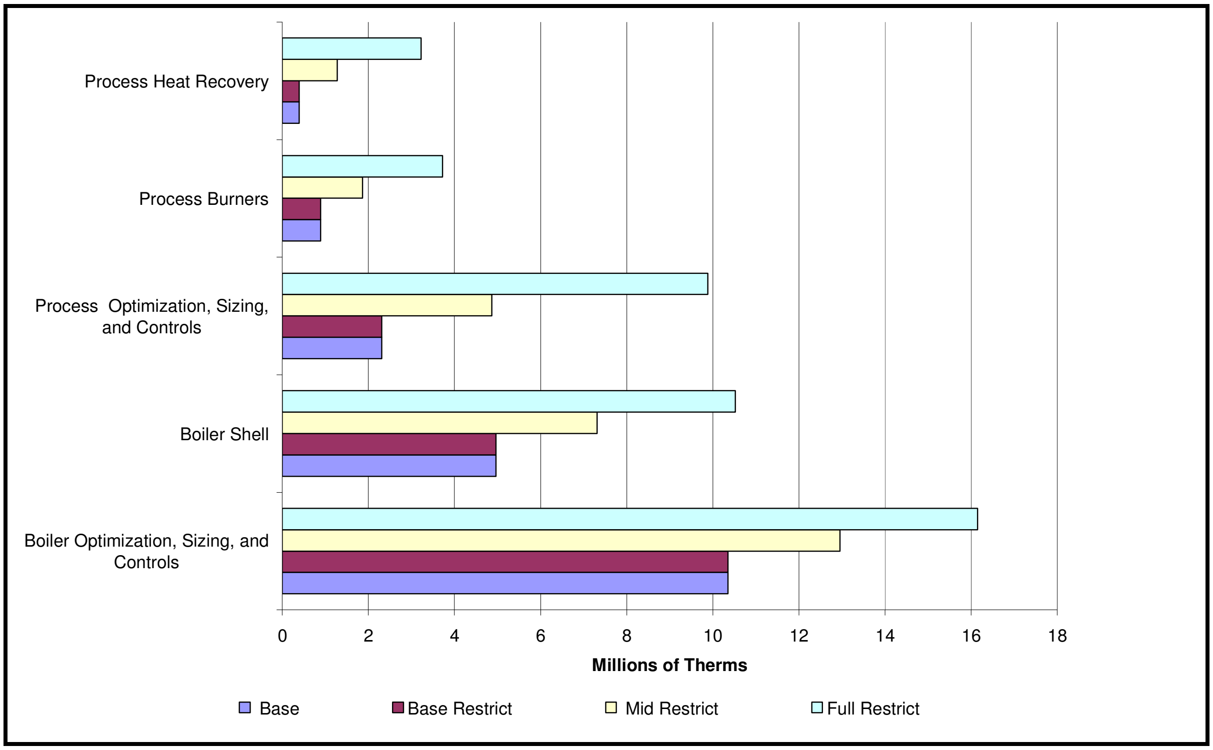
Figure 7-24: Estimated SCG Total Technical, Economic, Gross Market, and Naturally Occurring Gas Potential for the Existing Industrial Sector – 2007-2016



Refer to Table 7-3 for a description of the scenarios.

Figure 7-25 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all boiler optimization, controls, sizing, and maintenance measures into one measure group provides SCG with the highest level of potential for a single measures group within its industrial sector. The second highest measure saving group is boiler shell measures, which includes insulation and ducts.

Figure 7-25: SCG Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 7-3 for a description of the scenarios.

SDG&E Potential Gas Savings Forecasts for the Existing Industrial Sector

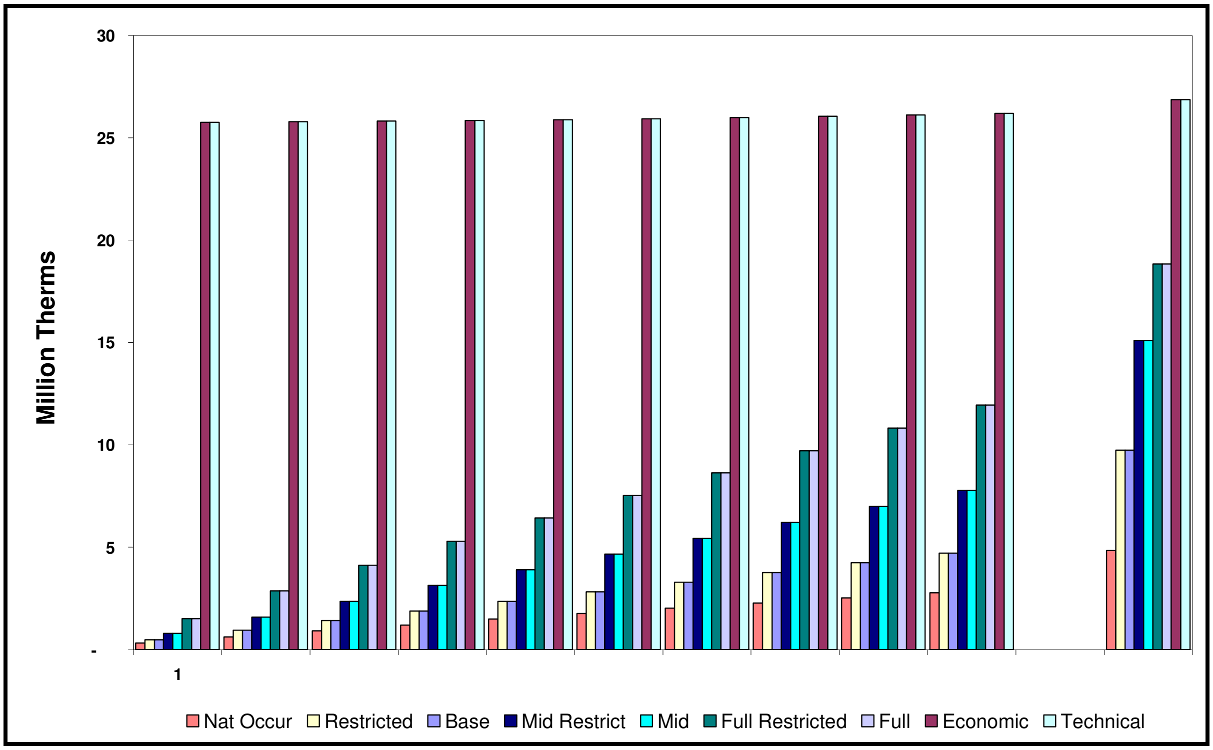
Table 7-27 lists the natural gas potential savings for SDG&E's existing industrial sector by scenario. At 2006 incentive levels, the natural gas potential savings is 5 million therms for 2007-2016 and 10 million therms for 2007-2026. Increasing incentives to the average between the 2006 level and full incremental measure cost (Mid scenario) is estimated to increase natural gas savings to 8 million therms for 2007-2016 and 15 million therms for 2007-2026. Setting incentives to Full incremental measure costs is forecast to increase potential to 12 million therms for 2007-2016 and 19 million therms for 2007-2026.

Table 7-27: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Existing Industrial Sector – 2007-2016 and 2026 (Millions of Therms)

Total	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Awareness Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradua l	Full Restrict Gradua l	Mid and Full Naturally Occurring
2007	26	26	0	0	0	0	0	1	1	2	2	1	1	0
2008	26	26	1	1	1	1	1	2	2	3	3	1	1	1
2009	26	26	1	1	1	1	1	2	2	4	4	2	2	1
2010	26	26	2	2	1	2	1	3	3	5	5	4	4	1
2011	26	26	2	2	1	2	2	4	4	6	6	5	5	1
2012	26	26	3	3	2	3	2	5	5	8	8	7	7	2
2013	26	26	3	3	2	4	2	5	5	9	9	8	8	2
2014	26	26	4	4	2	4	3	6	6	10	10	9	9	2
2015	26	26	4	4	3	5	3	7	7	11	11	10	10	3
2016	26	26	5	5	3	5	4	8	8	12	12	11	11	3
2026	27	27	10	10	5	11	8	15	15	19	19	19	19	5

Refer to Table 7-3 for a description of the scenarios.

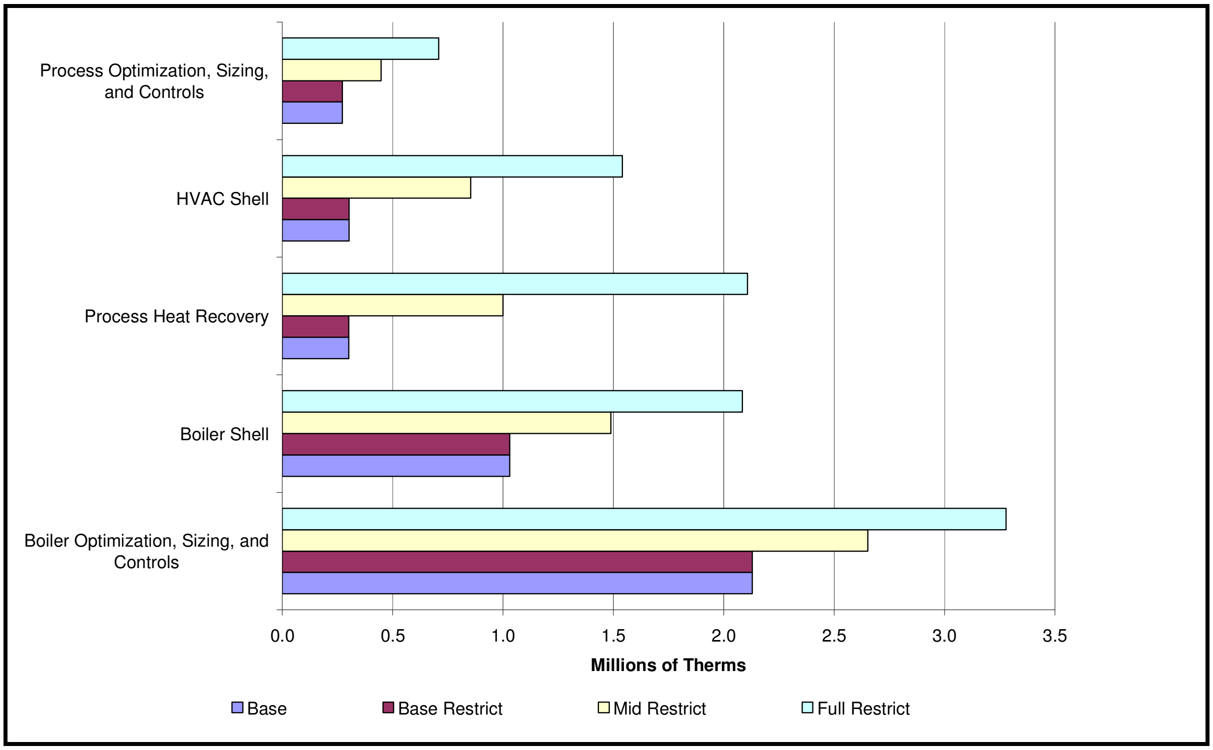
Figure 7-26: Estimated SDG&E Total Technical, Economic, Gross Market and Naturally Occurring Natural Gas Potential for the Existing Industrial Sector – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 7-3 for a description of the scenarios.

Figure 7-27 illustrates the natural gas savings potential from the top five savings measure groups. Grouping all boiler optimization, sizing, control, and maintenance measures into one measure group illustrates the importance of this measure in SDG&E's industrial energy efficiency natural gas program. The following top four saving measures include boiler shell measures, process heat recovery, HVAC shell measures, and process optimization, sizing, controls, and maintenance.

Figure 7-27: SDG&E Total Market Gross Natural Gas Savings Potential by Measure Group and Scenario for the Top Five Savings Measures – 2007-2016 (Millions of Therms)



Refer to Table 7-3 for a description of the scenarios.

Natural Gas Utility-Specific Cost and Benefits for Existing Industrial Buildings

Table 7-28 through Table 7-30present the costs and benefits associated with the alternative funding levels for each utility. These tables show that the forecast of the TRC is greater than 1.0 for all utilities under all funding levels.

Table 7-28: Summary of PG&E Gas Market Potential Costs and Benefits by Scenario for Existing Industrial Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	16	16	72	158
PDV Net Measure Costs	37	37	106	175
PDV Gross Program Costs	22	22	36	48
PDV Net Elec Avoided Cost Benefits	0	0	0	0
PDV Net Gas Avoided Cost Benefits	203	203	481	759
TRC	3.42	3.42	3.39	3.40

Refer to Table 7-3 for a description of the scenarios. PDV Net Measure Costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. The PDV Gross Program Costs are the non-incentive program costs.

Table 7-29: Summary of SCG Gas Market Potential Costs and Benefits by Scenario for Existing Industrial Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	12	12	53	135
PDV Net Measure Costs	25	25	77	149
PDV Gross Program Costs	17	17	27	40
PDV Net Elec Avoided Cost Benefits	0	0	0	0
PDV Net Gas Avoided Cost Benefits	132	132	318	553
TRC	3.12	3.12	3.04	2.94

Refer to Table 7-3 for a description of the scenarios. PDV Net Measure Costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. The PDV Gross Program Costs are the non-incentive program costs.

Table 7-30: Summary of SDG&E Gas Market Potential Costs and Benefits by Scenario for Existing Industrial Buildings – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	3	3	12	26
PDV Net Measure Costs	6	6	17	27
PDV Gross Program Costs	4	4	6	7
PDV Net Elec Avoided Cost Benefits	0	0	0	0
PDV Net Gas Avoided Cost Benefits	33	33	76	118
TRC	3.37	3.37	3.39	3.37

Refer to Table 7-3 for a description of the scenarios. PDV Net Measure Costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. The PDV Gross Program Costs are the non-incentive program costs.

7.4 Cost and Benefits for Existing Industrial Buildings

Table 7-31 presents the California IOU costs and benefits associated with the existing industrial energy efficiency programs under the alternative funding levels and TRC restrictions. The table shows that the forecast of the TRC is greater than 1.0 for all scenarios.

Table 7-31: Summary of Total California IOU Costs and Benefits for the Existing Industrial Sector – 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
PDV Gross Incentives	177	150	458	914
Net Measure Costs	415	313	614	936
Gross Program Costs	140	136	183	231
Net Elec Avoided Cost Benefits	955	904	1,382	1,872
Net Gas Avoided Cost Benefits	367	367	875	1,430
TRC	2.38	2.83	2.83	2.83

Refer to Table 7-3 for a description of the scenarios. PDV Net Measure Costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. The PDV Gross Program Costs are the non-incentive program costs.

7.5 Key Industrial Results

7.5.1 Summary of Key Results for Existing Industrial Buildings

The statewide market potential for electric energy efficiency at the currently funded level (Base scenario) is 1,836 gross GWh for 2007-2016 and 3,242 GWh for 2007-2026. The net Base scenario potential is 858 GWh over a 10-year period and 1,539 GWh over a 20-year period. Increasing incentives to a level equal to the mid-point between current incentives and full incremental costs (Mid scenario), is estimated to lead to energy savings of 2,413 GWh for 2007-2016 and 3,937 GWh for 2007-2026. Further ramping up incentives to cover Full incremental measure costs increases gross electric energy potential to 2,975 GWh for 2007-2016 and 4,527 GWh for 2007-2026.

The Base scenario gross market potential for coincident peak demand reduction is 297 MW over a 10-year period and 524 MW for 2007-2026. The Base scenario net potential is 141 MW for 2007-2016 and 252 MW over the 20-year forecast period. Increasing incentives to cover Full incremental costs increases the gross coincident peak demand potential to 485 MW for 2007-2016 and 736 MW for 2007-2026. The net Full scenario potential is 329 MW for 2007-2016 and 464 MW for 2007-2026.

The market potential for gross gas efficiency at the currently funded level (Base scenario) was 56 million therms over a 10-year period and 119 million therms for 2007-2026. The net base potential estimate was 23 million therms for 2007-2016 and 59 million therms for 2007-2026. Ramping up incentives to cover Full incremental costs increased the estimates of gross savings to 146 million therms for 2007-2016 and 245 million therms for 2007-2026.

8

Energy Efficiency Potential in Residential New Construction

This section presents the estimates of residential energy efficiency potential in newly constructed homes. Estimates of potential are presented for 2007-2016, and for 2026. Market potential was estimated for *eight* scenarios. The scenarios assume alternative levels of measure incentives and cost-effectiveness tests.[1] All market results are presented as total savings associated with cumulative gross adoptions over the estimation period. An estimate of technical potential and economic potential is presented for comparison purposes.

8.1 Overview

Itron estimated energy efficiency potential for residential new construction by building type and climate zone. The approach used was similar to the one used to estimate potential in existing residential buildings with several important differences. The differences include using packages of measures versus individual measures, the development of incremental costs, the development of energy savings, the number of building types, the number of scenarios, and the estimates of naturally occurring savings. Each is described in further detail below.

Appendix E includes a summary of the methodology on how the prototypes and the costs and savings were developed.

8.1.1 Packages of Measures

The objectives of the 2006 New Construction Potential Study included finding the savings potential for residential buildings that would approximate the building of ENERGY STAR® homes under the existing Standards (reaching 15% and 25% above the 2001 codes) and under the new Standards (reaching 10% and 15% above the 2005 codes) by Title 24 climate zone. Instead of estimating potential for the individual measures, it was necessary to develop packages of measures that could be added to the baseline home/building to allow it to reach the efficiency levels listed in Table 8-1. The packages developed in the 2006 New

[1] Unlike the analysis of potential in existing buildings, new construction did not include the Base Restrict with Higher Awareness scenario or the CFLs as Base Lighting scenario.

Construction Potential Study were used in this study. Redeveloping residential new construction packages was not in the scope of this project.

Appendix E includes more detail on the measures included in each package by building type and climate zone.

Table 8-1: Residential New Construction Measure Descriptions

End Use	Measure Description	Fuel Type
RNC	Least Cost Package to reach 15% above 2001 Standards	Electric and Gas
RNC	Least Cost Package to reach 25% above 2001 Standards	Electric and Gas
RNC	Least Cost Package to reach 10% above 2005 Standards	Electric and Gas
RNC	Least Cost Package to reach 15% above 2005 Standards	Electric and Gas

8.1.2 Incremental Costs

While the incremental measure costs used in the existing residential potential study were obtained primarily from the Database for Energy Efficient Resources (DEER), they were inappropriate for the new construction analysis. Over 90% of new homes in California are built by medium to large builders who might receive discounts on equipment/products, unlike the average residential consumer in the existing residential potential study who would be purchasing high efficiency equipment themselves.[2] Therefore, the incremental measure costs for high efficiency measures were developed by interviewing builders and contractors.[3] These individual measure costs were then aggregated to develop the package costs. The incremental costs used in this study relied on those used in the Itron 2006 study. Revising the incremental costs was not in the original scope of work and the PAC agreed to review only those costs where significant changes were expected over the last three years. The only change made was to the incremental costs of high efficiency air conditioners, which decreased by $100 to $150 (varies by building type).

8.1.3 Energy Savings

In order to account for the interactive effects of installing packages of measures, the savings used in the residential new construction analysis were developed using MICROPAS.[4]

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2 Itron, Inc. *Residential New Construction Baseline Study of Building Characteristics - Homes Built After 2001 Codes.* Prepared for Pacific Gas and Electric. August 2004.

3 Itron, Inc. *Incremental Costs Study*. Prepared for Pacific Gas and Electric. September 2003.

4 MICROPAS was chosen as the compliance tool because it is the tool of choice among energy consultants for performing low-rise residential compliance analysis. Interviews with MICROPAS developers indicate that more than 75% of energy professionals use their product. Further, two subsequent studies by Itron indicate that more than 90% of energy compliance documentation was completed using MICROPAS.

8.1.4 Building Types

The existing residential potential study developed inputs and estimated potential for three building types: single family detached homes, multifamily buildings, and mobile homes. For the new construction analysis, however, it was necessary to develop cost and savings estimates and estimates of potential for five building types due to differences in building shells (single family homes) and equipment types (multifamily buildings). The five building type groups include one-story single family detached homes, two-story single family detached homes, two-story single family attached homes (nobody above or below), two-story multifamily buildings (apartments), and three-story multifamily buildings (apartments).

Table 8-2: Residential New Construction Segments

Segments
Single Family Detached One Story
Single Family Detached Two Story
Single Family Attached Two Story
Multifamily Two Story
Multifamily Three Story

8.1.5 Scenarios

Table 8-3 provides the list of scenarios used to analyze the potential in existing buildings. The analysis of potential in new construction did not include the Base TRC Restricted Higher Awareness or CFLs as Base Lighting scenarios that were estimated in the existing potential analysis.

Table 8-3: Residential New Construction Scenario Descriptions

Scenario Name	Scenario Description
Base Incentive	Includes measures incentivized in the 2004-2005 program year with incentives that were available in 2006.
Mid Incentive	Includes all measures analyzed in the study with incentives half way between those that were available in 2006 and full incremental costs.
Full Incentive	Includes all measures analyzed with incentives set to full incremental costs.
Base Incentive TRC Restricted	Base incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Mid Incentive TRC Restricted	Mid incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Incentive TRC Restricted	Full incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Gradual	Includes all measures analyzed with incentives increasing from 2006 levels to full incremental costs in 2010.
Full Gradual TRC Restricted	Full gradual scenario with measures restricted to those with a TRC greater than or equal to 0.85.

8.1.6 Naturally Occurring Estimates

The residential new construction potential results do not report naturally occurring savings. This was by design and not a result of the forecast model. As explained in more detail in Appendix E, savings estimates were estimated by comparing the least cost package of each prototype reaching the specified program level (for example: 15% above the 2005 Title 24 Standards) with the 2005 baseline prototypes. Therefore, the gross savings provided are already reduced by the naturally occurring potential plus the nonparticipant spillover that is included in the baseline estimates. If the reader was to assume that free ridership and nonparticipant spillover were approximately equal, the results labeled as gross savings in every table and graph in this report could be considered net savings. However, since this analysis did not attempt to quantify the size of free ridership and spillover, we have continued using the term gross savings throughout this section.

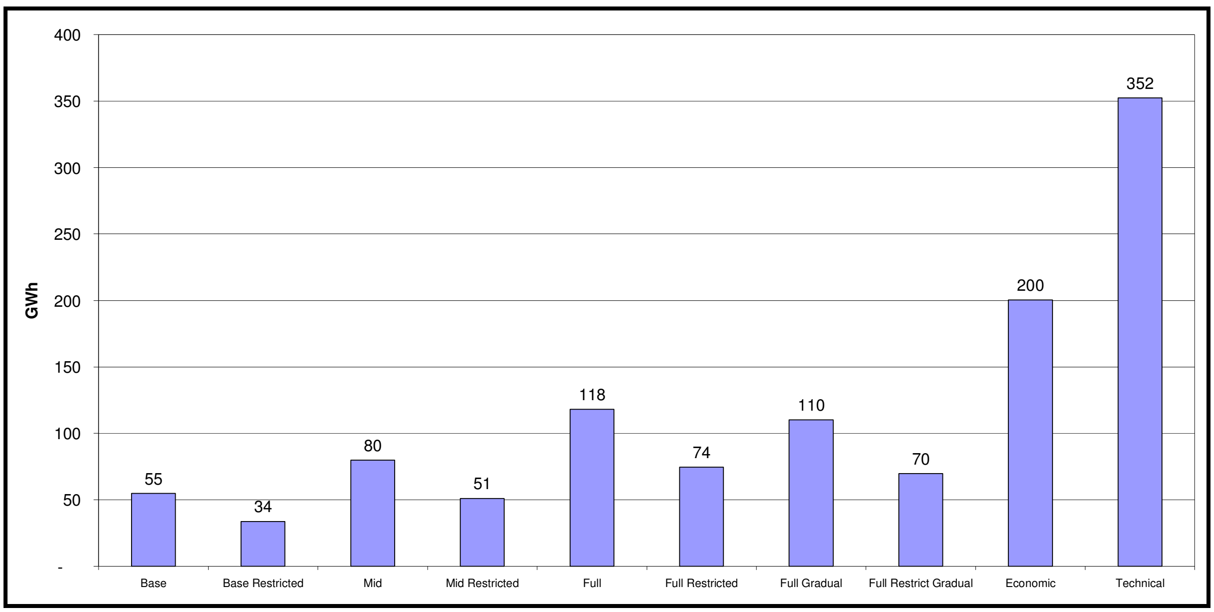
8.2 Electric Efficiency Potential in Residential New Construction

8.2.1 Residential New Construction Market Potential for Energy Efficiency

In this subsection, the results of the analysis of the potential for residential new construction are presented under the alternative market scenarios. Figure 8-1 and Figure 8-2 present the total estimated market, technical, and economic electric energy and demand savings potential resulting from the analysis for the three California IOUs: PG&E, SCE/SCG,[5] and SDG&E. The values are provided for 2016, the last year of the short run analysis.[6]

Economic potential is approximately 60% of technical potential. This is in part due to baseline homes along the coast being built substantially above Standards, which leads to small net energy savings.[7]

Figure 8-1: Forecasted California IOU Gross Market, Economic, and Technical Potential for Residential New Construction – 2007-2016 (GWh)



Refer to Table 8-3 for a description of the scenarios.

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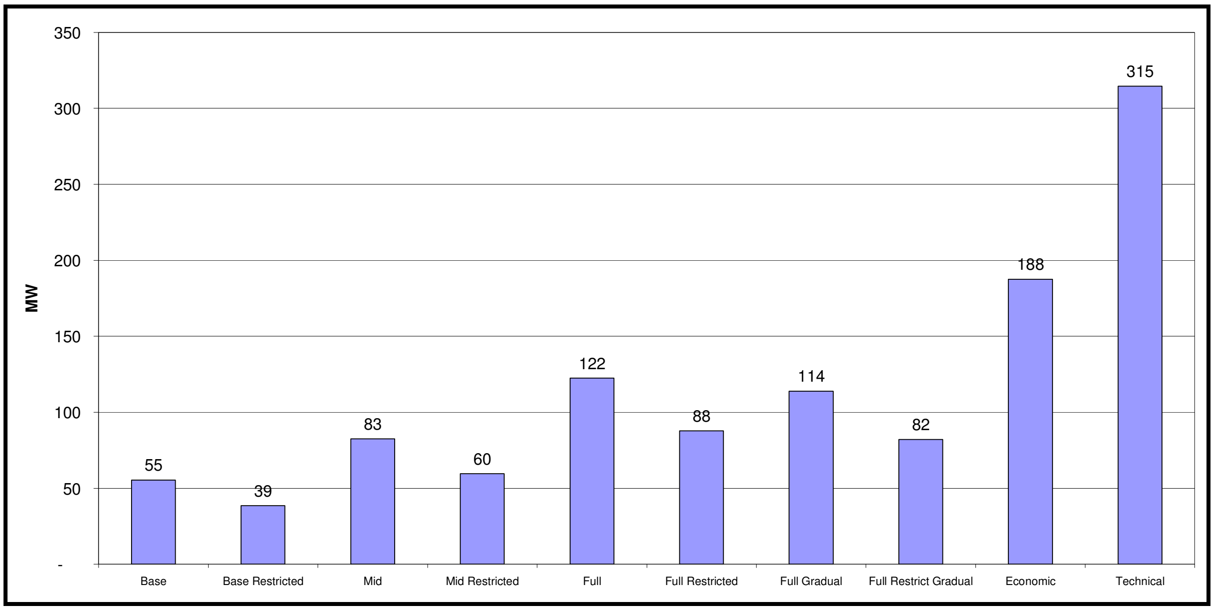
5 The combined service territories of SCE and SCG are presented together. Prior to 2006, the IOU RNC Programs focused on a performance based approach. In other words, incentives were not given for installation of individual measures (prescriptive) but rather for packages of measures which enabled the whole-house (HVAC, water heating and shell measures) to reach a certain level above the Standards. SCG and SCE previously worked in together on their RNC Programs.

6 The energy savings potential presented in this report are at the generation level.

7 Itron, Inc. *Residential New Construction Baseline Study of Building Characteristics - Homes Built After 2001 Codes.* Prepared for Pacific Gas and Electric. August 2004.

As shown in Figure 8-1, the estimated technical potential for energy savings is 352 GWh and the total estimated electric economic potential is 200 GWh for 2007-2016. The total gross Full incentive potential is 118 GWh and Base scenario incentive, or the Base forecast, is 55 GWh for 2007-2016. Figure 8-2 shows the estimated technical potential for coincident peak demand reduction to be 315 MW and total estimated economic potential to be 188 MW for 2007-2016. The total gross coincident peak demand potential under the Full scenario for 2007-2016 is 122 MW.

Figure 8-2: Forecasted California IOU Gross Market, Economic, and Technical Coincident Peak Demand Potential for Residential New Construction – 2007-2016 (MW)



Refer to Table 8-3 for a description of the scenarios.

Table 8-4 lists the total residential new construction market electric potential for 2007-2016 and for 2007-2026 by scenario, across the California IOUs. Potential estimates are provided for the intermediate forecast period (2007-2016) and for the entire forecast period (2007-2026). Total IOU market potential under the Base scenario for 2007-2016 is 55 GWh and for 2007-2026 is 123 GWh. These savings are the estimated energy savings potential if the IOUs continue the 2006 incentive levels and limit their program offerings to performance-based incentives.[8] Increasing incentives to Full incremental costs increases the total energy

8 The 2006-2008 IOU RNC Programs currently offer both prescriptive and performance based incentives. The majority of incentives given to builders under PG&E's RNC Program are performance based. SDG&E and SCG on the other hand have rebated a large number of prescriptive measures. Future potential studies should consider including both types of measures. (Note: During the planning phases of this Study, it was unclear how the IOUs plan these programs and the PAC agreed, in part due to budget constraints, to continue only including the performance based measures consistent with the 2006 Study.)

market potential estimates to 118 GWh for 2007-2016 and 230 GWh for 2007-2026. If program incentives were set halfway between Base scenario incentives and full incremental costs (the Mid scenario), estimated energy savings potential would be 80 GWh for 2007-2016 and 165 GWh for 2007-2026.

Total IOU market coincident peak demand potential is also listed in Table 8-4. The total IOU residential new construction market coincident peak demand potential under the Base scenario is 55 MW for 2007-2016 and 125 MW for 2007-2026. Increasing incentives to the halfway point between Base scenario and full incremental cost incentives increases the estimate of the coincident peak demand potential to 83 MW for 2007-2016 and 171 MW for 2007-2026. Further increasing incentives to Full incremental measure cost increases residential new construction coincident peak demand potential to 122 MW for 2007-2016 and 239 MW for 2007-2026.

The RNC potential analyses relied on the 2003 Baseline Study as the baseline of newly build homes in California.

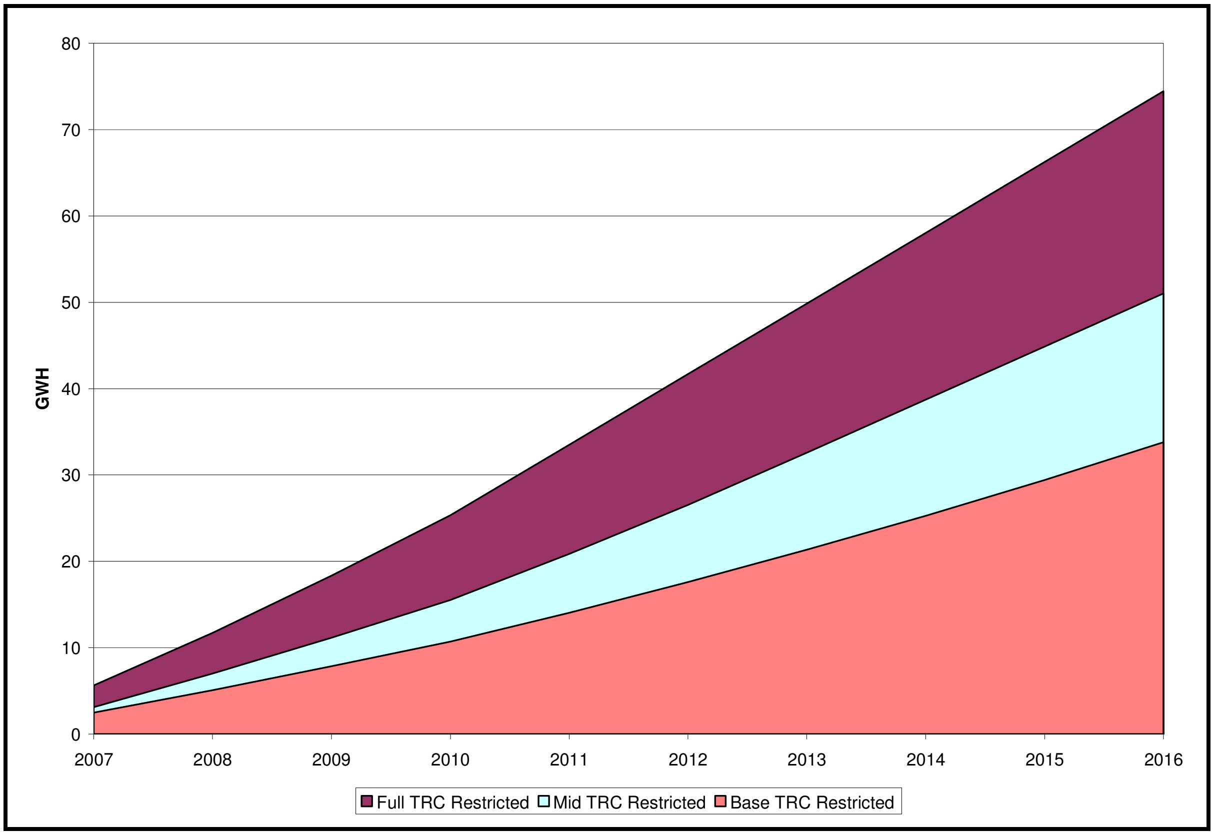
Table 8-4: Estimated California IOU Total Market Potential by Funding Level and Scenario for Residential New Construction – 2007-2016 and 2007-2026 (GWh and MW)

Funding Level	Gross Energy (GWh) 2016	Naturally Occurring Energy (GWh) 2016	Coincident Peak Demand (MW) 2016	Naturally Occurring Coincident Peak Demand (MW) 2016	Gross Energy (GWh) 2026	Naturally Occurring Energy (GWh) 2026	Coincident Peak Demand (MW) 2026	Naturally Occurring Coincident Peak Demand (MW) 2026
Base	55	-	55	-	123	-	125	-
Base Restricted	34	-	39	-	78	-	89	-
Mid	80	-	83	-	165	-	171	-
Mid Restricted	51	-	60	-	107	-	126	-
Full	118	-	122	-	230	-	239	-
Full Restricted	74	-	88	-	148	-	175	-
Full Gradual	110	-	114	-	227	-	235	-
Full Restrict Gradual	70	-	82	-	146	-	172	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

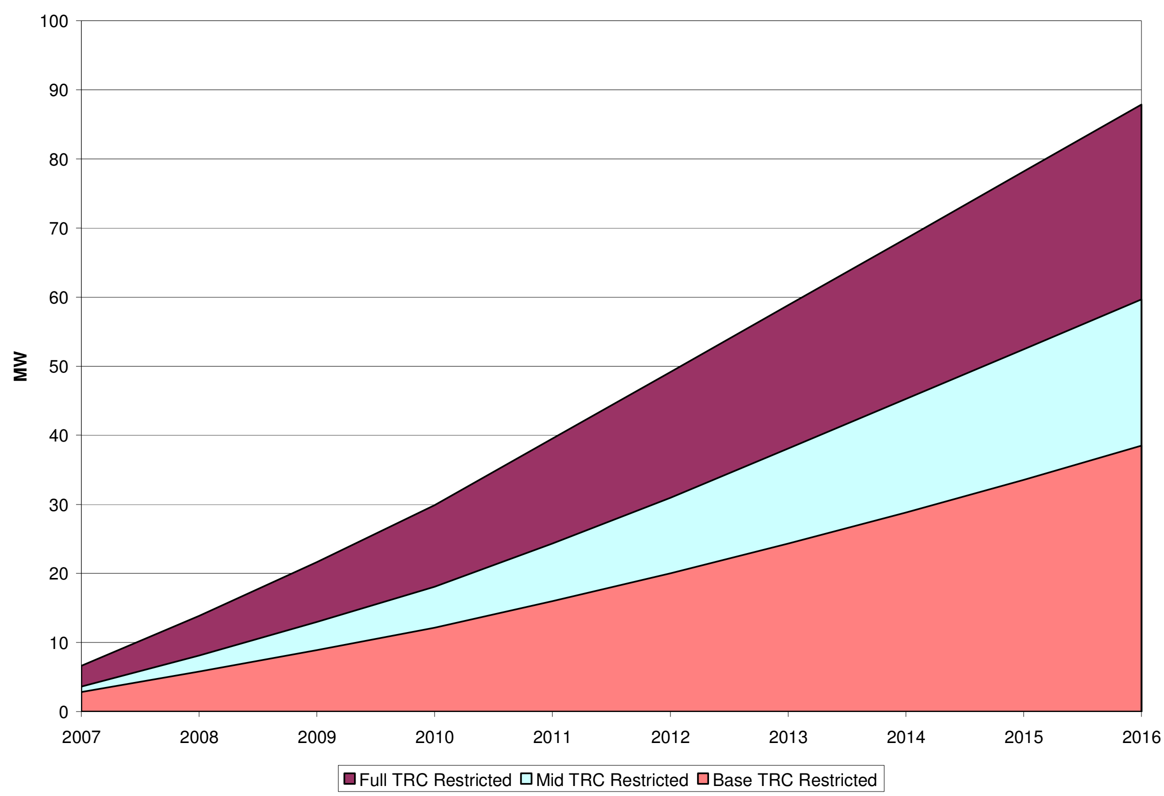
The results for the TRC restricted gross market scenarios are illustrated in Figure 8-3 and Figure 8-4. These graphs illustrate the yearly estimate of TRC restricted market potential from cumulative adoptions from 2007 to 2016.

Figure 8-3: Estimated Gross Total Energy Market Potential by TRC Restricted Funding Levels for Residential New Construction – 2007-2016 (GWh)



Refer to Table 8-3 for a description of the scenarios.

Figure 8-4: Estimated Gross Total Coincident Peak Demand Market Potential by TRC Restricted Funding Levels for Residential New Construction – 2007-2016 (MW)



Refer to Table 8-3 for a description of the scenarios.

Market Potential by Building Type for Residential New Construction

Table 8-5 and Table 8-6 summarize the energy market potential estimates by funding level and building type—single family and multifamily (which includes single family attached buildings)—for 2007-2016 and 2007-2026. For comparison, technical and economic estimates are listed in Table 8-7. As shown, the largest contributors to energy savings are single family residences with a contribution of 91% to the Base scenario's estimated energy savings potential for 2007-2016. Table 8-8, Table 8-9, and Table 8-10 provide similar results for coincident peak demand reduction. Again, the largest contributors to demand savings are single family units whose share of the economic potential is 96% for 2007-2016. Figure 8-5 and Figure 8-6 illustrate the estimated potential for the restricted scenarios by building type for the 2007-2016 analysis period.

Table 8-5 shows that increasing funding levels to the halfway point between Base scenario and Full incremental cost incentives increases the estimate of impacts from 50 GWh to 72 GWh for 2007-2016 for single family new construction and from 5 GWh to 7 GWh for multifamily new construction. Further increasing incentives to Full incremental measure cost increases residential new construction single family energy market potential to 104 GWh and multifamily energy market potential to 14 GWh for 2007-2016. Restricting program incentives to those measures with a TRC of 0.85 or above, reduces the Base market impacts by 38% for single family new construction for 2007-2016 and by 37% for 2007-2026, while multifamily impacts are reduced by 40% for 2007-2016 and 2007-2026. The savings numbers are highly dependent on the CEC forecast of housing growth as evidenced by the higher potential forecast by the previous study based on estimates of a significantly larger growth in new construction.

Table 8-5: Estimated California IOU Total Gross Market Energy Potential by Building Type and Funding Level for Residential New Construction – 2007-2016 (GWh)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Single Family	50	31	-	72	47	104	67	-
Multifamily	5	3	-	7	4	14	7	-
Total	**55**	**34**	**-**	**80**	**51**	**118**	**74**	**-**

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Table 8-6: Estimated California IOU Total Gross Market Energy Potential by Building Type and Funding Level for Residential New Construction – 2007-2026 (GWh)

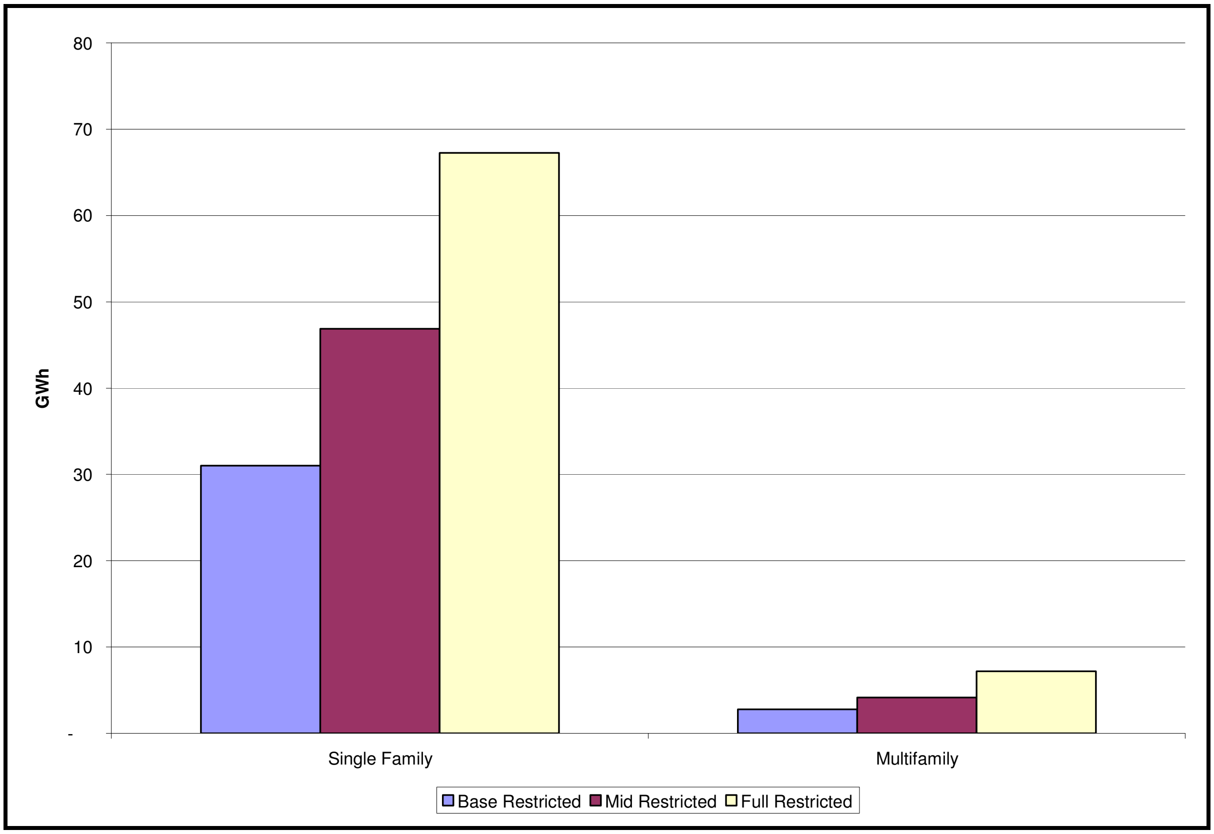
	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Single Family	113	71	-	150	99	204	134	-
Multi-family	10	6	-	15	9	27	14	-
Total	**123**	**78**	**-**	**165**	**107**	**230**	**148**	**-**

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Table 8-7: Estimated California IOU Total Technical and Economic Energy Potential by Building Type for Residential New Construction – 2007-2016 and 2007-2026 (GWh)

	Technical - 2016	Economic - 2016	Technical - 2026	Economic - 2026
Single Family	317	189	593	365
Multifamily	35	12	64	24
Total	**352**	**200**	**657**	**388**

Figure 8-5: Estimated California IOU Total Energy Potential by Building Type for Residential New Construction – 2007-2016 (GWh)



Refer to Table 8-3 for a description of the scenarios.

The results presented in Table 8-8 show that the contribution of single family residences to the total IOU residential new construction market coincident peak demand potential of 55 MW under the Base scenario is 52 MW. Increasing incentives to full incremental measure cost increases the single family new construction coincident peak demand potential to 113 MW. Restricting incentivized measures to those that are cost effective, reduces Base coincident demand potential to 37 MW, the mid incentive net coincident demand potential from 77 MW to 57 MW, and the full incentive net coincident demand potential to 83 MW for single family residences.

Table 8-8: Estimated California IOU Total Gross Market Coincident Peak Demand Potential by Building Type and Funding Level for Residential New Construction – 2007-2016 (MW)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Single Family	52	37	-	77	57	113	83	-
Multi-family	3	2	-	5	3	10	5	-
Total	**55**	**39**	**-**	**83**	**60**	**122**	**88**	**-**

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail

Table 8-9: Estimated California IOU Total Gross Market Coincident Peak Demand Potential by Building Type and Funding Level for Residential New Construction – 2007-2026 (MW)

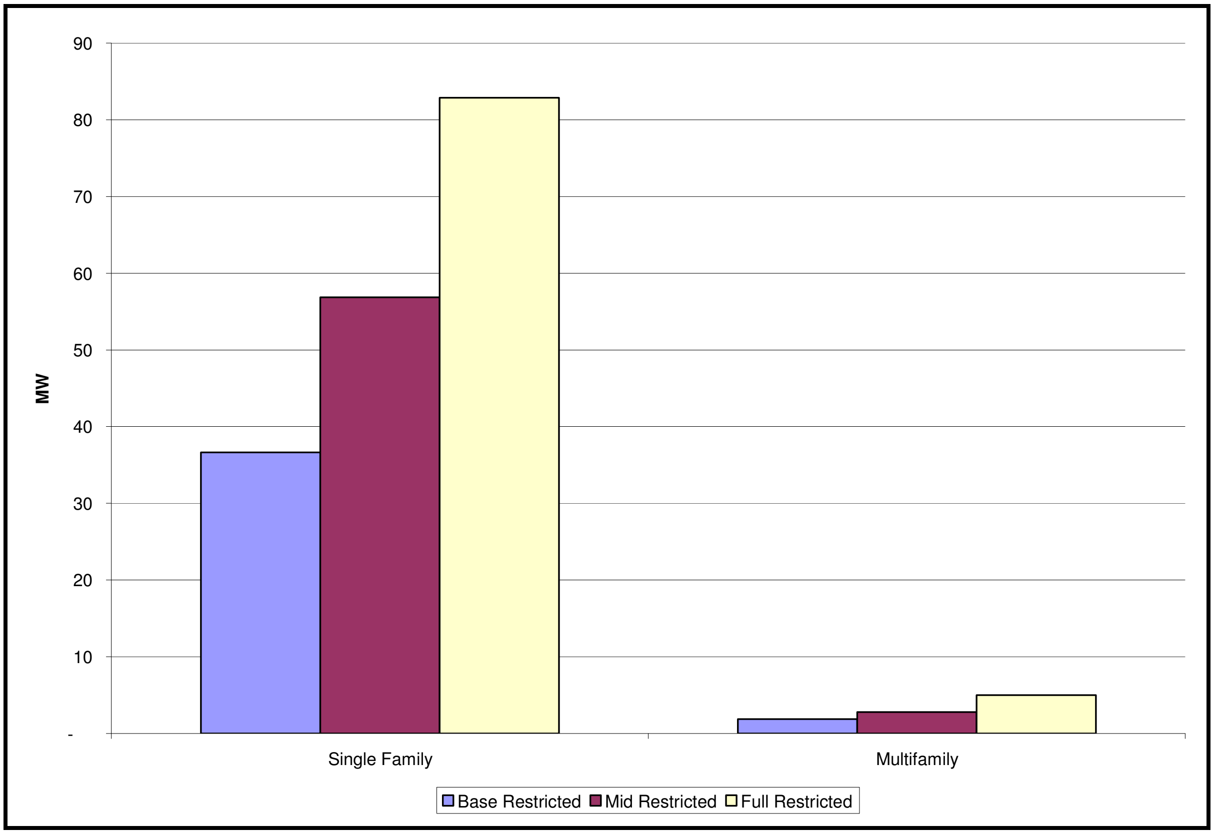
	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Single Family	118	84	-	161	120	221	165	-
Multifamily	7	4	-	10	6	18	10	-
Total	**125**	**89**	**-**	**171**	**126**	**239**	**175**	**-**

Refer to Table 8-3 for a description of the scenarios.

Table 8-10: Estimated California IOU Total Technical and Economic Coincident Peak Demand Potential by Building Type for Residential New Construction – 2007-2016 and 2007-2026 (MW)

	Technical - 2016	Economic - 2016	Technical - 2026	Economic - 2026
Single Family	292	180	548	349
Multifamily	23	8	41	16
Total	**315**	**188**	**589**	**365**

Figure 8-6: Estimated California IOU Total Coincident Peak Demand Potential for Residential New Construction – 2007-2016 (MW)



Refer to Table 8-3 for a description of the scenarios.

8.2.2 Residential Utility-Level Potential

PG&E Potential Energy Savings Forecasts for Residential New Construction

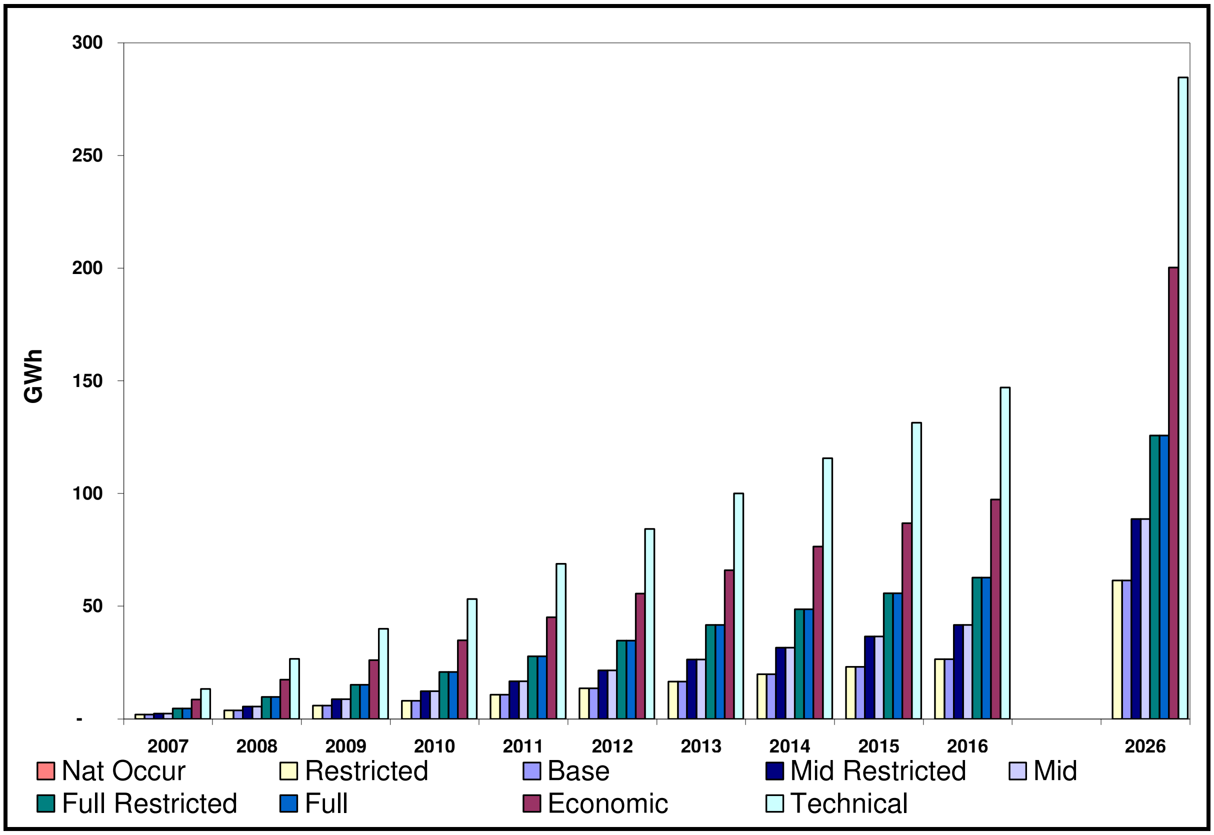
The results in Table 8-11 list the energy savings potential from residential new construction in PG&E's service territory, while Figure 8-7 illustrates the savings estimates. Estimated gross market savings potential under Base scenario incentives are 27 GWh for 2007-2016 and 62 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (Mid incentives scenario), increases the estimate of savings to 42 GWh for 2007-2016 and 89 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 63 GWh for 2007-2016 and 126 GWh for 2007-2026.

Table 8-11: PG&E Estimated Total Technical, Economic, and Gross Market Potential by Funding Level and Scenario for the Residential New Construction Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	13	9	2	2	-	2	2	5	5	3	3	-
2008	27	17	4	4	-	5	5	10	10	6	6	-
2009	40	26	6	6	-	9	9	15	15	11	11	-
2010	53	35	8	8	-	12	12	21	21	17	17	-
2011	69	45	11	11	-	17	17	28	28	23	23	-
2012	84	56	14	14	-	21	21	35	35	30	30	-
2013	100	66	17	17	-	26	26	42	42	37	37	-
2014	116	76	20	20	-	32	32	49	49	44	44	-
2015	131	87	23	23	-	37	37	56	56	51	51	-
2016	147	97	27	27	-	42	42	63	63	58	58	-
2026	285	200	62	62	-	89	89	126	126	124	124	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-7: PG&E Estimated Total Technical, Economic, and Gross Market Energy Potential for Residential New Construction – 2007-2016 and 2026 (GWh)



Refer to Table 8-3 for a description of the scenarios.

SCE/SCG Potential Energy Savings Forecasts for Residential New Construction

Table 8-12 lists the energy savings potential from residential new construction in the combined SCE/SCG service territories, while Table 8-9 illustrates the savings estimates. Estimated gross market savings potential under Base scenario incentives are 19 GWh for 2007-2016 and 41 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (Mid incentives scenario), increases the estimate of savings to 25 GWh for 2007-2016 and 51 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 39 GWh for 2007-2016 and 73 GWh for 2007-2026.

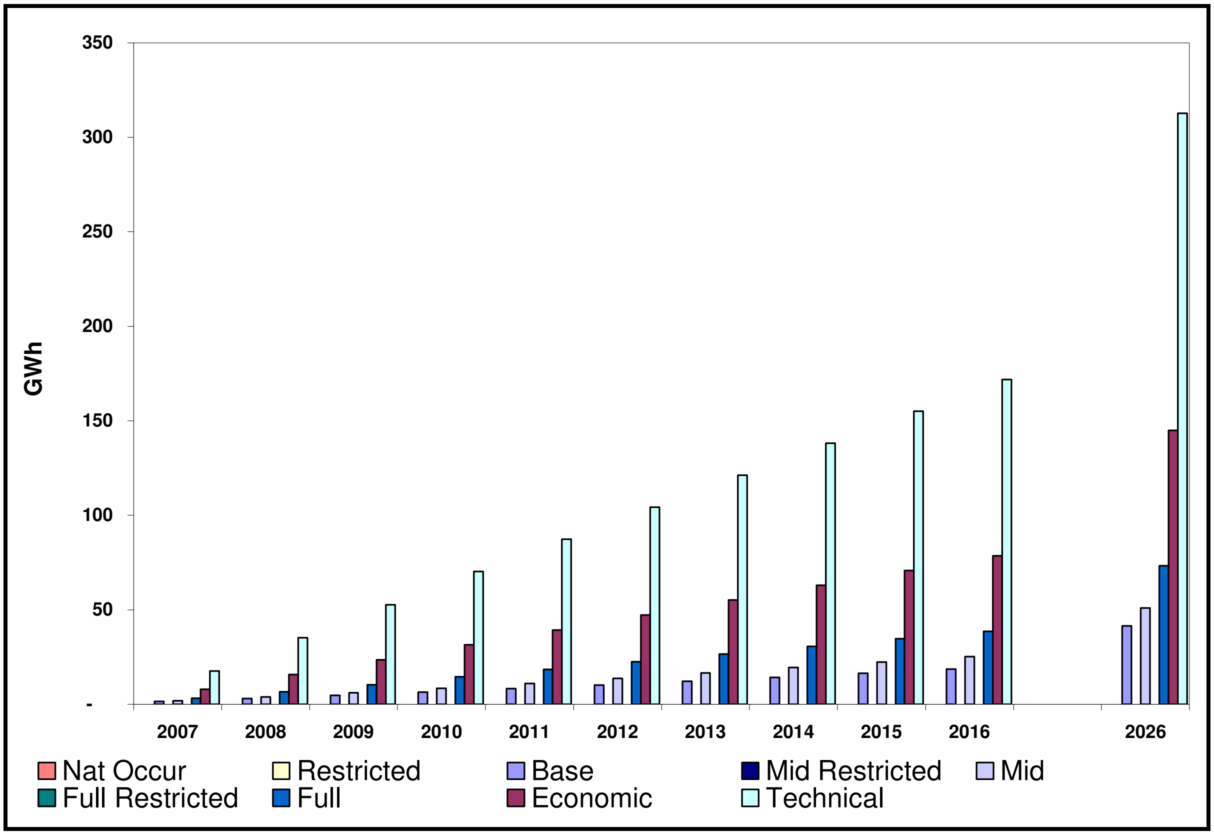
SCE's TRC Restricted residential new construction potential is zero due to the combination of high baseline levels of energy efficiency and the distribution of new construction by climate zone. The high baseline level of energy efficiency leaves less potential savings, reducing the likelihood of cost-effective savings. The high level of construction in coastal regions also leads to a reduction in cost effectiveness.

Table 8-12: SCE/ SCG Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Potential by Funding Level and Scenario for the Residential New Construction Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	18	8	1	-	-	2	-	3	-	2	-	-
2008	35	16	3	-	-	4	-	7	-	4	-	-
2009	53	24	5	-	-	6	-	10	-	7	-	-
2010	70	31	6	-	-	8	-	14	-	12	-	-
2011	87	39	8	-	-	11	-	18	-	16	-	-
2012	104	47	10	-	-	14	-	23	-	20	-	-
2013	121	55	12	-	-	16	-	27	-	24	-	-
2014	138	63	14	-	-	19	-	31	-	28	-	-
2015	155	71	16	-	-	22	-	35	-	32	-	-
2016	172	79	19	-	-	25	-	39	-	36	-	-
2026	313	145	41	-	-	51	-	73	-	72	-	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-8: SCE/ SCG Estimated Total Technical, Economic, and Gross Market Energy Potential for Residential New Construction – 2007-2016 and 2026 (GWh)



Refer to Table 8-3 for a description of the scenarios.

SDG&E Potential Energy Savings Forecasts for Residential New Construction

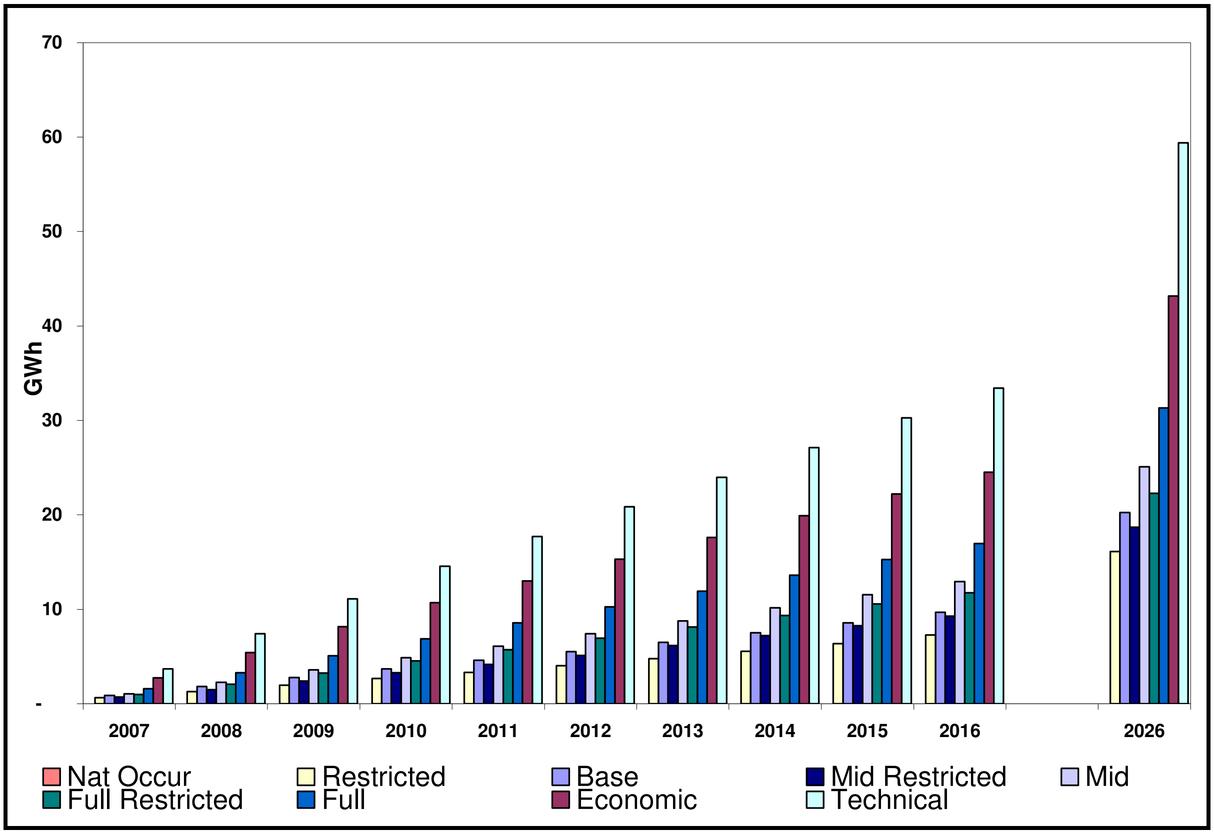
The results listed in Table 8-13 present the energy savings from residential new construction in SDG&E's service territory. Figure 8-9 illustrates SDG&E's energy savings by scenario. Estimated gross savings potential under Base scenario are 10 GWh for 2007-2016 and 20 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (Mid scenario), increases forecast potential savings to 13 GWh for 2007-2016, a 30% increase in savings. Through 2026, the Mid scenario's total gross market potential is 25 GWh, a 25% increase over the Base scenario estimates for 2007-2026, further increasing incentives to Full incremental measure cost increases potential savings to 17 GWh for 2007-2016 and 31 GWh for 2007-2026.

Table 8-13: SDG&E Estimated Total Technical, Economic, and Gross Market Potential by Funding Level Scenario for the Residential New Construction Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	3.7	2.7	0.9	0.6	-	1.0	0.7	1.6	1.0	1.1	0.8	-
2008	7.4	5.4	1.8	1.3	-	2.3	1.5	3.3	2.0	2.5	1.8	-
2009	11.1	8.1	2.8	2.0	-	3.6	2.4	5.1	3.3	4.2	2.9	-
2010	14.6	10.7	3.7	2.7	-	4.9	3.3	6.9	4.5	6.0	4.2	-
2011	17.7	13.0	4.6	3.3	-	6.1	4.1	8.6	5.7	7.6	5.4	-
2012	20.8	15.3	5.5	4.0	-	7.4	5.1	10.2	6.9	9.3	6.6	-
2013	24.0	17.6	6.5	4.8	-	8.8	6.1	11.9	8.1	11.0	7.8	-
2014	27.1	19.9	7.5	5.5	-	10.1	7.2	13.6	9.3	12.7	9.0	-
2015	30.3	22.2	8.6	6.4	-	11.5	8.2	15.3	10.5	14.4	10.2	-
2016	33.4	24.5	9.7	7.3	-	12.9	9.3	17.0	11.7	16.0	11.4	-
2026	59.4	43.2	20.3	16.1	-	25.1	18.7	31.3	22.3	30.9	22.1	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-9: SDG&E Estimated Gross Total Technical, Economic, and Market Energy Potential for Residential New Construction – 2007-2016 (GWh)



Refer to Table 8-3 for a description of the scenarios.

PG&E Potential Demand Savings Forecasts for Residential New Construction

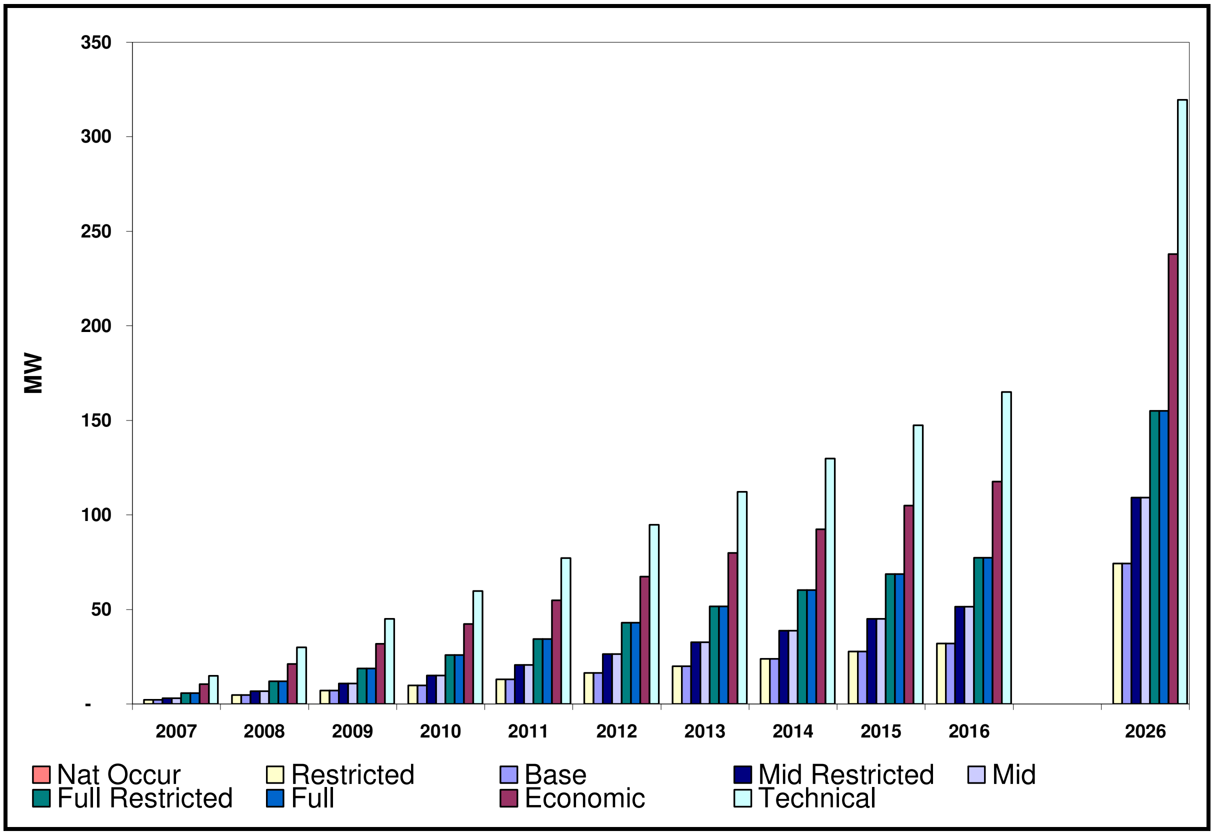
The results in Table 8-14 list the coincident peak demand savings from new construction homes in PG&E's service territory, while Figure 8-10 illustrates these estimates. The estimated coincident peak demand savings potential under the Base scenario is 32 MW for 2007-2016 and 74 MW for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (the Mid scenario), increases the estimate of coincident peak demand savings to 51 MW for 2007-2016 and 109 MW for 2007-2026. The growth rate in the coincident peak demand estimates between the Base and the Mid scenario is about 61% for 2007-2016. Further increasing incentives from Base scenario levels to Full incremental measure cost increases demand potential savings to 77 MW for 2007-2016 and 155 MW for 2007-2026.

Table 8-14: PG&E Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential by Funding Level and Scenario for the Residential New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	15	11	2	2	-	3	3	6	6	3	3	-
2008	30	21	5	5	-	7	7	12	12	8	8	-
2009	45	32	7	7	-	11	11	19	19	13	13	-
2010	60	42	10	10	-	15	15	26	26	20	20	-
2011	77	55	13	13	-	21	21	34	34	29	29	-
2012	95	67	16	16	-	26	26	43	43	38	38	-
2013	112	80	20	20	-	33	33	52	52	46	46	-
2014	130	92	24	24	-	39	39	60	60	55	55	-
2015	147	105	28	28	-	45	45	69	69	63	63	-
2016	165	118	32	32	-	51	51	77	77	72	72	-
2026	319	238	74	74	-	109	109	155	155	153	153	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-10: PG&E Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential for Residential New Construction – 2007-2016 and 2026 (MW)



Refer to Table 8-3 for a description of the scenarios.

SCE/SCG Potential Demand Savings Forecasts for Residential New Construction

The results in Table 8-15 list the peak demand savings from residential new construction in the combined SCE/SCG service territories. The estimated demand savings potential under Base scenario incentives is 15 MW for 2007-2016. Increasing incentives to the average between Base scenario incentives and full incremental measure costs, increases savings forecast for 2007-2016 to 20 MW. Increasing incentives to full incremental measure cost increases demand potential savings to 30 MW for 2007-2016, a 52% increase over the average incentive level estimate.

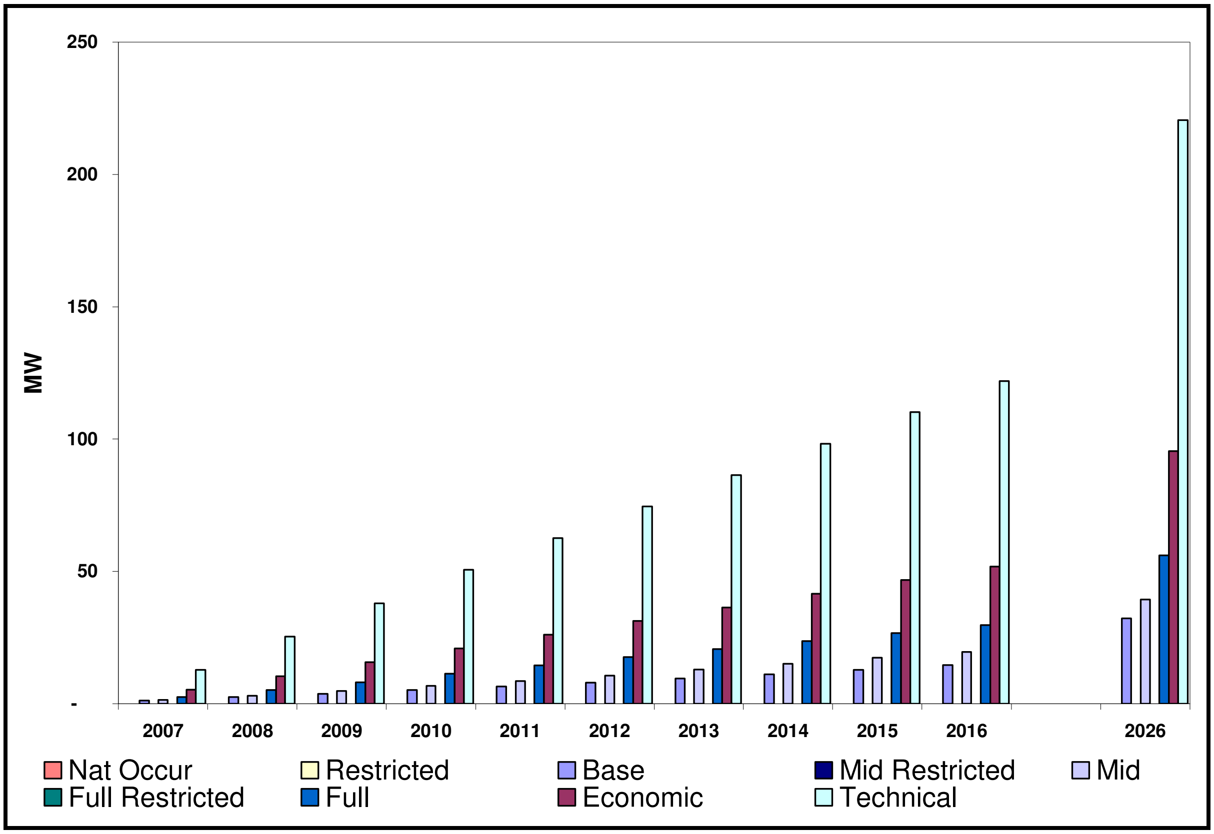
Table 8-15: SCE/SCG Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential by Scenario for the Residential New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	12.7	5.2	1.2	-	-	1.4	-	2.5	-	1.6	-	-
2008	25.3	10.4	2.4	-	-	3.0	-	5.2	-	3.5	-	-
2009	37.9	15.6	3.7	-	-	4.7	-	8.1	-	5.9	-	-
2010	50.6	20.8	5.1	-	-	6.7	-	11.4	-	9.1	-	-
2011	62.6	26.0	6.5	-	-	8.6	-	14.4	-	12.2	-	-
2012	74.5	31.2	8.0	-	-	10.6	-	17.5	-	15.3	-	-
2013	86.4	36.4	9.5	-	-	12.8	-	20.6	-	18.4	-	-
2014	98.3	41.6	11.1	-	-	15.1	-	23.6	-	21.4	-	-
2015	110.1	46.7	12.8	-	-	17.3	-	26.7	-	24.5	-	-
2016	122.0	51.8	14.6	-	-	19.5	-	29.7	-	27.5	-	-
2026	220.5	95.4	32.2	-	-	39.3	-	56.0	-	55.0	-	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-11 presents the potential coincident peak demand savings for the market scenarios and the Economic and Technical potential estimates for SCE.

Figure 8-11: SCE/SCG Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential for Residential New Construction – 2007-2016 and 2026 (MW)



Refer to Table 8-3 for a description of the scenarios.

SDG&E Potential Demand Savings Forecasts for Residential New Construction

The results in Table 8-16 list the coincident peak demand savings from residential new construction in SDG&E's service territory. The estimated gross coincident peak demand savings potential under the Base scenario (2006 incentive levels) is 8.8 MW for 2007-2016 and 18.2 MW for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs, increases forecast coincident peak demand potential to 11.7 MW for 2007-2016 and 22.7 MW for 2007-2026. Increasing incentives to Full incremental measure cost increases demand potential savings to 15.2 MW for 2007-2016 and 28.1 MW for 2007-2026. Restricting the Full incentive scenario to those measures that are nearly cost effective (TRC >0.85) reduces the coincident peak demand potential to 10.4 MW for 2007-2016 and 19.8 MW for 2007-2026.

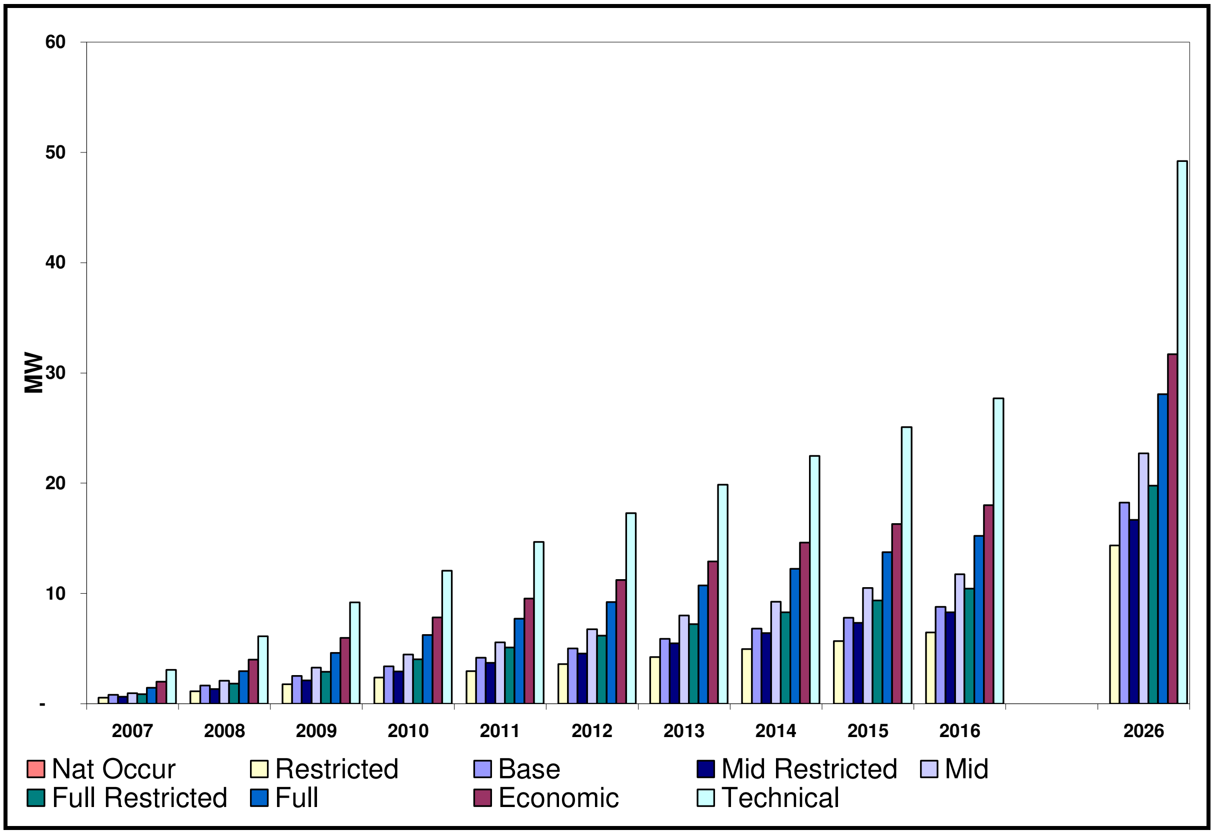
Table 8-16: SDG&E Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential by Scenario for the Residential New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	3.1	2.0	0.8	0.5	-	1.0	0.6	1.4	0.9	1.0	0.7	-
2008	6.1	4.0	1.6	1.1	-	2.1	1.3	3.0	1.8	2.3	1.6	-
2009	9.2	6.0	2.5	1.8	-	3.3	2.1	4.6	2.9	3.8	2.6	-
2010	12.1	7.8	3.4	2.4	-	4.5	2.9	6.2	4.0	5.4	3.7	-
2011	14.7	9.5	4.2	3.0	-	5.6	3.7	7.7	5.1	6.9	4.8	-
2012	17.3	11.2	5.0	3.6	-	6.8	4.5	9.2	6.2	8.4	5.8	-
2013	19.9	12.9	5.9	4.2	-	8.0	5.5	10.7	7.2	9.9	6.9	-
2014	22.5	14.6	6.8	4.9	-	9.2	6.4	12.2	8.3	11.4	8.0	-
2015	25.1	16.3	7.8	5.7	-	10.5	7.3	13.7	9.4	12.9	9.0	-
2016	27.7	18.0	8.8	6.5	-	11.7	8.3	15.2	10.4	14.4	10.1	-
2026	49.2	31.7	18.2	14.3	-	22.7	16.7	28.1	19.8	27.7	19.6	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-12 illustrates SDG&E's potential coincident peak demand savings associated with Technical, Economic and the market scenarios.

Figure 8-12: SDG&E Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential for Residential New Construction – 2007-2016 and 2026 (MW)



Refer to Table 8-3 for a description of the market funding scenarios.

8.3 Gas Efficiency Potential in Residential New Construction

8.3.1 Market Total Natural Gas Potential in Residential New Construction

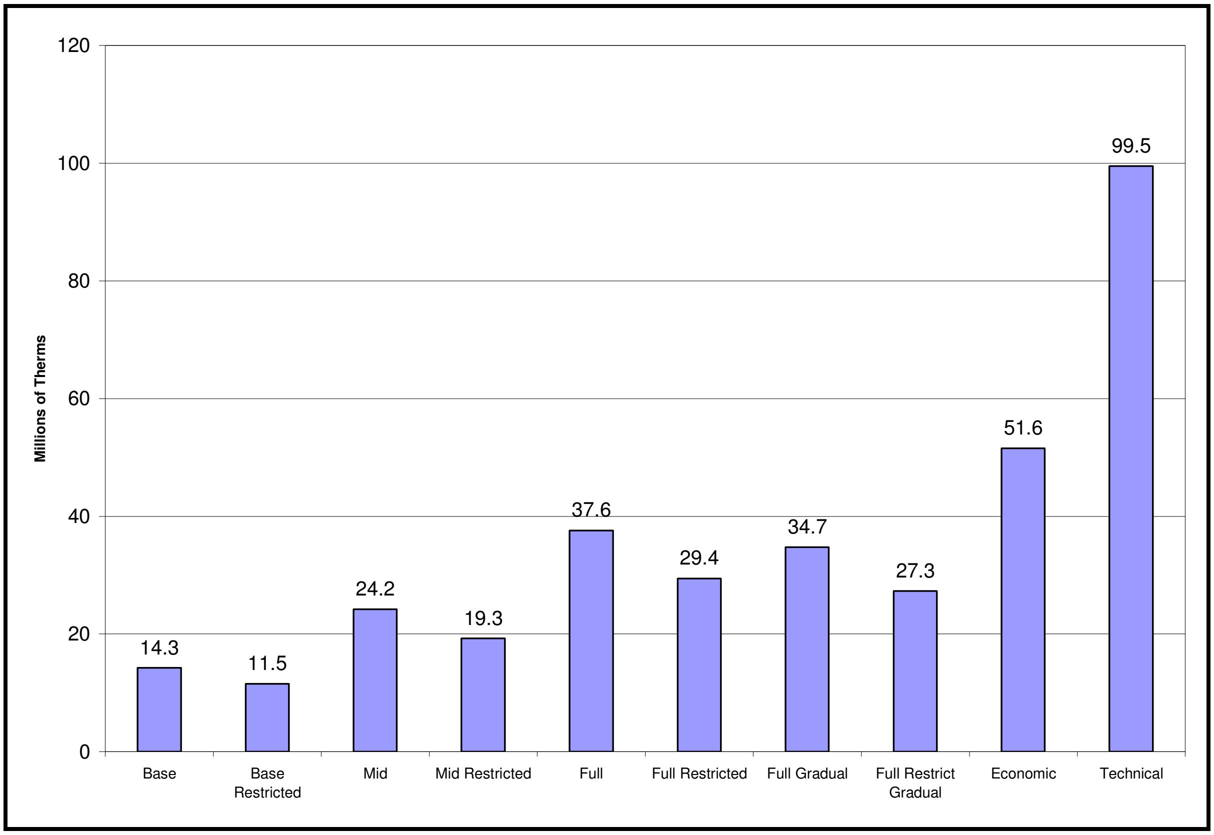
Total IOU Residential Market Potential

Figure 8-13 presents the total estimated potential estimates from the analysis for the three state investor-owned gas utilities of Pacific Gas & Electric (PG&E), Southern California Gas Company (SCG) and San Diego Gas & Electric (SDG&E). The values are provided for the last year of the short-term analysis, 2016.

As shown, total estimated Technical potential is just under 100 million therms, while the estimated Economic potential is 52 million therms and the Full scenario estimate is 38 million therms for measures adopted from 2007 to 2016 that are still installed in 2016. The

Full scenario does not restrict measures by cost effectiveness. Limiting the measures/packages in the Full scenario to those with a TRC greater to or equal to 0.85 reduces the estimate of potential to 29 million therms.

Figure 8-13: Estimated California IOU Total Technical, Economic, and Gross Market Potential for Residential New Construction – 2007-2016



Refer to Table 8-3 for a description of the scenarios.

Table 8-17 presents natural gas potential estimates by scenario for the intermediate forecast period, 2007-2016 and for the entire forecast period of 2007-2026 across three California IOUs (PG&E, SCG, and SDG&E). Total IOU market potential under the Base scenario is 14.3 million therms of natural gas potential for 2007-2016 and 32 million therms for 2007-2026. Increasing incentives to Full incremental costs increases the 2007-2016 total market forecast to 38 million therms and the 2007-2026 forecast to 73 million therms. Limiting packages in the Full scenario to those with a TRC > 0.85 reduces the potential estimates to 29 million therms for 2007-2016 and 58 million therms for 2007-2026. If program incentives are set half way between Base scenario incentives and full incremental costs, the Mid scenario, estimated 2007-2016 natural gas potential savings are 24 million therms and the 2007-2026 potential savings are 50 million therms.

Table 8-17: Estimated California IOU Total Market Potential by Scenario for Residential New Construction – 2007-2016 and 2007-2026 (Millions of Therms)

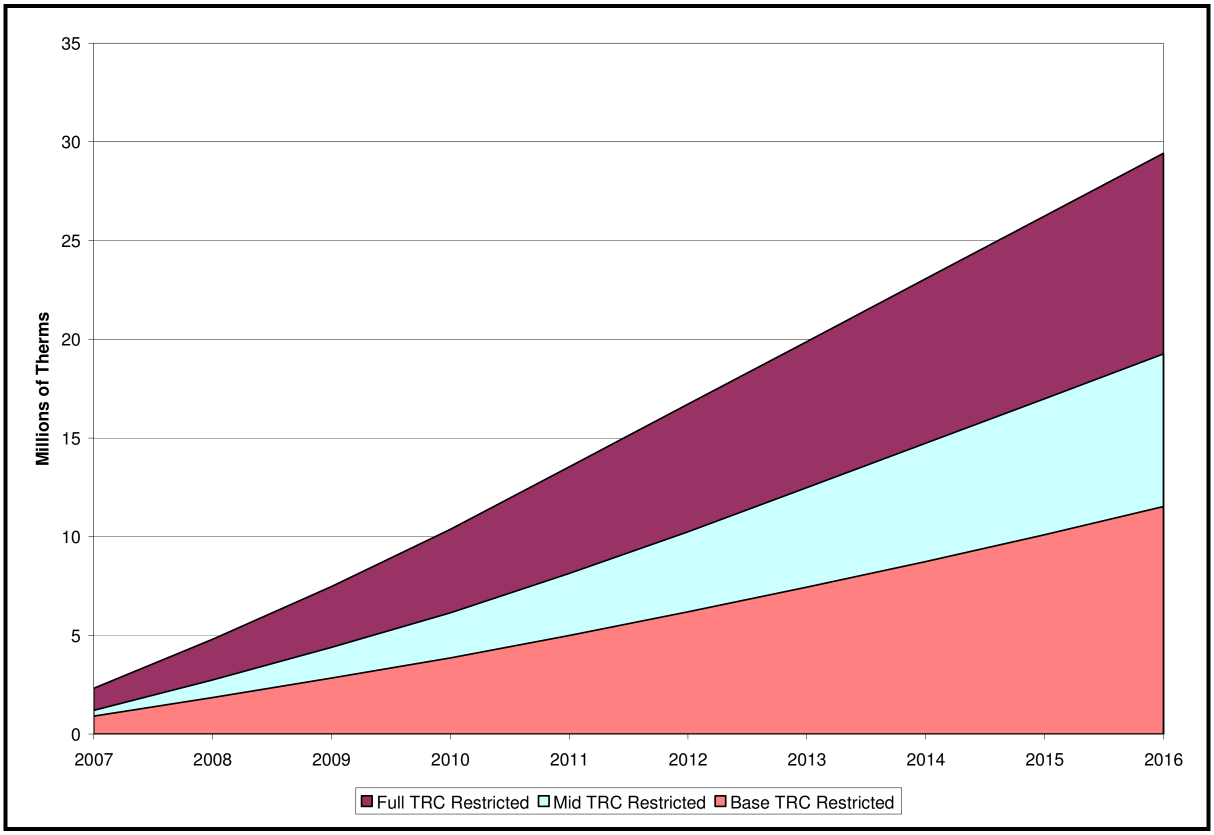
Funding Level	Millions of Gross Therms 2016	Naturally Occurring (Millions of Therms) 2016	Millions of Gross Therms 2026	Naturally Occurring (Millions of Therms) 2026
Base	14.3	-	31.6	-
Base Restricted	11.5	-	25.7	-
Mid	24.2	-	49.8	-
Mid Restricted	19.3	-	39.9	-
Full	37.6	-	73.0	-
Full Restricted	29.4	-	57.7	-
Full Gradual	34.7	-	71.7	-
Full Restrict Gradual	27.3	-	56.8	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Table 8-17 also presents potential estimates for a scenario in which the incentive levels were gradually increased to full incentive levels (by 2010). The results from this scenario indicate that the slower ramp of incentives, relative to the jump from 2006 Base scenario to 2007 full incentives, leads to a minor loss of potential relative to the Full and Full Restricted scenarios. Given the similarities in these forecasts, the remaining tables and figures will not present the potential estimates for the Full Gradual and the Full Restricted Gradual scenarios.

The results for the TRC restricted gross market scenarios are illustrated in Figure 8-14. These graphs illustrate the yearly estimates of market potential for the TRC restricted scenarios.

Figure 8-14: Estimated California IOU Gross Total Energy Market Potential by TRC Restricted Funding Levels for Residential New Construction – 2007-2016 (Millions of Therms)



Refer to Table 8-3 for a description of the scenarios.

<u>Market Potential by Building Type for Residential New Construction:</u>

Table 8-18 and Table 8-19 summarize the gas market potential estimates by funding level and building type for 2007-2016. For comparison, technical and economic estimates are listed in Table 8-20, while Figure 8-15 illustrates the estimates for the restricted potential by building type. As shown, the largest contributors to gas savings are single family residences with a contribution of 98% to the Base scenario's savings potential for 2007-2016 and 97% of the potential savings in the Full incentive scenario.

Table 8-18: Estimated California IOU Gross Total Market Gas Potential by Funding Level and Building Type for Residential New Construction – 2007-2016 (Millions of Therms)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Single Family	14.0	11.3	-	23.7	18.9	36.4	28.5	-
Multi-family	0.3	0.2	-	0.5	0.4	1.2	1.0	-
Total	**14.3**	**11.5**	**-**	**24.2**	**19.3**	**37.6**	**29.4**	**-**

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Table 8-19: Estimated California IOU Gross Total Market Gas Potential by Funding Level and Building Type for Residential New Construction – 2007-2026 (Millions of Therms)

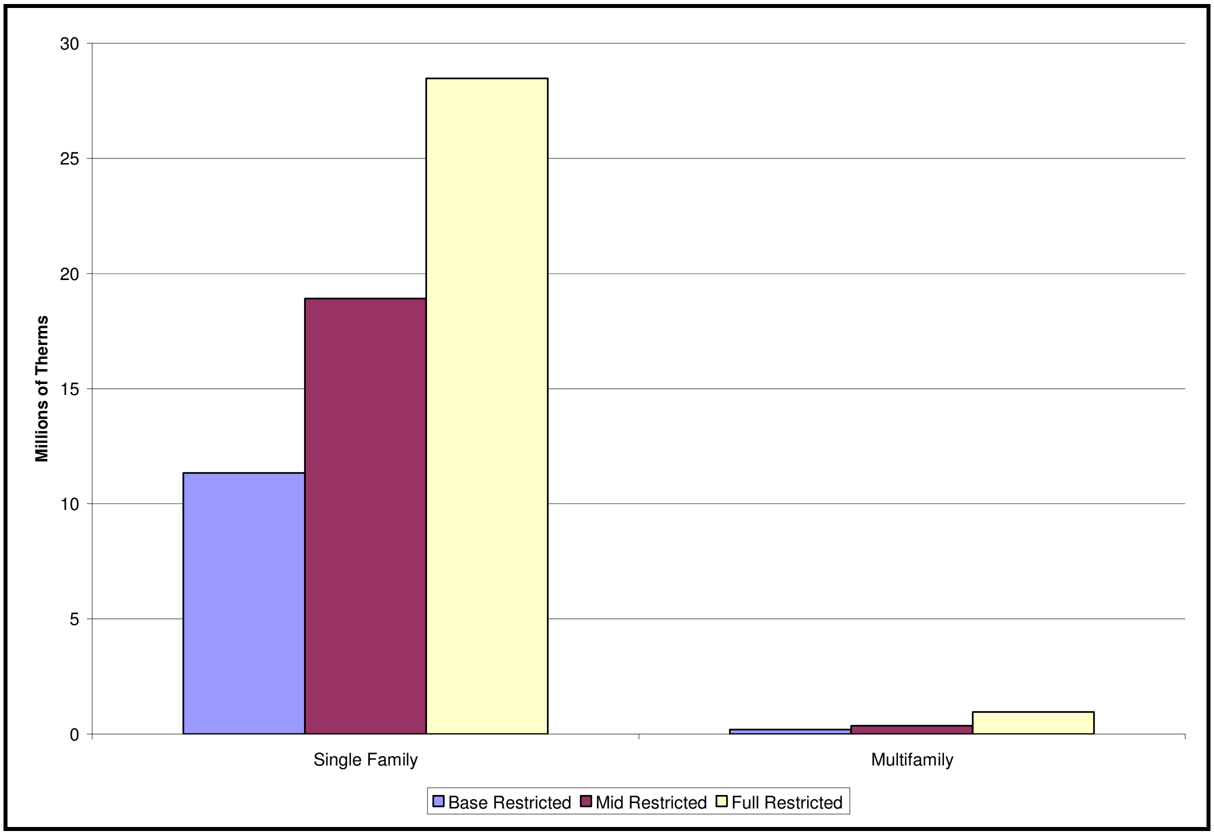
	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Single Family	31.0	25.2	-	48.8	39.2	70.6	55.9	-
Multi-family	0.6	0.4	-	1.0	0.7	2.4	1.9	-
Total	**31.6**	**25.7**	**-**	**49.8**	**39.9**	**73.0**	**57.7**	**-**

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Table 8-20: Estimated California IOU Total Technical and Economic Gas Potential by Building Type for Residential New Construction – 2007-2016 and 2026 (Millions of Therms)

	Technical - 2016	Economic - 2016	Technical - 2026	Economic - 2026
Single Family	96.1	50.6	181.6	100.8
Multifamily	3.4	1.0	6.4	2.2
Total	**100**	**52**	**188**	**103**

Figure 8-15: Estimated California IOU Total Technical and Economic Gas Potential by Building Type for Residential New Construction – 2007-2016 (Millions of Therms)



Refer to Table 8-3 for a description of the scenarios.

8.3.2 Utility-Level Residential Gas Potential, Benefits and Costs

In this section, market, technical, and economic potential are presented at the utility level. Figure 8-16, Figure 8-17, and Figure 8-18 illustrate and Table 8-21 through Table 8-23 list the estimates of potential electric energy savings for the various market scenarios for PG&E, SCE, and SDG&E, respectively.

<u>PG&E Potential Natural Gas Savings Forecasts for Residential New Construction</u>

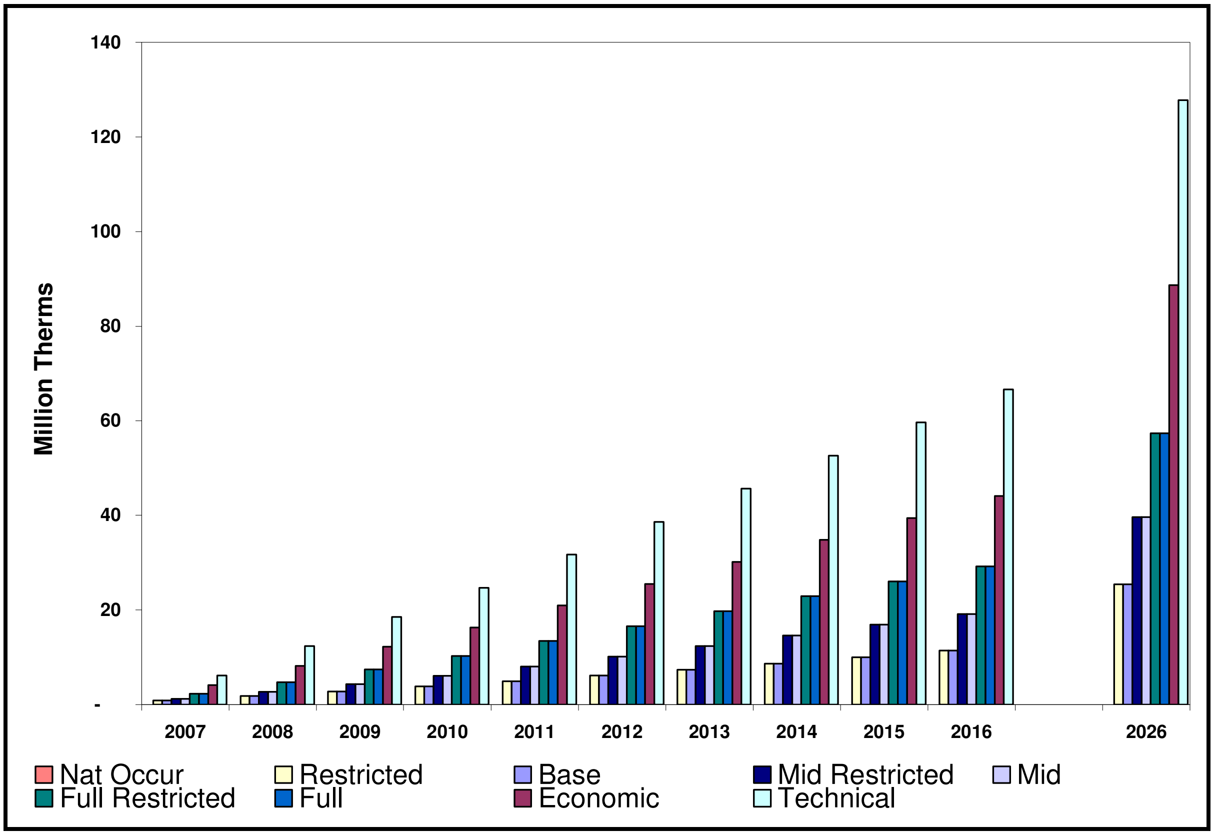
The results in Table 8-21 list the natural gas savings potential from residential new construction in PG&E's service territory, while Figure 8-16 illustrates the natural gas estimates. Estimated gross market savings potential under Base scenario incentives are 11 million therms for 2007-2016 and 25 million therms for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (mid incentives scenario), increases the estimate of savings to 19 millions of therms for 2007-2016 and 40 million therms for 2007-2026. Increasing incentives to Full incremental measure cost while restricting measures to those with a TRC > 0.85 increases the cost effective potential savings to 29million therms for 2007-2016 and 57 for 2007-2026. Figure 8-16 illustrates the yearly by scenario natural gas potential savings.

Table 8-21: PG&E Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Residential Sector – 2007-2016 and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	6.2	4.1	0.9	0.9	-	1.2	1.2	2.3	2.3	1.3	1.3	-
2008	12.4	8.2	1.8	1.8	-	2.7	2.7	4.8	4.8	3.0	3.0	-
2009	18.5	12.3	2.8	2.8	-	4.4	4.4	7.4	7.4	5.3	5.3	-
2010	24.7	16.3	3.8	3.8	-	6.1	6.1	10.3	10.3	8.2	8.2	-
2011	31.7	20.9	5.0	5.0	-	8.1	8.1	13.4	13.4	11.3	11.3	-
2012	38.7	25.5	6.1	6.1	-	10.2	10.2	16.6	16.6	14.5	14.5	-
2013	45.6	30.2	7.4	7.4	-	12.4	12.4	19.7	19.7	17.6	17.6	-
2014	52.6	34.8	8.7	8.7	-	14.6	14.6	22.9	22.9	20.8	20.8	-
2015	59.6	39.4	10.0	10.0	-	16.9	16.9	26.1	26.1	23.9	23.9	-
2016	66.7	44.1	11.4	11.4	-	19.1	19.1	29.2	29.2	27.1	27.1	-
2026	127.8	88.6	25.4	25.4	-	39.6	39.6	57.3	57.3	56.4	56.4	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-16: PG&E Estimated Total Technical, Economic, and Gross Market Natural Gas Potential for Residential New Construction – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 8-3 for a description of the scenarios.

SCE/SCG Potential Natural Gas Savings Forecasts for Residential New Construction

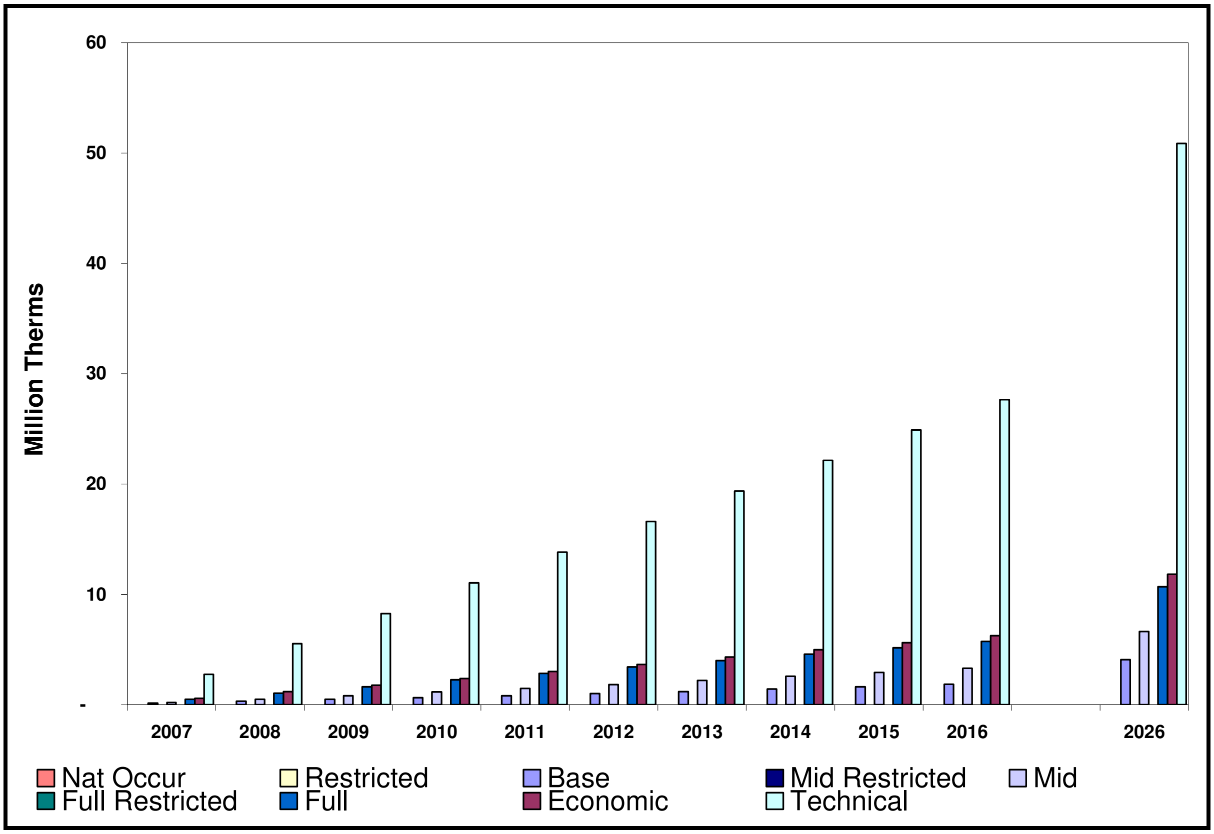
The results in Table 8-22 list the natural gas savings potential from residential new construction in SCE/SCG's service territory, while Figure 8-17 illustrates the natural gas potential. Estimated gross market savings potential under Base scenario incentives are 2 million therms for 2007-2016 and 4 million therms for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (Mid scenario), increases the estimate of savings to 3 million therms for 2007-2016 and 7 million therms for 2007-2026. Increasing incentives to Full incremental measure cost while restricting measures to those with a TRC > 0.85 increases the cost effective potential savings to 6 million therms for 2007-2016 and 11 million therms for 2007-2026. Figure 8-17 illustrates the yearly by scenario natural gas potential savings.

Table 8-22: SCE/SCG Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Residential New Construction Sector – 2007-2016 and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	2.8	0.6	0.1	-	-	0.2	-	0.5	-	0.2	-	-
2008	5.5	1.2	0.3	-	-	0.5	-	1.0	-	0.6	-	-
2009	8.3	1.8	0.5	-	-	0.8	-	1.6	-	1.0	-	-
2010	11.0	2.4	0.7	-	-	1.1	-	2.3	-	1.7	-	-
2011	13.8	3.0	0.8	-	-	1.5	-	2.8	-	2.2	-	-
2012	16.6	3.7	1.0	-	-	1.8	-	3.4	-	2.8	-	-
2013	19.4	4.3	1.2	-	-	2.2	-	4.0	-	3.4	-	-
2014	22.1	5.0	1.4	-	-	2.6	-	4.6	-	4.0	-	-
2015	24.9	5.6	1.6	-	-	2.9	-	5.2	-	4.6	-	-
2016	27.6	6.3	1.8	-	-	3.3	-	5.7	-	5.1	-	-
2026	50.9	11.8	4.1	-	-	6.6	-	10.7	-	10.4	-	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-17: Estimated SCE/SCG Gross Total Technical, Economic, and Market Gas Potential for Residential New Construction – 2007-2016



Refer to Table 8-3 for a description of the scenarios.

SDG&E Potential Gas Savings Forecasts for Residential New Construction

Table 8-23 lists the natural gas potential savings for SDG&E's residential new construction sector by scenario. At Base incentive levels, the natural gas potential savings is 1 million therms for 2007-2016 and 2.1 million therms for 2007-2026. Increasing incentives to the average between the Base level and full incremental measure cost (Mid scenario) is estimated to increase natural gas savings to 1.8 million therms for 2007-2016 and 3.6 million therms for 2007-2026. Restricting measures to those passing the TRC restriction (TRC > 0.85), the Mid Restricted potential is 0.1 million therms for 2007-2016 and 0.3 million therms for 2007-2026.

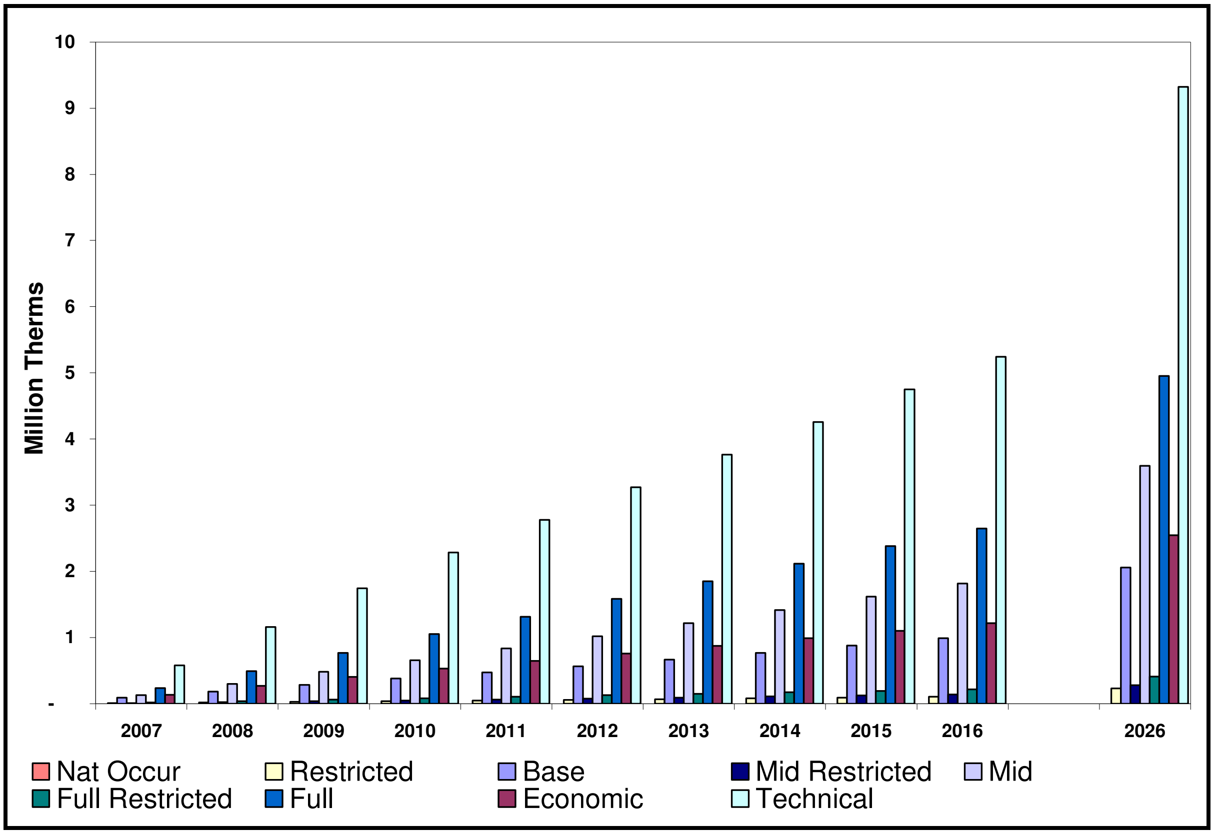
Table 8-23: SDG&E Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Residential New Construction Sector – 2007-2016 and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	0.6	0.1	0.1	0.0	-	0.1	0.0	0.2	0.0	0.1	0.0	-
2008	1.2	0.3	0.2	0.0	-	0.3	0.0	0.5	0.0	0.3	0.0	-
2009	1.7	0.4	0.3	0.0	-	0.5	0.0	0.8	0.1	0.6	0.0	-
2010	2.3	0.5	0.4	0.0	-	0.7	0.0	1.1	0.1	0.9	0.1	-
2011	2.8	0.6	0.5	0.0	-	0.8	0.1	1.3	0.1	1.1	0.1	-
2012	3.3	0.8	0.6	0.1	-	1.0	0.1	1.6	0.1	1.4	0.1	-
2013	3.8	0.9	0.7	0.1	-	1.2	0.1	1.8	0.1	1.7	0.1	-
2014	4.3	1.0	0.8	0.1	-	1.4	0.1	2.1	0.2	1.9	0.2	-
2015	4.7	1.1	0.9	0.1	-	1.6	0.1	2.4	0.2	2.2	0.2	-
2016	5.2	1.2	1.0	0.1	-	1.8	0.1	2.6	0.2	2.5	0.2	-
2026	9.3	2.5	2.1	0.2	-	3.6	0.3	5.0	0.4	4.9	0.4	-

Refer to Table 8-3 for a description of the scenarios. Naturally occurring savings were not specifically estimated in the residential new construction analysis because the gross savings estimates are relative to the 2003 Baseline Study. See Appendix E for more detail.

Figure 8-18 illustrates the technical, economic, and market forecasts of natural gas savings potential for SDG&E's residential new construction sector for the years 2007-2016 and 2026.

Figure 8-18: Estimated SDG&E Total Technical, Economic, and Gross Market Natural Gas Potential for Residential New Construction – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 8-3 for a description of the scenarios.

8.4 Costs and Benefits for the Residential New Construction Program

This section presents the costs and benefits from the electric and gas residential new construction estimates, creating an aggregate California IOU sum of costs, benefits, and benefit-to-cost ratios. The TRC test indicates that restricting measures to those that are cost effective yields Base, Mid, and Full Restricted scenario estimates that are cost effective or nearly cost effective. Restricting the scenarios to only cost effective packages, however, reduces the incentives, cost, and avoided cost benefits relative to the non-restricted scenarios. The reductions associated with the TRC restrictions implies that some packages incentivised by the utilities in 2004/2005 were not cost effective.

Table 8-24: Summary of the Costs and Benefits by Scenario for the Residential New Construction Sector 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	190	125	257	549
Net Measure Costs	213	142	274	492
Gross Program Costs	57	43	66	98
Net Avoided Cost Benefits	274	217	365	633
TRC	**1.01**	**1.17**	**1.07**	**0.96**

Refer to Table 8-3 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Utility-Specific Cost and Benefits for Residential New Construction

The utility-specific costs, benefits, and total resource cost ratios for four of the market potential funding scenarios are presented in Table 8-25, Table 8-26 and Table 8-27. The forecast shows that under the Base scenario estimates, of the three utilities, only PG&E offers cost-effective programs. For PG&E, the Base scenario benefit-to-cost ratio is 1.18, for SCE/SCG the ratio is 0.68, and for SDG&E it is 0.80. Restricting the utilities' RNC Programs to packages with a TRC > 0.85 significantly increases the benefit-to-cost ratio relative to the Base scenario for SDG&E only. The lower TRCs in SCE/SCG are primarily due to the low TRCs of program level homes built in coastal regions of their combined service territories.

Table 8-25: Summary of PG&E Market Potential Cost and Benefits by Scenario for Residential New Construction 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	106	106	235	519
Net Measure Costs	129	129	257	468
Gross Program Costs	41	41	64	94
Net Avoided Cost Benefits	200	200	346	541
TRC	**1.18**	**1.18**	**1.08**	**0.96**

Refer to Table 8-3 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 8-26: Summary of SCE Market Potential Cost and Benefits by Scenario for Residential New Construction 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	50	-	-	-
Net Measure Costs	47	-	-	-
Gross Program Costs	11	-	-	-
Avoided Cost Benefits	39	-	-	-
TRC	**0.68**	-	-	-

Refer to Table 8-3 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 8-27: Summary of SDG&E Market Potential Cost and Benefits by Scenario for Residential New Construction 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	33	18	22	30
Net Measure Costs	38	13	17	24
Gross Program Costs	5	2	3	4
Net Avoided Cost Benefits	35	16	20	25
TRC	**0.80**	**1.04**	**1.00**	**0.91**

Refer to Table 8-3 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

8.5 Key Residential Results and Future Research Recommendations

8.5.1 Summary of Key Results for Residential New Construction

The technical, economic, and market potential presented in this report dropped substantially when compared with the 2006 Potential Study. As has been highly publicized and widely seen in California, the housing market has slowed over the last few years. The decrease in current and forecasted new housing starts are the primary driver for the lower potential estimates.

The statewide market potential for electric energy efficiency as estimated in the Base scenario is 55 gross GWh over a 10-year period. The gross Base energy savings market potential is 16% of estimated Technical potential and 27% of estimated Economic potential. Increasing incentives to a level equal to the mid-point between Base scenario incentives and full incremental costs (Mid scenario), is estimated to lead to energy savings of 80 GWh-

2016, a 46% increase. Further ramping up incentives to cover full incremental measure costs increases gross electric energy potential to 118 GWh through 2016. The Full market scenario is 34% of estimated Technical potential and 59% of estimated Economic potential.

Restricting the Base scenario to measures with a TRC > 0.85 reduces the gross potential to 34 GWh, a reduction of about 38% for the forecast. Restricting measures to those with a TRC > 0.85, while increasing incentives to halfway between Base scenario and full incremental costs (mid restricted scenario), leads to 51 GWh of gross electric savings potential through 2016. Limiting the Mid scenario's potential estimates to those measures that are nearly cost-effective reduces the forecast by approximately 36% when compared to the Mid scenario. The Full Restricted scenario is estimated to provide 74% GWh of potential through 2016, 37% less than the Full scenario.

The Base scenario gross market potential for coincident peak demand reduction is 55 MW over a 10-year period. The gross Base coincident peak demand potential is 18% of the estimated technical potential and 30% of estimated Economic potential. Increasing incentives to cover full incremental costs increases the gross coincident peak demand potential to 122 MW. The Full market scenario estimate of gross coincident peak demand potential is 39% of estimated technical potential and 65% of estimated economic potential.

Restricting the Base scenario to measures that are nearly cost-effective leads to only a 6% drop in the ratio of gross market to technical potential (18% to 12%) and a 9% drop in the ratio of market to economic potential (30% to 21%). Restricting the Full scenario to measures that are nearly cost-effective reduces the ratio of market to technical potential by 11%s (39% to 28%) and the ratio of market to economic potential by 18%s (65% to 47%).

TRC results under the Base, Average, and Full market scenarios showed that when restricted to cost effective measures, only the Base and Mid incentive levels are cost effective. Specifically, the Base scenario incentive program resulted in a statewide benefit-cost ratio of 1.01. Under the cost-effectiveness restriction, the statewide Base benefit-cost ratio was 1.17, while the statewide full incremental cost incentive program scored 0.96 and the statewide average scenario-level incentive program scored 1.07.

9

Energy Efficiency Potential in Commercial New Construction

This section presents the estimates of commercial energy efficiency potential in new construction. Estimates of potential are presented for the period 2007-2016, and for 2007-2026. Market potential was estimated for eight scenarios. The scenarios assume alternative levels of measure incentives and cost-effectiveness tests.[1] All market results are presented savings associated with cumulative gross adoptions over the estimation period. An estimate of technical and economic potential is presented for comparison purposes.

9.1 Overview

Itron estimated energy efficiency potential for commercial new construction by building type and climate zone. The approach used was similar to the one used to estimate potential in existing commercial buildings with several important differences. The differences include using packages of measures versus individual measures, the development of incremental costs, the development of energy savings, the number of building types, and the number of scenarios. Each is described in further detail below.

Appendix F includes a summary of the methodology on how the costs and savings were developed.

9.1.1 Packages of Measures

As part of the 2006 Potential Study, Architectural Energy Corporation (AEC) and Itron jointly developed the estimates of commercial new construction energy efficiency potential. AEC developed many of the inputs including incremental costs, energy savings, time-of-use energy usage inputs, and calibration shares.

The objectives of the 2006 New Construction Potential Study included finding the saving potential for commercial buildings that would approximate the building of energy efficient buildings under the existing Standards (reaching 15 and 25% above the 2001 codes) and

[1] Unlike the analysis of potential in existing buildings, new construction did not include the Base Restrict with Higher Awareness scenario or the CFLs as Base Lighting scenario.

under the new Standards (reaching 10 and 15% above the 2005 codes) by Title 24 Climate Zone. Instead of estimating potential for the individual measures, it was necessary to develop packages of measures that could be added to the baseline building to allow it to reach of the efficiency levels listed in Table 9-1. The scope of the 2008 potential study called for re-estimating the potential associated with the 2006 commercial packages.

Appendix F includes more detail on the measures included in each package by building type and climate zone.

Table 9-1: Commercial New Construction Measure Descriptions

End Use	Measure Description	Fuel Type
NCCom	Least Cost Package to reach 15% above 2001 Stds	Electric and Gas
NCCom	Least Cost Package to reach 25% above 2001 Stds	Electric and Gas
NCCom	Least Cost Package to reach 10% above 2005 Stds	Electric and Gas
NCCom	Least Cost Package to reach 15% above 2005 Stds	Electric and Gas

9.1.2 Incremental Costs

Sources for the incremental measure costs used in the Commercial New Construction Potential Study included the 2005 DEER Measure Cost Study, the R.S. Means "Costworks" construction cost estimating database, and construction cost estimates obtained directly from distributors and contractors.[2] These individual measure costs were then aggregated to develop the package costs. The scope of the 2008 potential study call for using the commercial new construction costs from the 2006 Commercial New Construction Potential Study.

9.1.3 Energy Savings

The incremental measure savings used in the Potential Study were also obtained from DEER. However, since individual measure savings are not additive and the measure savings may not be equivalent when added to a new commercial building as opposed to an existing commercial building, the savings for the packages of measures were developed using DOE-2.1E simulations. In addition to the interactive effects of measures on building energy savings, the effects of the packages of measures on HVAC system size were calculated from the DOE-2.1 simulations. The energy savings estimates used in the 2008 commercial new construction analysis are consistent with those used in the 2006 study.

[2] Itron, Inc. 2004-2005 DataBase for Energy Efficiency Resources (DEER) Update Study: Final Report. Prepared for Southern California Edison. December 2005.

9.1.4 Building Types

The commercial new construction analysis includes cost and savings estimates and estimated potential for 11 commercial building types: colleges, grocery stores, health care buildings, lodging, large office buildings, retail, restaurants, schools, small office buildings, warehouses, and miscellaneous commercial buildings.[3]

9.1.5 Scenarios

Table 9-2 provides the list of scenarios used to analyze the potential in existing buildings. The analysis of potential in new construction did not include the Base TRC Restricted Higher Awareness or CFLs as Base Lighting scenarios.

Table 9-2: Scenario Descriptions

Scenario Name	Scenario Description
Base Incentive	Includes measures incentivized in the 2004-2005 program year with incentives that were available in 2006.
Mid Incentive	Includes all measures analyzed in the study with incentives half way between those that were available in 2006 and full incremental costs.
Full Incentive	Includes all measures analyzed with incentives set to full incremental costs.
Base Incentive TRC Restricted	Base incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Mid Incentive TRC Restricted	Mid incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Incentive TRC Restricted	Full incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Gradual	Includes all measures analyzed with incentives increasing from 2006 levels to full incremental costs in 2010.
Full Gradual TRC Restricted	Full gradual scenario with measures restricted to those with a TRC greater than or equal to 0.85.

9.1.6 Naturally Occurring Estimates

The commercial new construction potential results do not report naturally occurring savings. This was by design and not a result of the forecast model. As explained in more detail in Appendix F, savings estimates were estimated by comparing the least-cost package of each building reaching the specified program level (for example, 15% above the 2005 Title 24 Standards) with the 2005 baseline buildings. Therefore, the gross savings provided are already reduced by the naturally occurring potential plus the nonparticipant spillover included in the baseline estimates. If the reader was to assume that free ridership and

[3] The miscellaneous building type includes many different types of buildings and businesses. Miscellaneous would include laundries, churches, strip mall retail, dry cleaners, gyms, prisons, and social centers. Miscellaneous is not limited to these types of businesses, this is only a partial listing to provide information on the wide range of business types and sizes included in this category.

nonparticipant spillover were approximately equal, the results labeled as gross savings in every table and graph in this report could be considered net savings. However, since this analysis did not attempt to quantify the size of free ridership and spillover, the term gross savings continues to be used throughout this section.

9.2 Electric Efficiency Potential in Commercial New Construction

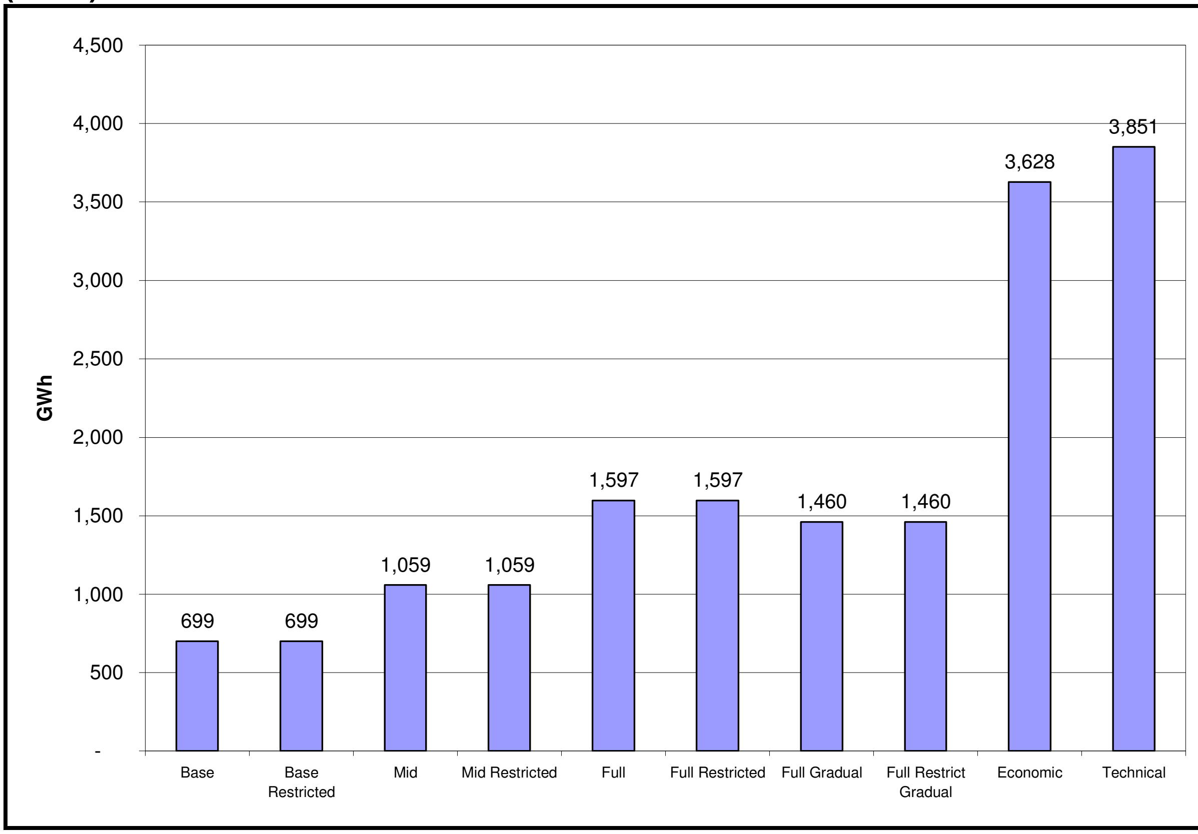
9.2.1 Commercial New Construction Market Potential for Energy Efficiency

In this subsection, the commercial new construction potential analysis results are presented under the alternative market scenarios. Figure 9-1 and Figure 9-2 present the total estimated market, technical, and economic electric energy and demand savings potential resulting from the analysis for three California investor-owned utilities: PG&E, SCE/SCG, and SDG&E.[4] The values are provided for 2016, the last year of the short run analysis.[5]

[4] The combined service territories of SCE and SCG are presented together.

[5] The energy savings potential presented in this report are at the generation level.

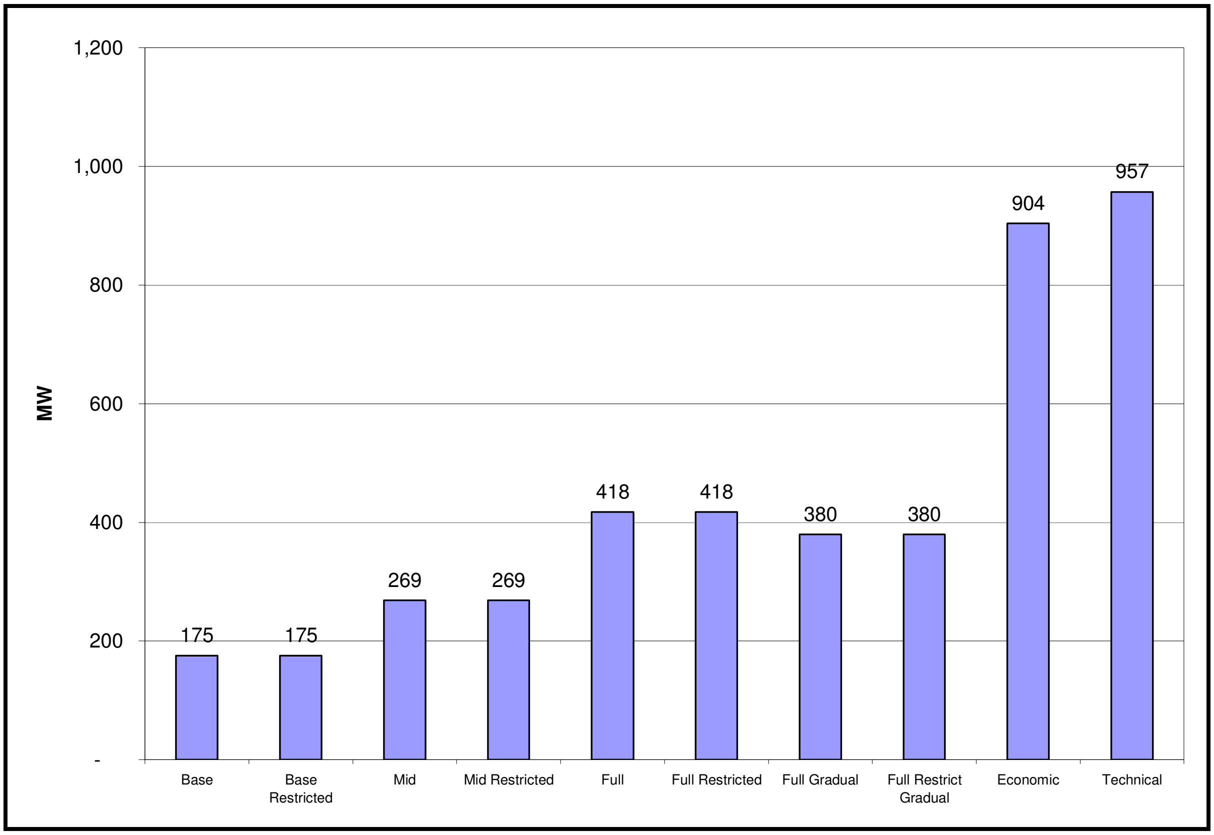
Figure 9-1: Forecasted California IOU Total Gross Market, Economic, and Technical Electric Potential for Commercial New Construction– 2007-2016 (GWh)



Refer to Table 9-2 for a description of the scenarios.

As shown in Figure 9-1, the estimated technical potential for commercial new construction from 2007-2016 is 3,851 GWh and the total estimated electric economic potential is 3,628 GWh. The total gross full incentive potential is 1,597 GWh and Base scenario forecast is 699 GWh for 2007-2016. Figure 9-2 shows that the total estimated technical potential for coincident peak demand reduction is 957 MW and the total estimated economic potential is 904 MW for 2007-2016. The total gross coincident peak demand potential under the Full scenario is 418 MW for 2007-2016.

Figure 9-2: Forecasted California Total Gross Market, Economic, and Technical Coincident Peak Demand Potential for Commercial New Construction – 2007-2016 (MW)



Refer to Table 9-2 for a description of the scenarios.

The total commercial new construction market electric potential by scenario, across California IOUs, is listed in Table 9-3. Potential estimates are provided for the intermediate forecast period, 2007-2016 and for the entire forecast period 2007-2026. Total IOU market potential under the Base scenario is 699 GWh of energy for 2007-2016 and 1,376 GWh for 2007-2026. These savings are the estimated energy savings potential if the IOUs continue the 2006 incentive levels and limit their program offerings to those measures with program accomplishments during the 2004/2005 program cycle. Increasing incentives to Full incremental costs, increases the total energy market potential estimates to 1,597 GWh for 2007-2016 and 3,074 GWh for 2007-2026. If program incentives were set half way between Base scenario incentives and full incremental costs, the Mid scenario, estimated energy savings potential is 1,059 GWh for 2007-2016 and 2,086 GWh for 2007-2026. Limiting measures to those that are cost-effective causes no reduction in savings in the Base, Mid, or Full scenario.

Total IOU market coincident peak demand potential is also listed in Table 9-3. The total IOU commercial new construction market coincident peak demand potential under the Base scenario is 175 MW for 2007-2016 and 374 MW for 2007-2026. Increasing incentives to the halfway point between Base scenario and full incremental cost incentives increases the estimate of total coincident peak demand potential to 269 MW for 2007-2016 and 532 MW for 2007-2026. Further increasing incentives to full incremental measure cost increases commercial new construction coincident peak demand potential to 418 MW for 2007-2016 and 807 MW for 2007-2026. Restricting incentivized measures to those that are cost-effective, causes no reduction in savings in the Base, Mid, or Full scenario.

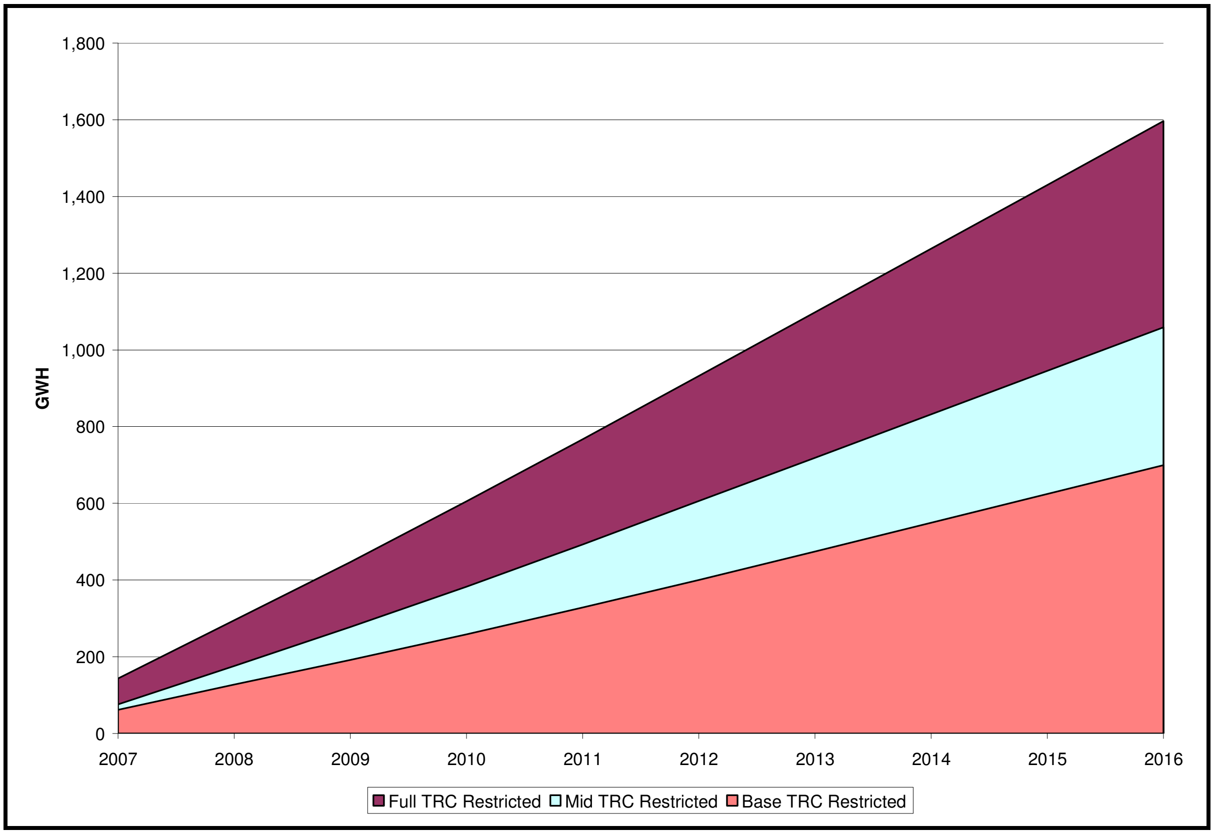
Table 9-3: Estimated California IOU Total Market Potential by Scenario and Funding Level for Commercial New Construction – 2007-2016 and 2007-2026 (GWh and MW)

Scenario	Gross Energy (GWh) 2016	Naturally Occurring Energy (GWh) 2016	Coincident Peak Demand (MW) 2016	Naturally Occurring Coincident Peak Demand (MW) 2016	Gross Energy (GWh) 2026	Naturally Occurring Energy (GWh) 2026	Coincident Peak Demand (MW) 2026	Naturally Occurring Coincident Peak Demand (MW) 2026
Base	699	-	175	-	1,376	-	347	-
Base Restricted	699	-	175	-	1,376	-	347	-
Mid	1,059	-	269	-	2,086	-	532	-
Mid Restricted	1,059	-	269	-	2,086	-	532	-
Full	1,597	-	418	-	3,074	-	807	-
Full Restricted	1,597	-	418	-	3,074	-	807	-
Full Gradual	1,460	-	380	-	3,017	-	791	-
Full Restrict Gradual	1,460	-	380	-	3,017	-	791	-

Refer to Table 9-2 for a description of the scenarios.

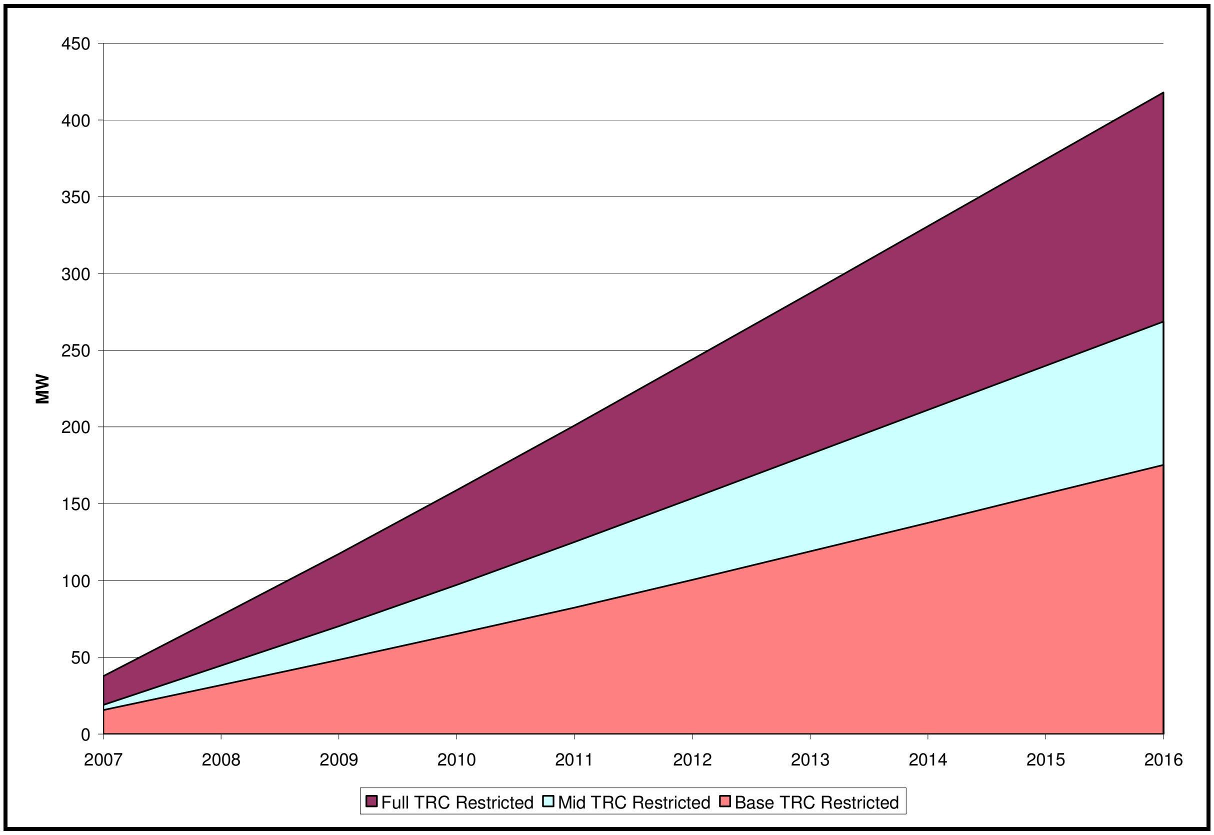
Table 9-3 also presents potential estimates for a scenario in which the incentives levels were gradually increased to Full incentive levels (by 2010). The results for the TRC Restricted Gross Market scenarios are illustrated in Figure 9-3 and Figure 9-4. These graphs illustrate the yearly estimate of TRC restricted market potential from cumulative adoptions from 2007 to 2016.

Figure 9-3: Estimated California IOU Gross Total Energy Market Potential by TRC Restricted Funding Levels for Commercial New Construction – 2007-2016 (GWh)



Refer to Table 9-2 for a description of the scenarios.

Figure 9-4: Estimated California IOU Gross Total Coincident Peak Demand Market Potential by TRC Restricted Funding Levels for Commercial New Construction – 2007-2016 (MW)



Refer to Table 9-2 for a description of the scenarios.

Market Potential by Building Type for Commercial New Construction:

Table 9-4 and Table 9-5 summarize the energy market potential estimates by funding level and building type: colleges, grocery stores, healthcare buildings, lodging, large office buildings, retail, restaurants, schools, small office buildings, warehouses, and miscellaneous commercial buildings for 2007-2016 and 2007-2026. For comparison, Table 9-6 lists technical and economic estimates. As shown, the largest contributors to energy savings potential are retail buildings with a Base scenario estimated energy savings potential of 141 GWh for 2007-2016 and 276 GWh for 2007-2026.

Table 9-7, Table 9-8, and Table 9-9 provide similar results for coincident peak demand reduction. In this case, the largest contributors to demand savings are large offices with a Base scenario savings potential of 36 MW for 2007-2016 and 75 MW for 2007-2026 followed closely by retail buildings with a Base scenario savings potential of 35 MW for 2007-2016 and 68 MW for 2007-2026. Figure 9-5 and Figure 9-6 present the estimated restricted energy and demand savings potential by building type through 2016. Table 9-4 shows that increasing funding levels to the halfway point between Base scenario and Full incremental cost incentives increases the estimate of impacts from 88 GWh to 182 GWh for 2007-2016 for the restaurant segment, from 135 GWh to 180 GWh for the grocery stores segment and from 141 GWh to 181 GWh for the retail segment.

Table 9-4: California IOU Estimated Total Gross Market Energy Potential by Funding Level and Building Type for Commercial New Construction – 2007-2016 (GWh)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
College	29	29	-	38	38	57	57	-
Grocery Stores	135	135	-	180	180	235	235	-
Health Care	28	28	-	49	49	76	76	-
Lodging	53	53	-	65	65	81	81	-
Large Office	103	103	-	124	124	151	151	-
Misc.	74	74	-	151	151	271	271	-
Retail	141	141	-	181	181	284	284	-
Restaurant	88	88	-	182	182	253	253	-
School	9	9	-	24	24	78	78	-
Small Office	37	37	-	58	58	89	89	-
Warehouse	2	2	-	6	6	23	23	-
Total	**699**	**699**	**-**	**1,059**	**1,059**	**1,597**	**1,597**	**-**

Refer to Table 9-2 for a description of the scenarios.

Table 9-5: California IOU Estimated Total Gross Market Energy Potential by Funding Level and Building Type for Commercial New Construction – 2007-2026 (GWh)

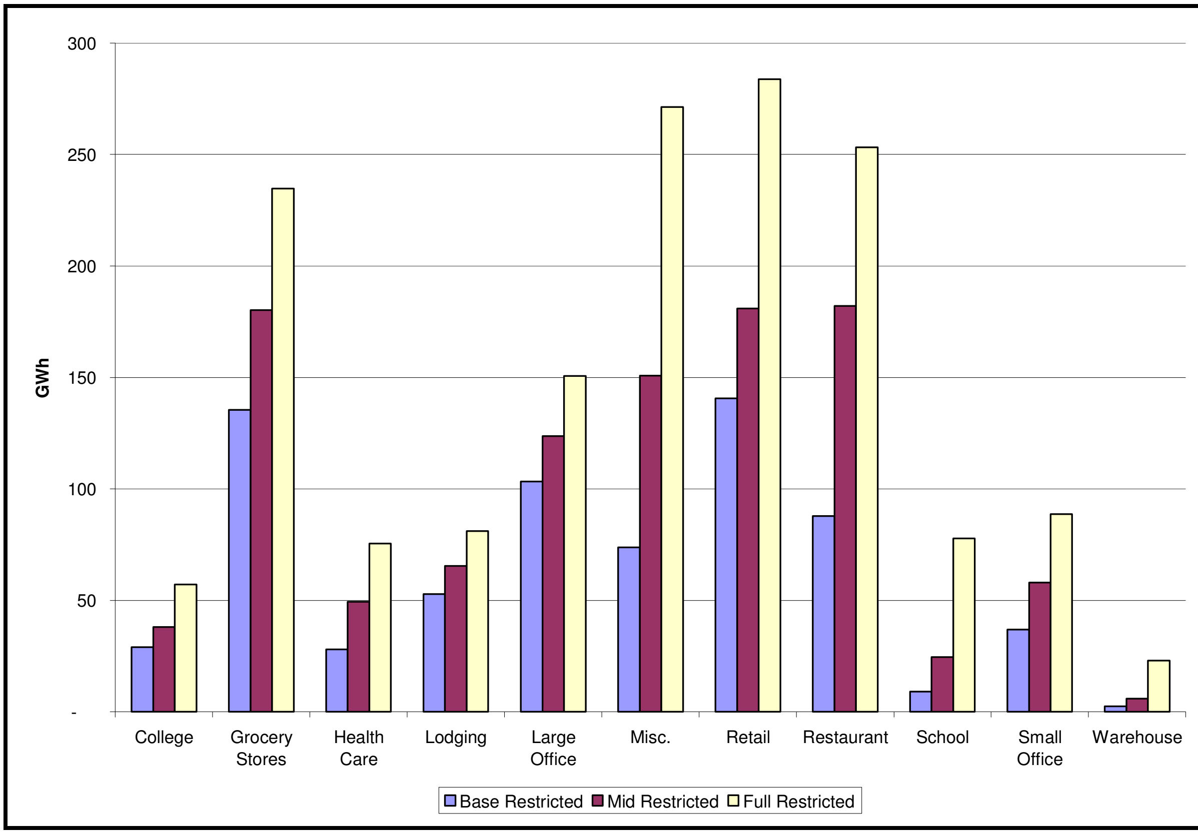
	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
College	54	54	-	71	71	105	105	-
Grocery Stores	263	263	-	349	349	447	447	-
Health Care	57	57	-	101	101	151	151	-
Lodging	102	102	-	125	125	152	152	-
Large Office	212	212	-	252	252	303	303	-
Misc.	145	145	-	299	299	520	520	-
Retail	276	276	-	352	352	543	543	-
Restaurant	172	172	-	359	359	484	484	-
School	18	18	-	50	50	153	153	-
Small Office	73	73	-	115	115	172	172	-
Warehouse	5	5	-	12	12	43	43	-
Total	**1,376**	**1,376**	**-**	**2,086**	**2,086**	**3,074**	**3,074**	**-**

Refer to Table 9-2 for a description of the scenarios.

Table 9-6: California IOU Estimated Total Technical and Economic Energy Potential by Building Type for Commercial New Construction – 2007-2016, 2007-2026 (GWh)

	Technical – 2016	Economic - 2016	Technical - 2026	Economic - 2026
College	181	181	322	322
Grocery Stores	723	723	1,364	1,364
Health Care	177	177	347	347
Lodging	317	317	582	582
Large Office	420	420	823	823
Misc.	571	571	1,074	1,074
Retail	644	644	1,216	1,216
Restaurant	332	126	624	235
School	132	132	254	254
Small Office	196	196	374	374
Warehouse	158	141	300	274
Total	**3,851**	**3,628**	**7,279**	**6,863**

Figure 9-5: California IOU Estimated Total Energy Potential by Building Type for Commercial New Construction – 2007-2016 (GWh)



Refer to Table 9-2 for a description of the scenarios.

Table 9-7 shows that the Base scenario contribution of the retail segment to the total IOU commercial new construction market coincident peak demand potential is 35 MW for 2007-2016, just behind the 36 MW for large offices, while the restaurant segment's energy savings potential is estimated at 20 MW. Increasing incentives to Full incremental measure cost increases the 2007-2016 estimate of coincident peak demand potential for the retail segment to 68 MW and for large offices and restaurants to 57 MW.

Table 9-7: Estimated California IOU Total Gross Market Coincident Peak Demand Potential by Funding Level and Building Type for Commercial New Construction – 2007-2016 (MW)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
College	9	9	-	13	13	22	22	-
Grocery Stores	24	24	-	32	32	41	41	-
Health Care	9	9	-	16	16	25	25	-
Lodging	9	9	-	11	11	14	14	-
Large Office	36	36	-	45	45	57	57	-
Misc.	17	17	-	35	35	65	65	-
Retail	35	35	-	44	44	68	68	-
Restaurant	20	20	-	41	41	57	57	-
School	4	4	-	10	10	29	29	-
Small Office	13	13	-	22	22	35	35	-
Warehouse	1	1	-	1	1	6	6	-
Total	**175**	**175**	**-**	**269**	**269**	**418**	**418**	**-**

Refer to Table 9-2 for a description of the scenarios.

Table 9-8: Estimated California IOU Total Gross Market Coincident Peak Demand Potential by Funding Level and Building Type for Commercial New Construction – 2007-2026 (MW)

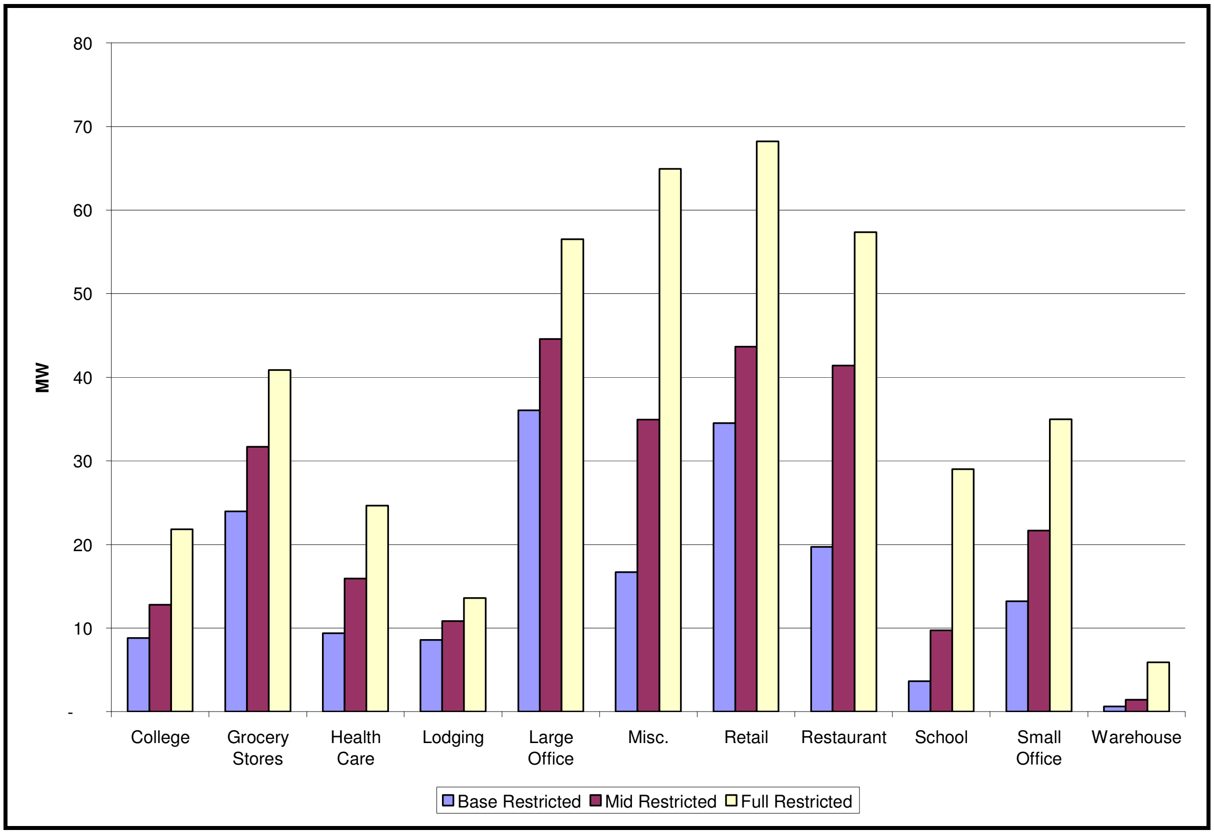
	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
College	16	16	-	24	24	40	40	-
Grocery Stores	46	46	-	61	61	78	78	-
Health Care	19	19	-	33	33	49	49	-
Lodging	16	16	-	21	21	25	25	-
Large Office	75	75	-	92	92	115	115	-
Misc.	33	33	-	69	69	124	124	-
Retail	68	68	-	85	85	130	130	-
Restaurant	39	39	-	82	82	110	110	-
School	7	7	-	20	20	57	57	-
Small Office	26	26	-	43	43	68	68	-
Warehouse	1	1	-	3	3	11	11	-
Total	**347**	**347**	**-**	**532**	**532**	**807**	**807**	**-**

Refer to Table 9-2 for a description of the scenarios.

Table 9-9: Estimated California IOU Total Technical and Economic Coincident Peak Demand Potential by Building Type for Commercial New Construction – 2007-2016, 2007-2026 (MW)

	Technical - 2016	Economic - 2016	Technical - 2026	Economic - 2026
College	65	65	116	116
Grocery Stores	121	121	227	227
Health Care	54	54	107	107
Lodging	52	52	95	95
Large Office	147	147	291	291
Misc.	136	136	256	256
Retail	154	154	291	291
Restaurant	75	24	140	46
School	49	49	95	95
Small Office	72	72	137	137
Warehouse	32	29	61	56
Total	**957**	**904**	**1,815**	**1,715**

Figure 9-6: Estimated California IOU Total Coincident Peak Demand Potential by End Use for Commercial New Construction – 2007-2016 (MW)



Refer to Table 9-2 for a description of the scenarios.

9.2.2 Commercial Utility-Level Potential

PG&E Potential Energy Savings Forecasts for Commercial New Construction

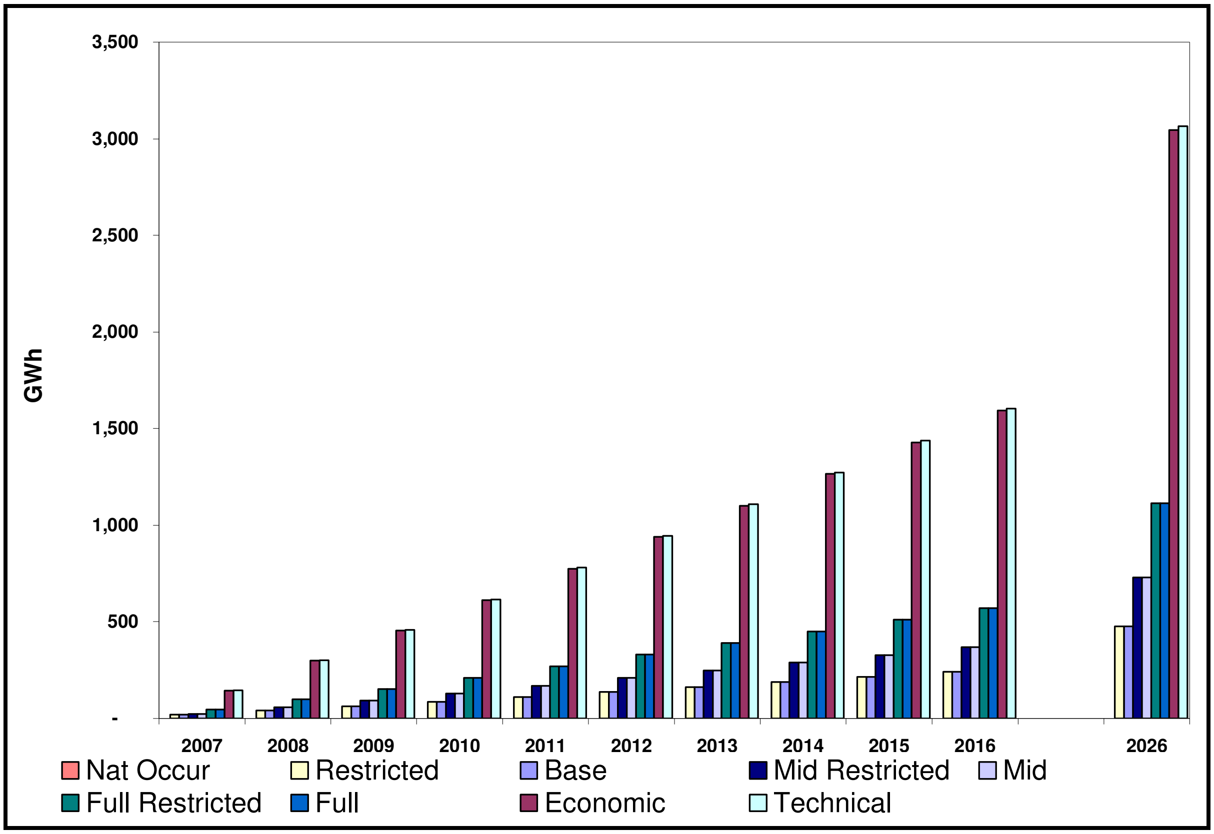
Table 9-10 lists the energy savings potential estimates for commercial new construction in PG&E's service territory, while Figure 9-7 illustrates the savings estimates. Estimated gross market savings potential under Base scenario incentives are 240 GWh for 2007-2016 and 475 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (Mid scenario) increases the savings estimate to 367 GWh for 2007-2016 and 730 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 570 GWh for 2007-2016 and 1,113 GWh for 2007-2026. Restricting incentivized measures to those that are cost-effective causes no change in the Base, Mid or Full scenario.

Table 9-10: PG&E Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Commercial New Construction Sector – 2007-2016, and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	144	143	19	19	-	23	23	46	46	23	23	-
2008	301	299	41	41	-	57	57	98	98	58	58	-
2009	458	455	63	63	-	92	92	153	153	104	104	-
2010	616	612	86	86	-	129	129	210	210	162	162	-
2011	780	775	111	111	-	169	169	270	270	221	221	-
2012	946	939	137	137	-	209	209	330	330	282	282	-
2013	1,109	1,101	162	162	-	248	248	390	390	341	341	-
2014	1,273	1,265	188	188	-	288	288	450	450	401	401	-
2015	1,438	1,429	214	214	-	328	328	510	510	462	462	-
2016	1,604	1,593	240	240	-	367	367	570	570	522	522	-
2026	3,066	3,045	475	475	-	730	730	1,113	1,113	1,092	1,092	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-7: PG&E Estimated Total Technical, Economic, and Gross Market Energy Potential for Commercial New Construction – 2007-2016, 2026 (GWh



Refer to Table 9-2 for a description of the scenarios.

SCE/SCG Potential Energy Savings Forecasts for Commercial New Construction

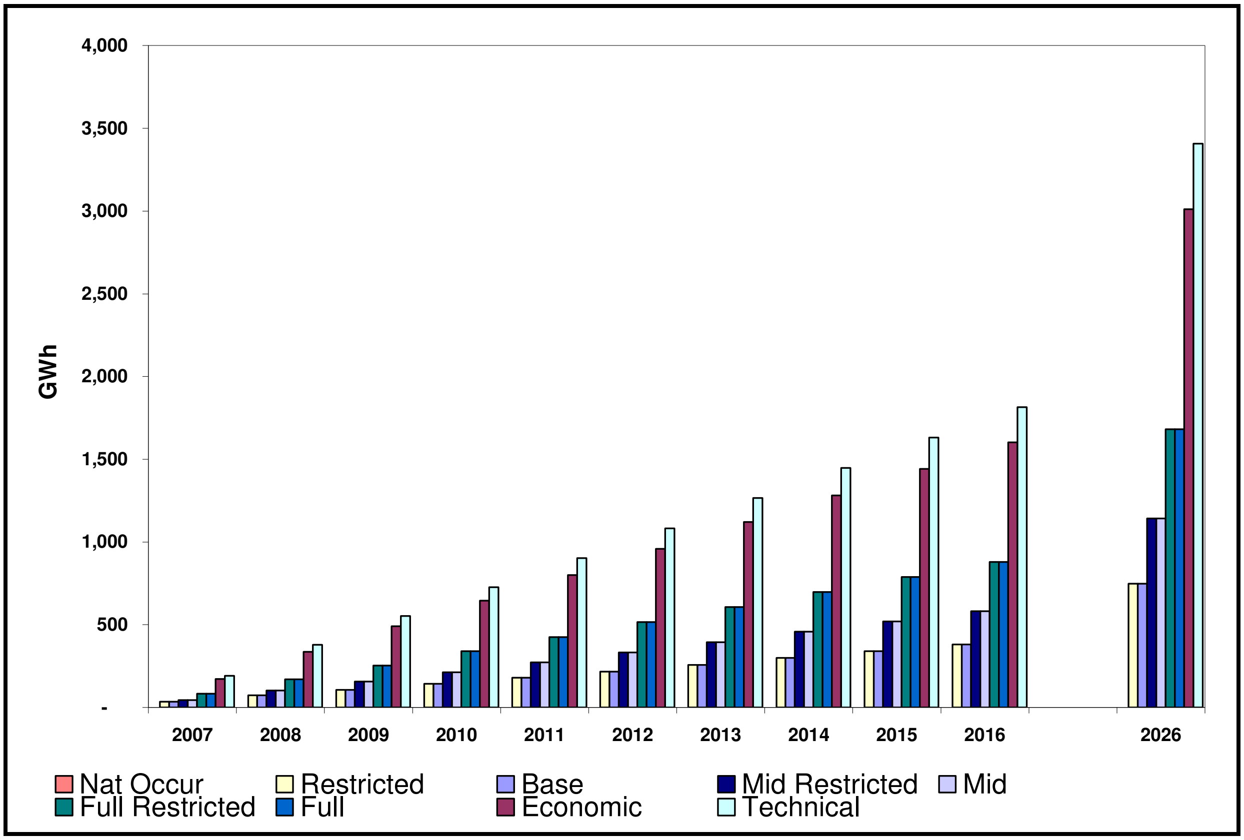
Table 9-11 lists the energy savings potential from commercial new construction in the combined SCE/SCG service territories while Figure 9-8 illustrates the savings estimates. Estimated gross market savings potential under Base scenario incentives are 380 GWh for 2007-2016 and 747 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (Mid scenario) increases the savings estimate to 582 GWh for 2007-2016 and 1,142 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 879 GWh for 2007-2016 and 1,682 GWh for 2007-2026.

Table 9-11: SCE/SCG Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Commercial New Construction Sector – 2007-2016, and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	192	172	36	36	-	44	44	84	84	45	45	-
2008	378	336	72	72	-	101	101	170	170	103	103	-
2009	552	491	107	107	-	156	156	253	253	174	174	-
2010	727	646	143	143	-	213	213	339	339	260	260	-
2011	902	800	179	179	-	272	272	426	426	347	347	-
2012	1,082	959	218	218	-	333	333	515	515	436	436	-
2013	1,266	1,120	258	258	-	395	395	606	606	527	527	-
2014	1,448	1,281	298	298	-	457	457	697	697	618	618	-
2015	1,631	1,442	339	339	-	519	519	788	788	709	709	-
2016	1,814	1,602	380	380	-	582	582	879	879	800	800	-
2026	3,407	3,012	747	747	-	1,142	1,142	1,682	1,682	1,649	1,649	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-8: SCE/SCG Estimated Total Technical, Economic, and Gross Market Energy Potential for Commercial New Construction – 2007-2016, 2026 (GWh)



Refer to Table 9-2 for a description of the scenarios.

SDG&E Potential Energy Savings Forecasts for Commercial New Construction

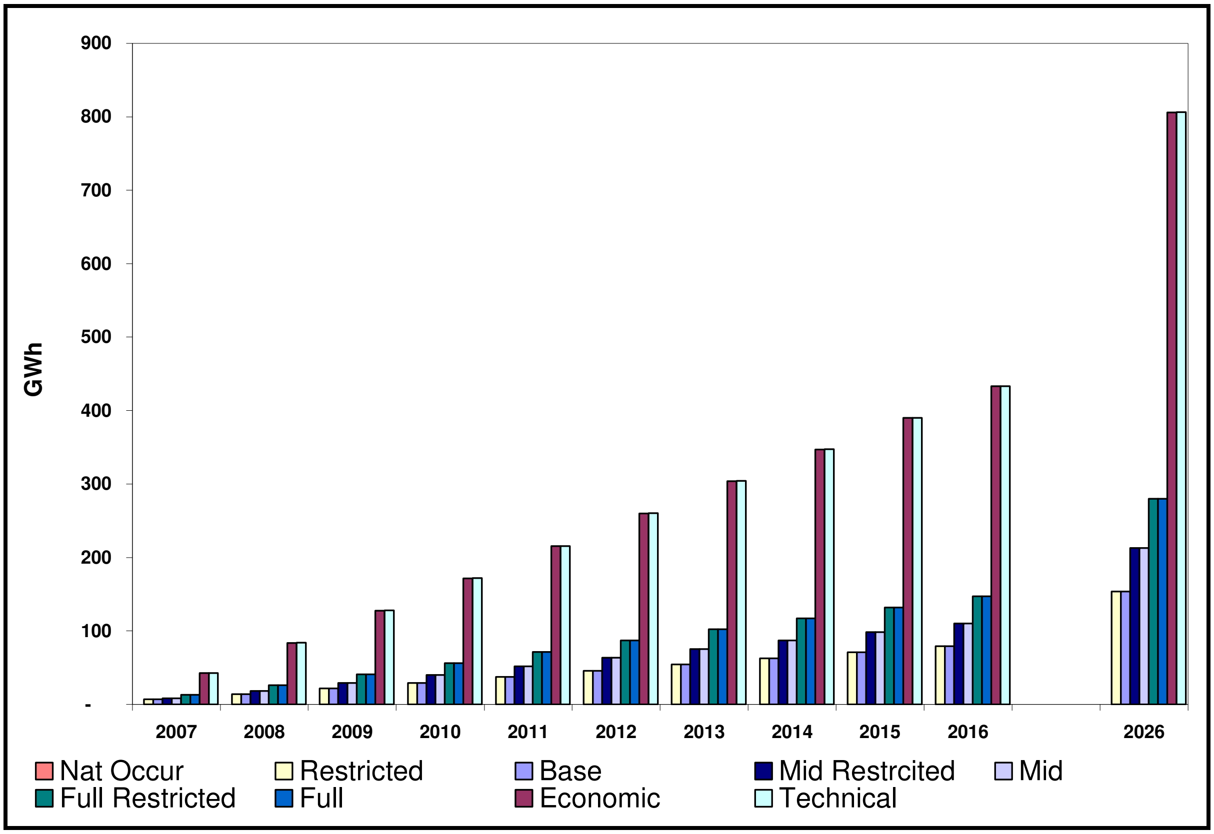
Table 9-12 presents the energy savings from commercial new construction in SDG&E's service territory. Figure 9-9 illustrates SDG&E's energy savings by scenario. Estimated gross savings potential under Base scenario are 79 GWh for 2007- 2016 and increase to 154 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (Mid scenario) increases forecast potential savings to 110 GWh for 2007-2016, a 39% increase in savings over the Base scenario estimates for 2016. For 2007-2026, the Mid scenario's total gross market potential is 213 GWh, a 38% increase over the Base scenario estimates for 2007-2026. Further increasing incentives for measures to their Full incremental cost increases the potential savings to 147 GWh for 2007-2016 and 280 GWh for 2007-2026.

Table 9-12: SDG&E Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Commercial New Construction Sector – 2007-2016, and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	43	43	7	7	-	8	8	13	13	8	8	-
2008	84	84	14	14	-	18	18	26	26	19	19	-
2009	128	128	22	22	-	29	29	41	41	32	32	-
2010	172	172	30	30	-	40	40	56	56	47	47	-
2011	216	216	38	38	-	52	52	72	72	62	62	-
2012	260	260	46	46	-	64	64	87	87	78	78	-
2013	304	304	54	54	-	76	76	102	102	93	93	-
2014	347	347	63	63	-	87	87	117	117	108	108	-
2015	390	390	71	71	-	98	98	132	132	123	123	-
2016	433	433	79	79	-	110	110	147	147	138	138	-
2026	806	806	154	154	-	213	213	280	280	276	276	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-9: SDG&E Estimated Total Gross Technical, Economic, and Market Energy Potential for Commercial New Construction – 2004-2016



Refer to Table 9-2 for a description of the scenarios.

PG&E Potential Demand Savings Forecasts for Commercial New Construction

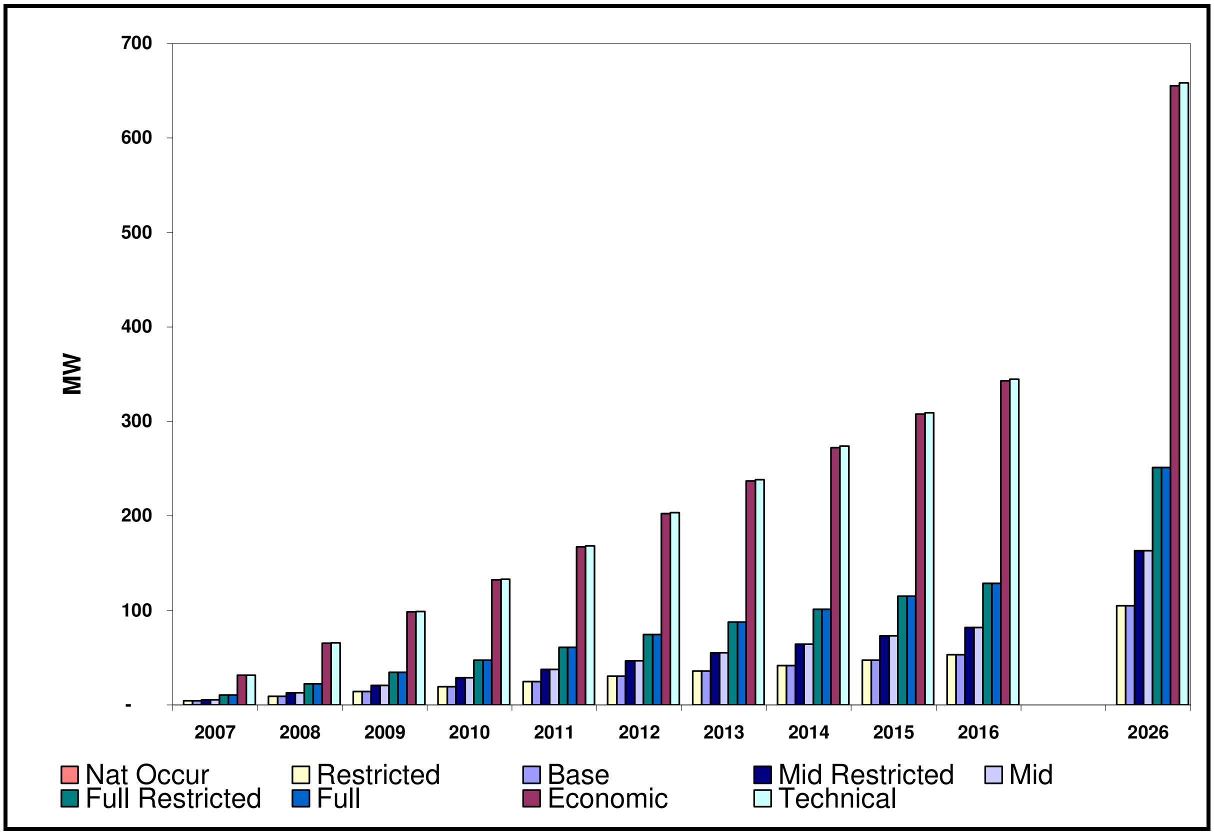
Table 9-13 lists the coincident peak demand savings from commercial new construction in PG&E's service territory, while Figure 9-10 illustrates these estimates. The estimated coincident peak demand savings potential under the Base scenario is 53 MW for 2007-2016 and 105 MW for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (the Mid scenario) increases the estimate of coincident peak demand savings to 82 MW for 2007-2016 and 163 MW for 2007-2026. The growth rate in the coincident peak demand estimates between the Base and Mid scenario is about 55% through 2016. Further increasing incentives from 2006 levels to Full incremental measure cost increases demand potential savings to 129 MW for 2007-2016 and 251 MW for 2007-2026.

Table 9-13: PG&E Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential by Scenario for the Commercial New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	31	31	4	4	-	5	5	10	10	5	5	-
2008	65	65	9	9	-	13	13	22	22	13	13	-
2009	99	98	14	14	-	21	21	35	35	23	23	-
2010	133	132	19	19	-	29	29	47	47	36	36	-
2011	168	167	25	25	-	38	38	61	61	50	50	-
2012	203	202	30	30	-	46	46	74	74	63	63	-
2013	238	237	36	36	-	55	55	88	88	77	77	-
2014	274	272	42	42	-	64	64	101	101	90	90	-
2015	309	308	47	47	-	73	73	115	115	104	104	-
2016	345	343	53	53	-	82	82	129	129	117	117	-
2026	658	655	105	105	-	163	163	251	251	246	246	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-10: PG&E Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential for Commercial New Construction – 2007-2016 and 2026 (MW)



Refer to Table 9-2 for a description of the scenarios.

<u>SCE/SCG Potential Demand Savings Forecasts for Commercial New Construction</u>

Table 9-14 lists the end-use peak demand savings from commercial new construction in SCE's service territory. The estimated demand savings potential under Base scenario incentives is 105 MW for 2007-2016 and 208 MW for 2007-2026. Increasing incentives to the average between Base scenario incentives and Full incremental measure costs increases savings forecast for 2007-2016 to 163 MW and for 2007-2026 to 323 MW. Increasing incentives to Full incremental measure cost increases demand potential savings to 258 MW for 2007-2016, a 52% increase over the average incentive level estimate.

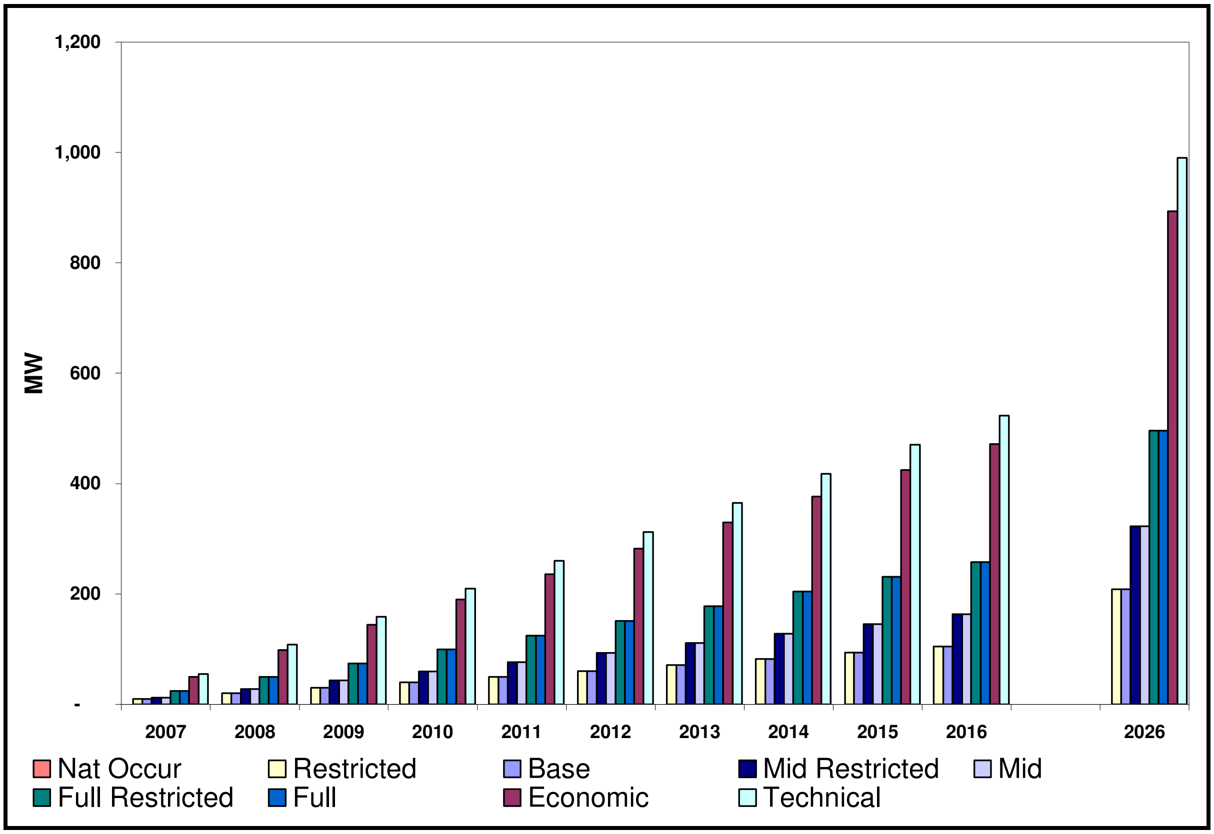
Table 9-14: SCE/SCG Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential by Scenario for the Commercial New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	55	50	10	10	-	12	12	24	24	12	12	-
2008	108	98	20	20	-	28	28	49	49	28	28	-
2009	159	144	30	30	-	43	43	74	74	49	49	-
2010	210	190	40	40	-	60	60	99	99	75	75	-
2011	260	235	50	50	-	76	76	125	125	100	100	-
2012	312	282	60	60	-	93	93	151	151	126	126	-
2013	365	330	71	71	-	111	111	177	177	153	153	-
2014	418	377	82	82	-	128	128	204	204	179	179	-
2015	471	424	94	94	-	145	145	231	231	206	206	-
2016	523	472	105	105	-	163	163	257	257	233	233	-
2026	990	894	208	208	-	323	323	496	496	486	486	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-11 presents the potential coincident peak demand savings for the market scenarios and the economic and technical potential estimates for SCE.

Figure 9-11: SCE/SCG Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential for Commercial New Construction – 2007-2016 and 2026 (MW)



SDG&E Potential Demand Savings Forecasts for Commercial New Construction

Table 9-15 lists the coincident peak demand savings from commercial new construction in SDG&E's service territory. The estimated gross coincident peak demand savings potential under the Base scenario (2006 incentive levels) is 17 MW for 2007-2016 and 33 MW for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs, increases forecast coincident peak demand potential to 24 MW for 2007-2016 and 46 MW for 2007-2026. Increasing incentives to full incremental measure cost increases demand potential savings to 32 MW for 2007-2016 and 60 MW for 2007-2026.

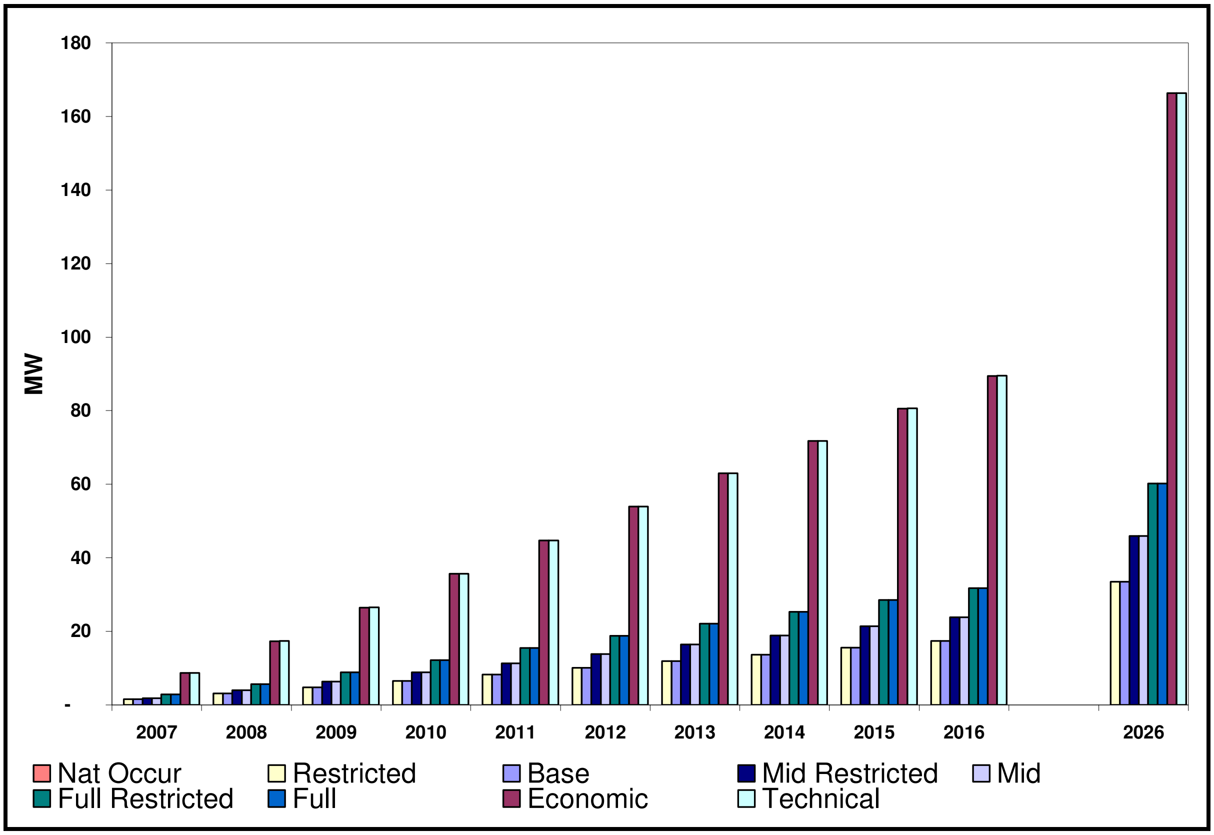
Figure 9-12 illustrates SDG&E's potential coincident peak demand savings associated with Technical, Economic and the market scenarios.

Table 9-15: SDG&E Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential by Scenario for the Commercial New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	8.7	8.7	1.5	1.5	-	1.8	1.8	2.8	2.8	1.8	1.8	-
2008	17.3	17.3	3.1	3.1	-	4.0	4.0	5.7	5.7	4.0	4.0	-
2009	26.5	26.4	4.8	4.8	-	6.3	6.3	8.9	8.9	6.9	6.9	-
2010	35.6	35.6	6.5	6.5	-	8.8	8.8	12.2	12.2	10.2	10.2	-
2011	44.7	44.7	8.2	8.2	-	11.3	11.3	15.4	15.4	13.5	13.5	-
2012	53.9	53.9	10.0	10.0	-	13.9	13.9	18.8	18.8	16.8	16.8	-
2013	63.0	63.0	11.9	11.9	-	16.4	16.4	22.1	22.1	20.1	20.1	-
2014	71.8	71.7	13.7	13.7	-	18.9	18.9	25.3	25.3	23.3	23.3	-
2015	80.6	80.6	15.5	15.5	-	21.3	21.3	28.5	28.5	26.5	26.5	-
2016	89.5	89.5	17.3	17.3	-	23.8	23.8	31.7	31.7	29.7	29.7	-
2026	166.4	166.3	33.4	33.4	-	45.9	45.9	60.1	60.1	59.3	59.3	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-12: SDG&E Estimated Total Technical, Economic, and Gross Market Coincident Peak Demand Potential for Commercial New Construction – 2007-2016, and 2026 (MW)



Refer to Table 7-2 for a description of the market funding scenarios.

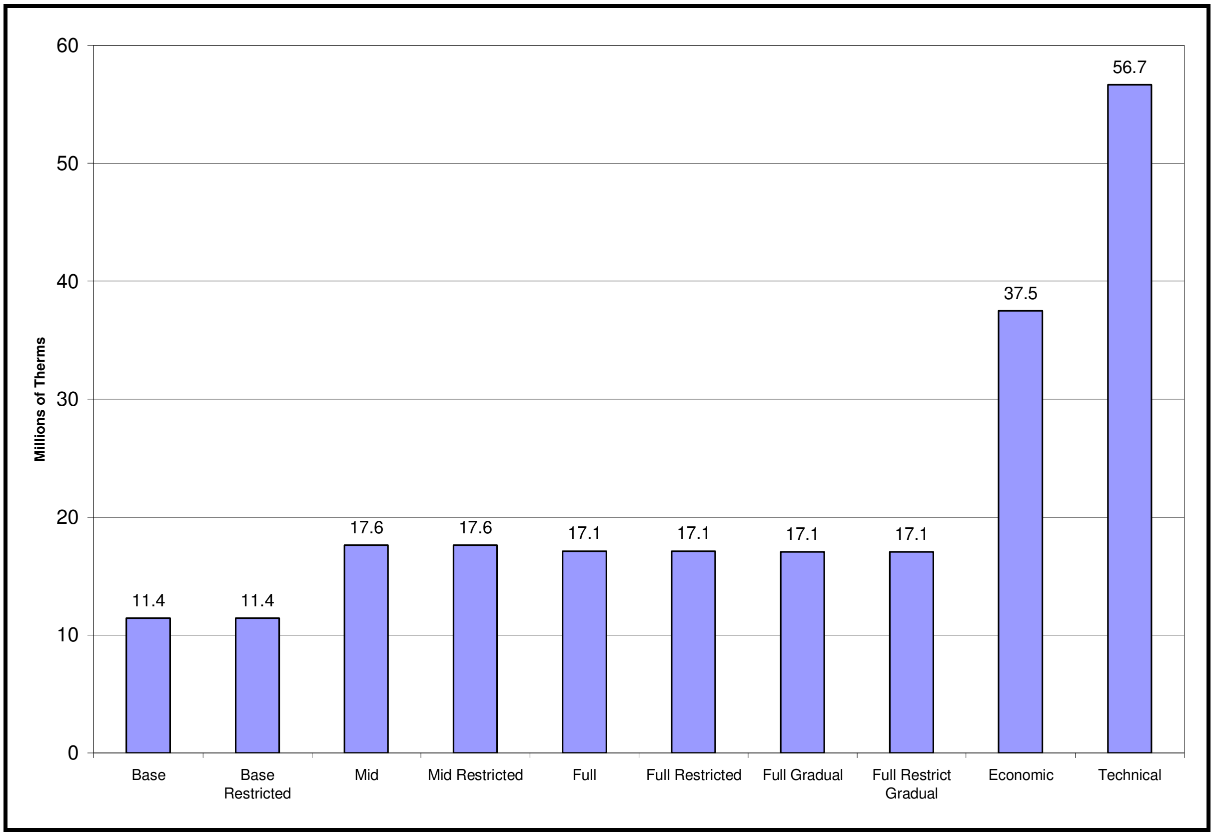
9.3 Gas Efficiency Potential in Commercial New Construction

9.3.1 Market Total Natural Gas Potential in Commercial New Construction

Total IOU Commercial Market Potential

Figure 9-13 presents the total estimated gas usage and potential estimates from the analysis for the three California IOUs savings potential. The values are provided for the last year of the short-term analysis, 2016.

Figure 9-13: Estimated California IOU Total Technical, Economic, and Gross Market Potential for Commercial New Construction – 2007-2016



Refer to Table 9-2 for a description of the scenarios.

Table 9-16 presented natural gas potential estimates by scenario for the intermediate forecast period, 2007-2016 and for the entire forecast period 2007-2026 across three California IOUs (PG&E, SCE, and SDG&E). Total IOU market potential under the Base scenario is 11 million therms of natural gas potential for 2007-2016 and 22 million therms for 2007-2026. Increasing incentives to Full incremental costs increases the total market forecast to 17 million therms for 2007-2016 and 32 million therms for 2007-2026. If program incentives are set halfway between Base scenario incentives and Full incremental costs, the Mid scenario, estimated natural gas potential savings are 18 million therms for 2007-2016 and 34 million therms for 2007-2026. The estimated Mid scenario potential savings are greater than the Full scenario due to savings from different mixtures of buildings types. Since packages of measures are analyzed instead of individual measures, some packages actually increase gas usage, but in return save more electricity.

Table 9-16: Estimated California IOU Total Market Potential by Scenario for Commercial New Construction – 2007-2016 (Millions of Therms)

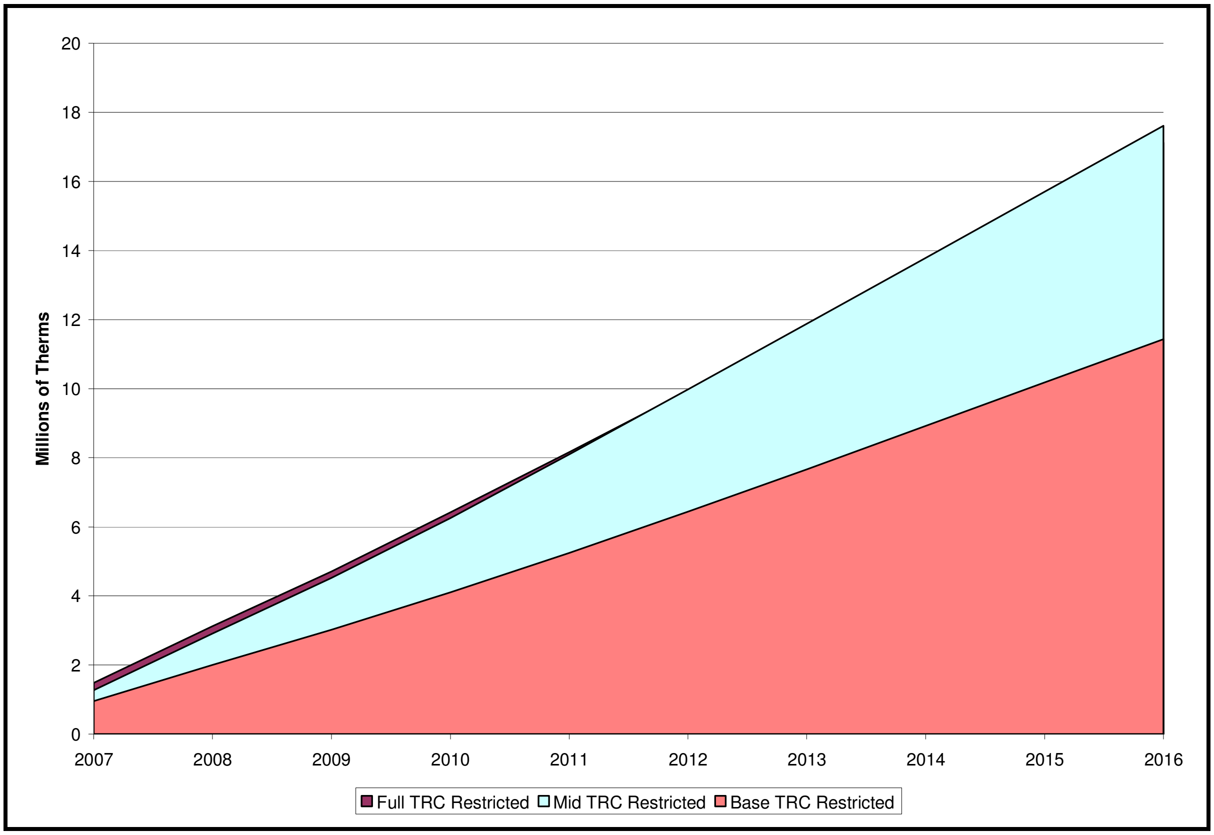
Funding Level	Millions of Gross Therms 2016	Naturally Occurring (Millions of Therms) 2016	Millions of Gross Therms 2026	Naturally Occurring (Millions of Therms) 2026
Base	11.4	-	22.4	-
Base Restricted	11.4	-	22.4	-
Mid	17.6	-	34.3	-
Mid Restricted	17.6	-	34.3	-
Full	17.1	-	32.4	-
Full Restricted	17.1	-	32.4	-
Full Gradual	17.1	-	32.4	-
Full Restrict Gradual	17.1	-	32.4	-

Refer to Table 9-2 for a description of the scenarios.

Table 9-16 also presents potential estimates for a scenario in which the incentive levels were gradually increased from Base scenario incentive levels (in 2006) to Full incentive levels (by 2010). The results from this scenario indicate that the slower ramp of incentives, relative to the jump from 2006 Base scenario to 2007 Full incentives, leads to a minor loss of potential relative to the Full and Full restricted scenarios. Given the similarities in these forecasts, the remaining tables and figures will not present the potential estimates for the Full gradual and the Full restricted gradual scenarios.

The results for the TRC restricted gross market scenarios are illustrated in Figure 9-14. These graphs illustrate the yearly estimates of market potential for the TRC restricted scenarios.

Figure 9-14: Estimated California IOU Gross Total Energy Market Potential by TRC Restricted Funding Levels for Commercial New Construction – 2007-2016 (Millions of Therms)



Refer to Table 9-2 for a description of the scenarios.

Market Potential by Building Type for Commercial New Construction:

Table 9-17 and Table 9-18 summarize the gas market potential estimates by funding level and building type for 2007-2016. For comparison, technical and economic estimates are listed in Table 9-19. Figure 9-15 illustrates the estimates of restricted potential by building type for the 2007-2016 analysis period. As shown, the largest contributors to gas savings are restaurants with a contribution of 9 million therms, or 82% of all Base scenario commercial new construction natural gas potential for 2007-2016. As briefly mentioned above and explained in detail in Appendix F, some packages of measures for some building types result in negative gas savings (i.e. an increase in gas usage). In addition, since each building type has two packages of measures by region, it can result in estimated gas savings potential in some scenarios and potential increased gas usage in others.

Table 9-17: Estimated California IOU Total Gross Market Gas Potential by Funding Level and Building Type for Commercial New Construction – 2007-2016 (Millions of Therms)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
College	0.6	0.6	-	0.5	0.5	0.4	0.4	-
Grocery Stores	(0.6)	(0.6)	-	(0.8)	(0.8)	(1.2)	(1.2)	-
Health Care	0.0	0.0	-	(0.1)	(0.1)	(0.8)	(0.8)	-
Lodging	1.1	1.1	-	1.3	1.3	1.4	1.4	-
Large Office	0.8	0.8	-	0.6	0.6	0.2	0.2	-
Misc.	0.1	0.1	-	(0.9)	(0.9)	(2.8)	(2.8)	-
Retail	0.2	0.2	-	(0.3)	(0.3)	(2.1)	(2.1)	-
Restaurant	9.2	9.2	-	17.7	17.7	23.2	23.2	-
School	(0.0)	(0.0)	-	(0.2)	(0.2)	(0.7)	(0.7)	-
Small Office	(0.0)	(0.0)	-	(0.1)	(0.1)	(0.3)	(0.3)	-
Warehouse	0.0	0.0	-	0.0	0.0	(0.1)	(0.1)	-
Total	**11.4**	**11.4**	**-**	**17.6**	**17.6**	**17.1**	**17.1**	**-**

Refer to Table 9-2 for a description of the scenarios.

Table 9-18: Estimated California IOU Total Gross Market Gas Potential by Funding Level and Building Type for Commercial New Construction – 2007-2026 (Millions of Therms)

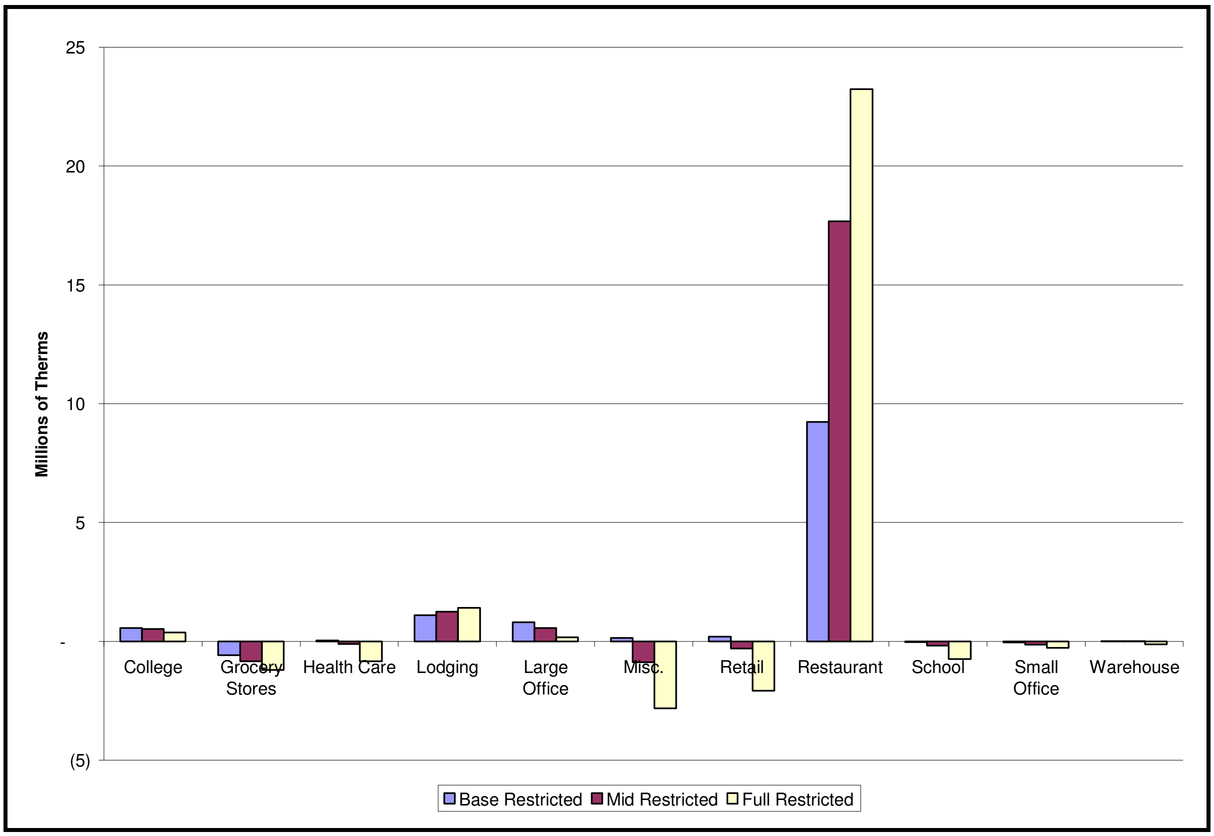
	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
College	1.0	1.0	-	0.9	0.9	0.7	0.7	-
Grocery Stores	(1.1)	(1.1)	-	(1.6)	(1.6)	(2.3)	(2.3)	-
Health Care	0.1	0.1	-	(0.2)	(0.2)	(1.7)	(1.7)	-
Lodging	2.1	2.1	-	2.4	2.4	2.7	2.7	-
Large Office	1.6	1.6	-	1.1	1.1	0.3	0.3	-
Misc.	0.3	0.3	-	(1.8)	(1.8)	(5.5)	(5.5)	-
Retail	0.4	0.4	-	(0.7)	(0.7)	(4.0)	(4.0)	-
Restaurant	18.1	18.1	-	34.9	34.9	44.6	44.6	-
School	(0.1)	(0.1)	-	(0.4)	(0.4)	(1.5)	(1.5)	-
Small Office	(0.1)	(0.1)	-	(0.3)	(0.3)	(0.5)	(0.5)	-
Warehouse	0.0	0.0	-	0.0	0.0	(0.2)	(0.2)	-
Total	**22.4**	**22.4**	**-**	**34.3**	**34.3**	**32.4**	**32.4**	**-**

Refer to Table 9-2 for a description of the scenarios.

Table 9-19: Estimated California IOU Total Technical and Economic Gas Potential by Building Type for Commercial New Construction – 2007-2016, 2007-2026 (Millions of Therms)

	Technical - 2016	Economic - 2016	Technical - 2026	Economic - 2026
College	3	3	6	6
Grocery Stores	(1)	(1)	(2)	(2)
Health Care	2	2	3	3
Lodging	4	4	8	8
Large Office	6	6	12	12
Misc.	11	11	21	21
Retail	2	2	4	4
Restaurant	25	6	48	12
School	1	1	1	1
Small Office	1	1	2	2
Warehouse	2	2	3	3
Total	**57**	**37**	**107**	**71**

Figure 9-15: Estimated California IOU Total Gas Potential by Building Type for Commercial New Construction – 2007-2016 (Millions of Therms)



Refer to Table 9-2 for a description of the scenarios.

9.3.2 Utility-Level Commercial Gas Potential

In this section, market, technical and economic potential are presented at the utility level. The utility-specific costs and savings are listed below. Figure 9-16, Figure 9-17, and Figure 9-18 illustrate, and Table 9-20 through Table 9-22 list the estimates of potential electric energy savings for the various market scenarios for PG&E, SCE/SCG, and SDG&E, respectively.

PG&E Potential Natural Gas Savings Forecasts for Commercial New Construction

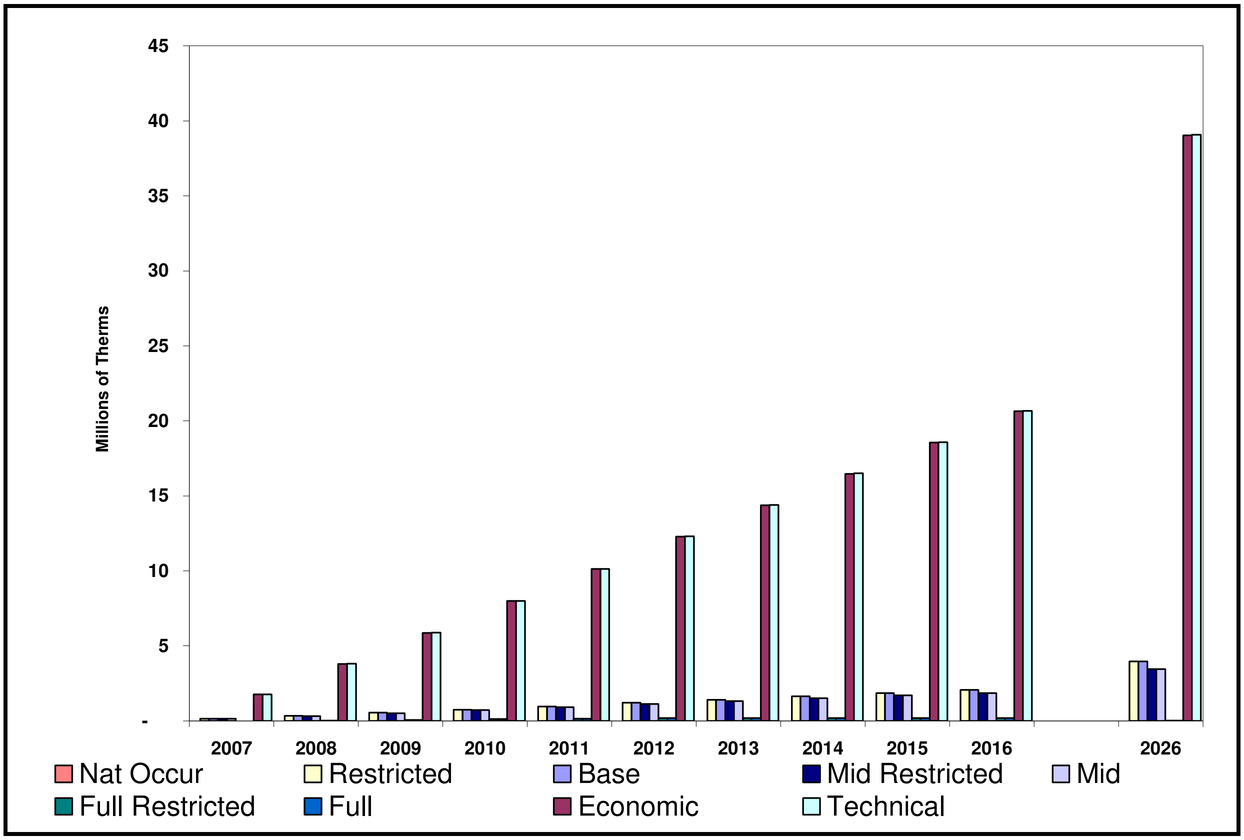
Table 9-20 lists the natural gas savings potential from commercial new construction in PG&E's service territory, while Figure 9-16 illustrates the natural gas estimates. Estimated gross market savings potential under Base scenario incentives are 2.1 million therms for 2007-2016 and 4.0 million therms for 2007-2026. Increasing incentives to the average between Base scenario incentives and Full incremental measure costs (Mid scenario) brings the estimate of savings to 1.9 millions of therms for 2007-2016 and 3.4 million therms for 2007-2026. Increasing incentives to Full incremental measure cost gives us potential savings of 0.2 million therms for 2007-2016 and 0.02 for 2007-2026. Figure 9-16 illustrates the yearly-by scenario natural gas potential savings.

Table 9-20: PG&E Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Commercial Sector – 2007-2016, and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	1.77	1.77	0.14	0.14	-	0.14	0.14	(0.01)	(0.01)	0.15	0.15	-
2008	3.81	3.80	0.34	0.34	-	0.32	0.32	0.02	0.02	0.33	0.33	-
2009	5.89	5.88	0.54	0.54	-	0.51	0.51	0.07	0.07	0.45	0.45	-
2010	7.99	7.98	0.75	0.75	-	0.72	0.72	0.12	0.12	0.50	0.50	-
2011	10.14	10.13	0.97	0.97	-	0.93	0.93	0.16	0.16	0.54	0.54	-
2012	12.31	12.29	1.20	1.20	-	1.14	1.14	0.19	0.19	0.57	0.57	-
2013	14.40	14.38	1.42	1.42	-	1.33	1.33	0.20	0.20	0.57	0.57	-
2014	16.50	16.48	1.64	1.64	-	1.51	1.51	0.20	0.20	0.57	0.57	-
2015	18.59	18.56	1.85	1.85	-	1.69	1.69	0.19	0.19	0.57	0.57	-
2016	20.67	20.65	2.06	2.06	-	1.87	1.87	0.18	0.18	0.56	0.56	-
2026	39.09	39.04	3.97	3.97	-	3.44	3.44	0.02	0.02	0.19	0.19	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-16: PG&E Estimated Total Technical, Economic, and Gross Market Natural Gas Potential for Commercial New Construction – 2007-2016, 2026 (Millions of Therms)



Refer to Table 9-2 for a description of the scenarios.

SCE/SCG Potential Natural Gas Savings Forecasts for Commercial New Construction

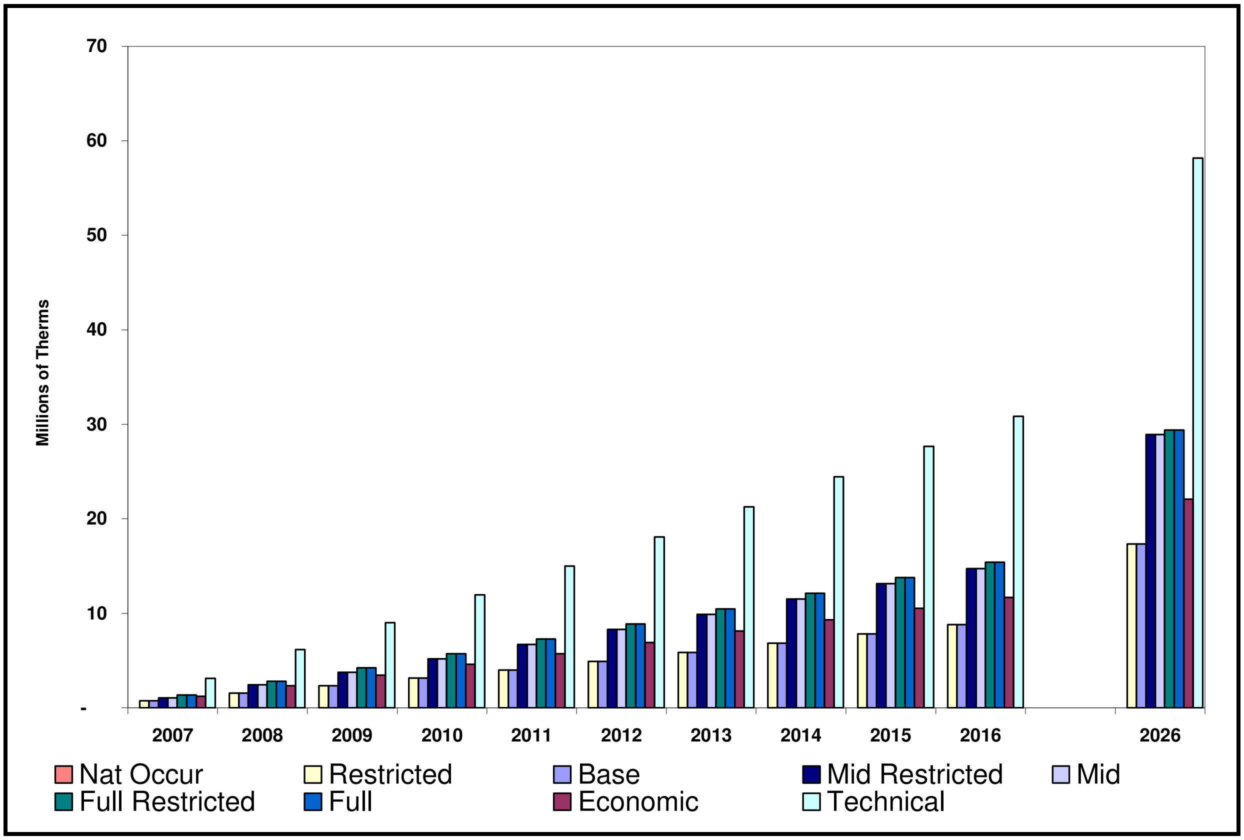
The results in Table 9-21 list the natural gas savings potential from commercial new construction in SCE/SCG's service territory, while Figure 9-17 illustrates the natural gas potential. Estimated gross market savings potential under Base scenario incentives are 8.8 million therms for 2007-2016 and 17.3 million therms for 2007-2026. Increasing incentives to the average between Base scenario incentives and Full incremental measure costs (Mid scenario) increases the savings estimate to 14.8 million therms for 2007-2016 and 28.9 million therms for 2007-2026. Increasing incentives to Full incremental measure cost increases the cost-effective potential savings to 15.4 million therms for 2007-2016 and 29.4 million therms for 2007-2026. Figure 9-17 illustrates the yearly by scenario natural gas potential savings.

Table 9-21: SCE/SCG Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Commercial New Construction Sector – 2007-2016, and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	3.1	1.2	0.8	0.8	-	1.1	1.1	1.4	1.4	1.1	1.1	-
2008	6.2	2.4	1.6	1.6	-	2.4	2.4	2.8	2.8	2.5	2.5	-
2009	9.0	3.5	2.3	2.3	-	3.8	3.8	4.2	4.2	3.9	3.9	-
2010	12.0	4.6	3.2	3.2	-	5.2	5.2	5.7	5.7	5.4	5.4	-
2011	15.0	5.7	4.0	4.0	-	6.7	6.7	7.3	7.3	7.0	7.0	-
2012	18.1	6.9	4.9	4.9	-	8.3	8.3	8.9	8.9	8.6	8.6	-
2013	21.3	8.1	5.9	5.9	-	9.9	9.9	10.5	10.5	10.2	10.2	-
2014	24.5	9.3	6.9	6.9	-	11.5	11.5	12.1	12.1	11.8	11.8	-
2015	27.7	10.5	7.8	7.8	-	13.1	13.1	13.8	13.8	13.5	13.5	-
2016	30.9	11.7	8.8	8.8	-	14.8	14.8	15.4	15.4	15.1	15.1	-
2026	58.2	22.1	17.3	17.3	-	28.9	28.9	29.4	29.4	29.3	29.3	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-17: Estimated SCE/SCG Total Gross Technical, Economic, and Market Gas Potential for Commercial New Construction – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 9-2 for a description of the scenarios.

SDG&E Potential Gas Savings Forecasts for Commercial New Construction

Table 9-22 lists the natural gas potential savings for SDG&E's commercial new construction sector by scenario. At 2006 incentive levels, the natural gas potential savings is 0.5 million therms for 2007-2016 and 1.1 million therms for 2007-2026. Increasing incentives to the average between the 2006 level and full incremental measure cost (Mid scenario) is estimated to increase natural gas savings to 1 million therms for 2007-2016 and 2 million therms for 2007-2026.

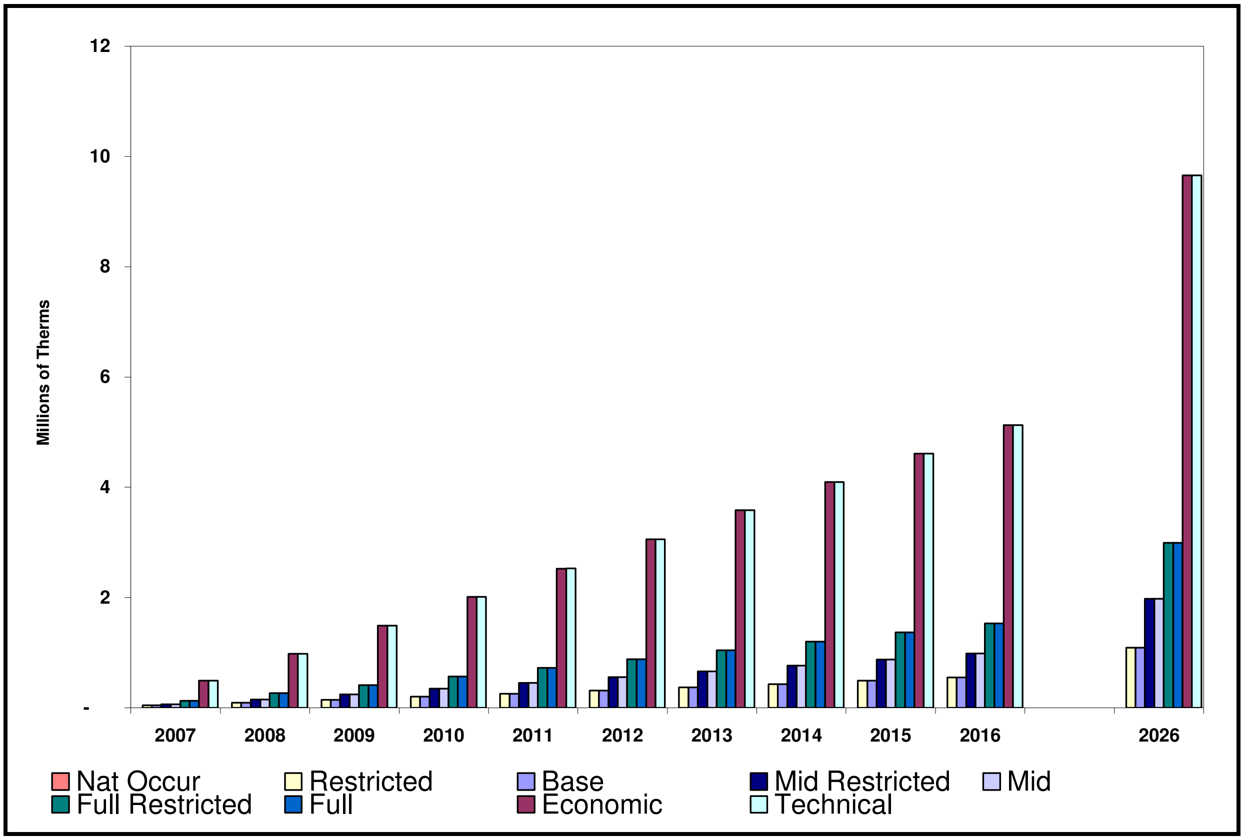
Table 9-22: SDG&E Estimated Total Technical, Economic, and Gross Market Potential by Scenario for the Commercial New Construction Sector – 2007-2016, and 2026 (Millions of Therms)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	0.5	0.5	0.0	0.0	-	0.1	0.1	0.1	0.1	0.1	0.1	-
2008	1.0	1.0	0.1	0.1	-	0.1	0.1	0.3	0.3	0.2	0.2	-
2009	1.5	1.5	0.1	0.1	-	0.2	0.2	0.4	0.4	0.3	0.3	-
2010	2.0	2.0	0.2	0.2	-	0.3	0.3	0.6	0.6	0.4	0.4	-
2011	2.5	2.5	0.3	0.3	-	0.4	0.4	0.7	0.7	0.6	0.6	-
2012	3.1	3.1	0.3	0.3	-	0.6	0.6	0.9	0.9	0.7	0.7	-
2013	3.6	3.6	0.4	0.4	-	0.7	0.7	1.0	1.0	0.9	0.9	-
2014	4.1	4.1	0.4	0.4	-	0.8	0.8	1.2	1.2	1.1	1.1	-
2015	4.6	4.6	0.5	0.5	-	0.9	0.9	1.4	1.4	1.2	1.2	-
2016	5.1	5.1	0.5	0.5	-	1.0	1.0	1.5	1.5	1.4	1.4	-
2026	9.7	9.7	1.1	1.1	-	2.0	2.0	3.0	3.0	2.9	2.9	-

Refer to Table 9-2 for a description of the scenarios.

Figure 9-18 illustrates the technical, economic, and market forecasts of natural gas savings potential for SDG&E's commercial new construction sector for the years 2007-2016 and 2026.

Figure 9-18: Estimated SDG&E Total Technical, Economic, and Gross Market Natural Gas Potential for Commercial New Construction – 2007-2016 and 2026 (Millions of Therms)



Refer to Table 9-2 for a description of the scenarios.

9.4 Costs and Benefits for the Commercial New Construction Program

This section presents the cost and benefit from the electric and gas commercial new construction estimates, creating an aggregate California IOU sum of costs, benefits, and benefit-to-cost ratios.

Table 9-23: Summary of the California IOU Costs and Benefits by Scenario for the Commercial New Construction Sector 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	115	115	531	1,879
Net Measure Costs	119	119	655	1,669
Gross Program Costs	44	44	66	94
Net Avoided Cost Benefits	337	337	863	1,621
TRC	**2.07**	**2.07**	**1.20**	**0.92**

Refer to Table 9-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

The TRC test indicates that the Base scenario estimate is cost-effective. Restricting measures to those that are nearly cost-effective causes no change in the statewide TRC cost-benefit ratio for the Base scenarios. Increasing funding to Full incremental measure costs while restricting measures to those with a TRC > 0.85 is estimated to reduce the level of the program TRC to slightly below 1.0. For the commercial new construction analysis, limiting measure to those that are nearly cost-effective does not change the estimated TRC. The Base scenario TRC is equal to the Base Restricted and the Full scenario TRC is equal to the Full Restricted TRC.

Utility-Specific Cost and Benefits for Commercial New Construction

The utility-specific costs, benefits, and total resource cost ratios for four of the market potential funding scenarios are presented in Table 9-24, Table 9-25, and Table 9-26. The forecast shows that under the Base scenario estimates, all four utilities offer cost-effective commercial new construction programs. For PG&E, the Base scenario benefit-to-cost ratio is 2.93, for SCE/SCG the ratio is 1.73, and 2.11 for SDG&E. If funding is increased to the Mid incentive level, the TRCs for all utilities decline, but remain cost-effective. The decline in the TRC indicates that as incentives are increased, the benefits associated with the increase in incentives are less than the increase in costs, though the total program is still cost-effective. Further increasing funding to the Full funding level, only PG&E continues to be cost-effective with a TRC above 1.0.

Table 9-24: Summary of PG&E Market Potential Cost and Benefits by Scenario for Commercial New Construction 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	35	35	130	472
Net Measure Costs	25	25	148	411
Gross Program Costs	17	17	25	36
Net Avoided Cost Benefits	122	122	293	545
TRC	**2.93**	**2.93**	**1.69**	**1.22**

Refer to Table 9-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 9-25: Summary of SCE/SCG Market Potential Cost and Benefits by Scenario for Commercial New Construction 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	67	67	343	1,225
Net Measure Costs	83	83	438	1,105
Gross Program Costs	23	23	36	51
Net Avoided Cost Benefits	183	183	487	929
TRC	**1.73**	**1.73**	**1.03**	**0.80**

Refer to Table 9-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 9-26: Summary of SDG&E Market Potential Cost and Benefits by Scenario for Commercial New Construction 2007-2026

Costs and Benefits in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	12	12	58	182
Net Measure Costs	11	11	68	153
Gross Program Costs	4	4	5	7
Net Avoided Cost Benefits	31	31	83	146
TRC	**2.11**	**2.11**	**1.13**	**0.91**

Refer to Table 9-2 for a description of the market funding scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

9.5 Key Commercial New Construction Results and Future Research Recommendations

9.5.1 Summary of Key Results for Commercial New Construction

The statewide market potential for electric energy efficiency for newly constructed commercial buildings at the Base scenario level is estimated to be 699 gross GWh over a 10-year period. Increasing incentives to a level equal to the Mid-point between Base scenario incentives and full incremental costs (Mid scenario), is estimated to lead to energy savings of 1,059 GWh for 2007-2016, a 51% increase. Further ramping up incentives to cover full incremental measure costs increases gross electric energy potential to 1,597 GWh for 2007-2016.

Restricting the Base scenario to measures with a TRC > 0.85 does not change the gross potential forecast. Restricting packages to those with a TRC > 0.85 while increasing incentives to half way between Base scenario incentives and full incremental costs (Mid restricted scenario) leads to 1,059 GWh of gross electric savings potential for 2007-2016, the same potential as the non-restricted Mid scenario. The Full restricted and the Full non-restricted scenarios are estimated to provide 1,597 GWh of potential through 2016.

The Base scenario gross market potential for coincident peak demand reduction is 175 MW over a 10-year period. Increasing incentives to cover full incremental costs increases the gross coincident peak demand potential to 418 MW for 2007-2016.

The market potential for gross gas efficiency at the Base scenario level was 11.4 million therms for 2007-2016. Ramping up incentives to cover Full incremental costs increased the estimates of gross savings to 17.1 million therms for 2007-2016.

TRC results for commercial new construction programs, when restricted to cost-effective packages under the Base scenario, Mid, and Full market scenarios showed that the Base and Mid incentive levels are cost-effective. Specifically, the Base scenario incentive program resulted in a statewide benefit-cost ratio of 2.07, while the statewide Mid incremental cost incentive program scored 1.2 while the statewide Full scenario-level incentive program estimated TRC was 0.92.

10

Energy Efficiency Potential in Industrial New Construction

This section presents the estimates of industrial energy efficiency potential in newly constructed industrial space. Estimates of potential are presented for the period 2007-2016, and 2007-2026. Market potential was estimated for nine scenarios. The scenarios assume alternative levels of measure incentives and cost-effectiveness tests. All market results are presented as both gross and net total savings associated with cumulative adoptions over the estimation period. An estimate of technical and economic potential is presented for comparison purposes.

10.1 Overview

Under the 2006 Potential Study contract, RLW Analytics (RLW) and Itron jointly developed the estimates of industrial new construction energy efficiency potential. RLW developed many of the inputs including incremental costs and energy savings, and calibration shares, while time-of-use energy usage inputs were developed jointly with AEC. RLW's methodology can be found in Appendix G. The scope of the current project did not include the development of new inputs for the industrial new construction sector. The scope of this project entailed using the old inputs with new forecasts of economic growth, rates, and avoided costs.

Energy efficiency potential for industrial new construction was estimated by industrial category and by IOU. The industrial portion of the 2006 New Construction Potential Study developed cost and savings estimates and estimated potential for three industrial categories, electronics manufacturing, wastewater treatment and refrigerated warehouses. The scope of this project is also limited to the three industrial categories. The results shown in this section do not attempt to represent the energy potential for all newly constructed industrial buildings, but rather reflect the potential for only those building types agreed upon by the new construction advisory group.[1]

[1] The three NAICs were chosen based on where experts thought most of the new construction in the industrial sector was most likely expected to occur.

The approach used was similar to the one used for estimating potential in existing industrial buildings, however, there are several important differences. The differences include the development of incremental costs, the development of energy savings, and the number of industrial categories, and the number of scenarios. Each is described in further detail below.

10.1.1 Measures

Table 10-1 presents the measures analyzed in this study for newly constructed industrial facilities. Appendix G includes more detail on the measures included in each package by building type and climate zone.

Table 10-1: Industrial New Construction Measure Descriptions

End Use	Measure Description	Fuel Type
NCInd	Floating Head Pressure - Variable Setpoint Variable Fan Speed	Electric
NCInd	Air Unit VFDs	Electric
NCInd	Lighting Controls	Electric
NCInd	Efficient Compressor Motor	Electric
NCInd	Floating Suction Pressure	Electric
NCInd	Efficient Condenser	Electric
NCInd	PE Motors and VFDs	Electric
NCInd	Low Pressure UV Lamps	Electric
NCInd	Belt Press Dewatering	Electric
NCInd	Efficient Blowers	Electric
NCInd	Reduced Pipe Friction	Electric
NCInd	Pumping Head Reduction	Electric
NCInd	Design Changes	Electric
NCInd	Premium Efficiency Pump and Motors	Electric
NCInd	VSD (Pumps)	Electric
NCInd	VSD Air Compressor <100HP (Compressed Air)	Electric
NCInd	VSD Air Compressor 100+HP (Compressed Air)	Electric
NCInd	Thermal Mass Dryer (Compressed Air)	Electric
NCInd	High Efficiency VSD Chiller	Electric
NCInd	Waterside Economizer for Process	Electric
NCInd	15% above 2001 Standards	Electric
NCInd	25% above 2001 Standards	Electric
NCInd	10% above 2005 Standards	Electric
NCInd	15% above 2005 Standards	Electric
NCInd	Centralized Exhaust Optimization	Electric
NCInd	Unoccupied Airflow Setback	Electric
NCInd	Pressurized Plenum - Recirc	Electric

Table 10-1 (cont'd): Industrial New Construction Measure Descriptions

End Use	Measure Description	Fuel Type
NCInd	Efficient Fan Selection 70%	Electric
NCInd	Proper Air Change Rates (6 ACH)	Electric
NCInd	Low Pressure Drop Filter	Electric
NCInd	Low Face Velocity AHU	Electric
NCInd	Efficient Fan Filter Units	Electric
NCInd	High Efficiency VSD Chiller +CWB Off.	Electric
NCInd	Waterside Economizer for Process	Electric
NCInd	Dual Temperature Cooling Loops	Electric
NCInd	Primary Only VSD HVAC Pumps	Electric
NCInd	NEMA Premium + Efficient HVAC Pump	Electric
NCInd	VSD Air Compressor <100HP	Electric
NCInd	VSD Air Compressor 100+HP	Electric
NCInd	Compressed Air Thermal Mass Dryer	Electric
NCInd	NEMA Premium Motor + Efficient Vacuum Pump	Electric
NCInd	Process Vacuum Pump VSD	Electric
NCInd	NEMA Premium Motor + Efficient DI Water Pump	Electric
NCInd	Deionized Water Pump VSD	Electric
NCInd	High Efficacy Precision Industrial Lighting	Electric

10.1.2 Incremental Costs

Sources for the incremental measure costs used in the New Construction Potential Study included the 2005 DEER Measure Cost Study, the R.S. Means "Costworks" construction cost estimating database, DOE's Motor Master Software, utility incentive project documentation and construction cost estimates obtained directly from equipment manufacturers, distributors, and contractors.[2]

10.1.3 Energy Savings

Energy savings were calculated via two different methods due to availability of data. For electronics manufacturing, the forecasted load increase was disaggregated by end use. Measure savings were applied to end uses by considering the market applicability of each individual measure.

Wastewater and refrigerated warehouses used a sample of projects similar to the commercial analysis. The market applicability of a given measure was estimated by the saturation of the measure in the sample. The savings percentage of the sample was projected to the sector load increase to determine sector level energy savings.

[2] Itron, Inc. *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study: Final Report.* Prepared for Southern California Edison. December 2005.

10.1.4 Building Types

The Potential Study developed inputs and estimated potential for four building types: clean rooms (3674), refrigerated warehouses, electronics manufacturing (sic 36 not 3674) and waste water treatments plants.[3]

10.1.5 Scenarios

Table 10-2 provides the list of scenarios used to analyze the potential in existing buildings. The analysis of potential in the industrial new construction sector included all of the scenarios analyzed in the existing industrial sector.

Table 10-2: Scenario Descriptions

Scenario Name	Scenario Description
Base Incentive	Includes measures incentivized in the 2004-2005 program year with incentives that were available in 2006.
Mid Incentive	Includes all measures analyzed in the study with incentives half way between those that were available in 2006 and full incremental costs.
Full Incentive	Includes all measures analyzed with incentives set to Full incremental costs.
Base Incentive TRC Restricted	Base incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Mid Incentive TRC Restricted	Mid incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Incentive TRC Restricted	Full incentive scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Full Gradual	Includes all measures analyzed with incentives increasing from 2006 levels to Full incremental costs in 2010.
Full Gradual TRC Restricted	Full gradual scenario with measures restricted to those with a TRC greater than or equal to 0.85.
Base TRC Restricted Higher Awareness	The Base incentive TRC restricted scenario with a higher level of awareness for both the program and the naturally occurring analysis.

10.2 Electric Efficiency Potential in Industrial New Construction

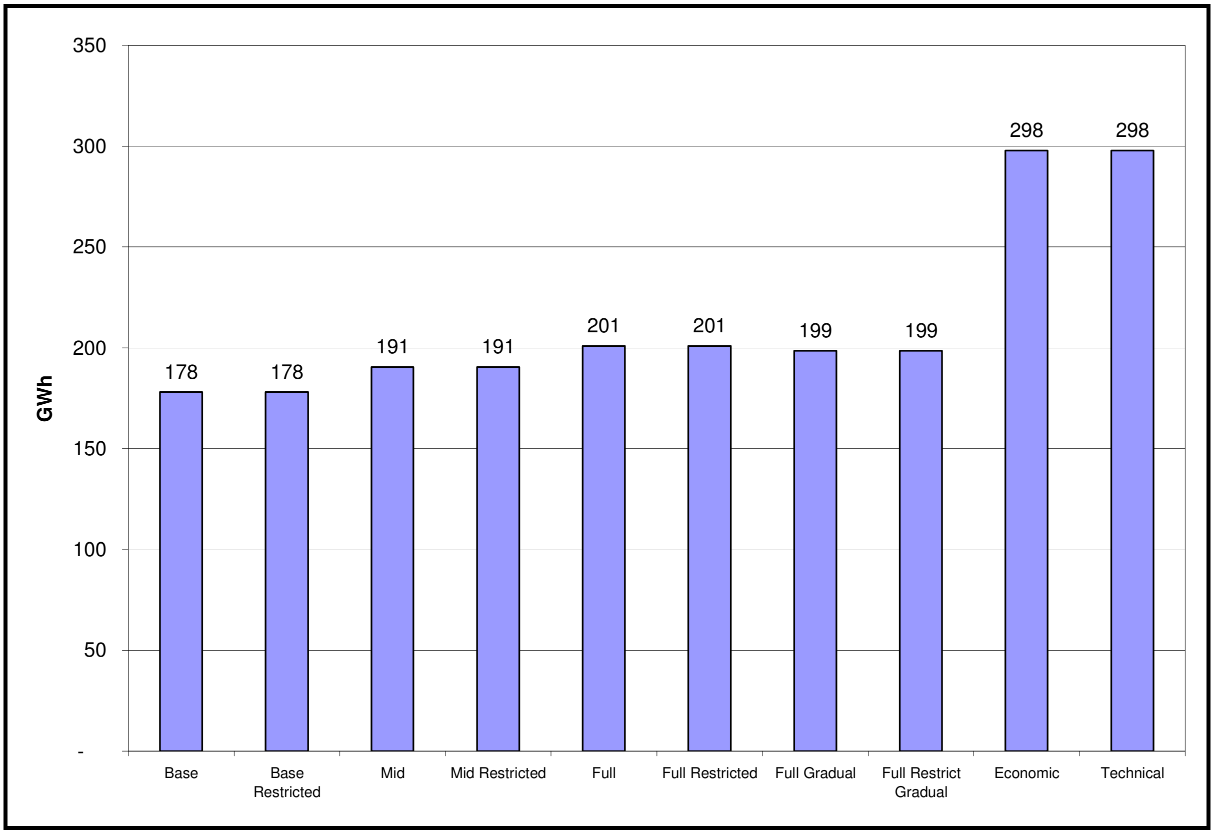
10.2.1 Industrial New Construction Market Potential for Energy Efficiency

In this subsection, the results of the analysis of the potential for industrial new construction are presented under the alternative market scenarios. Figure 10-1 and Figure 10-2 present the total estimated market, technical, and economic electric energy and demand savings potential resulting from the analysis for the three electric investor-owned utilities: Pacific Gas &

[3] The limited number of building types analyzed is consistent with the building types analyzed for the 2006 Potential Study. The restricted number of building types was chosen during the New Construction Baseline Study 2006.

Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E).[4] The values are provided for 2016, the last year of the short run analysis.[5]

Figure 10-1: Forecasted California IOU Total Gross Market, Economic, and Technical Potential for Industrial New Construction – 2007-2016 (GWh)



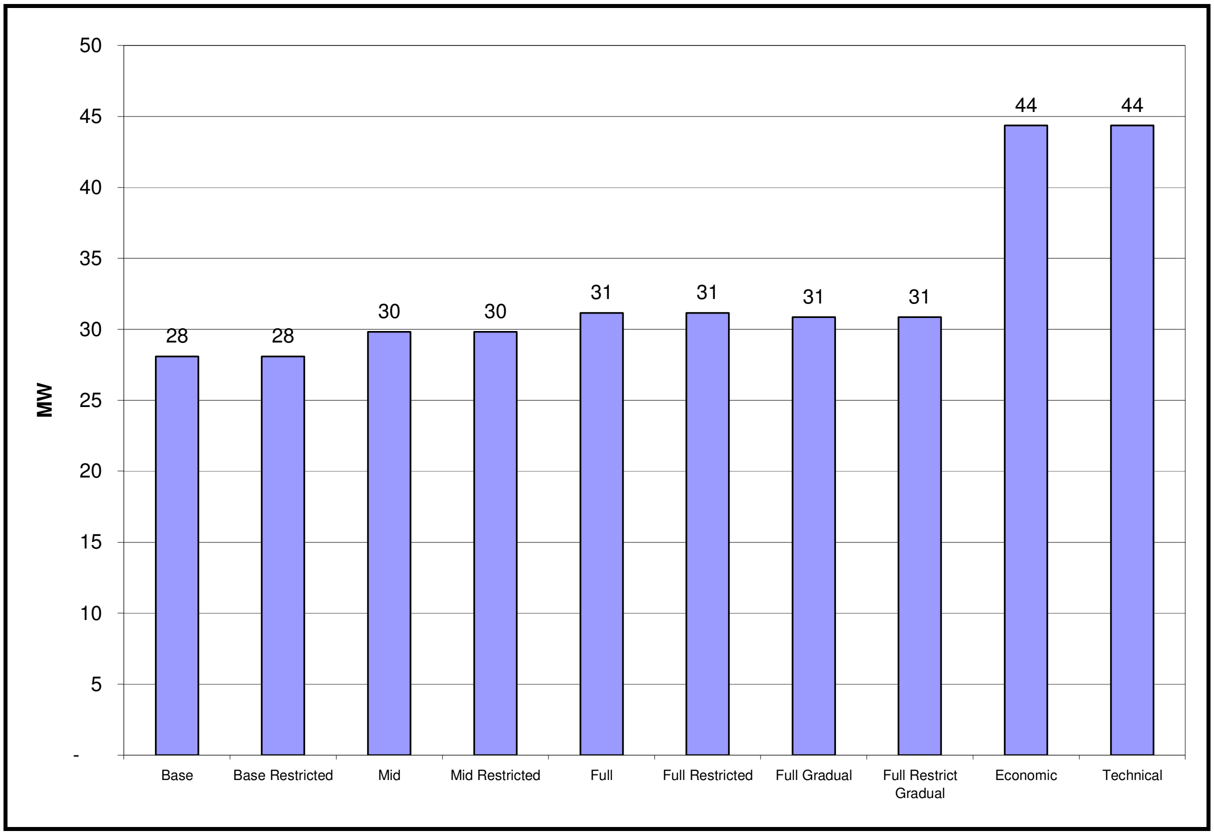
Refer to Table 10-2 for a description of the scenarios.

As shown in Figure 10-1, the estimated technical potential for 2007-2016 is 298 GWh and total estimated electric economic potential is 298 GWh. The total gross Full incentive potential is 201 GWh and the Base incentive forecast is 178 GWh for 2007-2016. Figure 10-2 shows total estimated technical potential for coincident peak demand reduction for 2007-2016 is 44 MW, total estimated economic potential to be also 44 MW and total gross coincident peak demand potential under the Full scenario at 31 MW.

4 Similar to the 2006 Potential Study, this study only analyzed electric savings measures in the industrial new construction sector.

5 The energy savings potential presented in this report is at the generation level.

Figure 10-2: Forecasted California IOU Total Gross Market, Economic, and Technical Coincident Peak Demand Potential for Industrial New Construction – 2007-2016 (MW)



Refer to Table 10-2 for a description of the scenarios.

The total industrial new construction market electric potential by scenario, across the three California electric IOUs, is listed in Table 10-3. Potential estimates are provided for the intermediate forecast period, 2007-2016 and for the entire forecast period, 2007-2026. Total IOU market potential under the Base scenario is 178 GWh of energy for 2007-2016 and 266 GWh for 2007-2026. Increasing incentives to Full incremental costs increases the total energy market potential estimates to 201 GWh for 2007-2016 and 304 GWh for 2007-2026. If program incentives were set half way between Base scenario incentives and Full incremental costs, the Mid scenario, estimated energy savings potential is 191 GWh for

2007-2016 and 290 GWh for 2007-2026. Limiting measures to those that are cost-effective causes no reduction in savings in the Base, Mid or Full scenarios.[6]

Total IOU market coincident peak demand potential is also listed in Table 10-3. The total gross IOU industrial new construction market coincident peak demand potential under the Base scenario is 28 MW for 2007-2016 and 42 MW for 2007-2026. Increasing incentives to the halfway point between Base scenario incentives and Full incremental cost incentives increases the estimate of gross coincident peak demand potential to 30 MW for 2007-2016 and 45 MW for 2007-2026. Further increasing incentives to Full incremental measure cost increases industrial new construction coincident peak demand potential to 31 MW for 2007-2016 and 47 MW for 2007-2026. Restricting incentivized measures to those that are cost-effective causes no reduction in savings in the Base, Mid or Full scenarios.

Table 10-3 also presents potential estimates for a scenario in which the incentives levels were gradually increased from Base scenario incentive levels to Full incentive levels from 2007 to 2010. The results from this scenario indicate that the slower ramp of incentives, when compared to the instantaneous jump from Base scenario incentives to Full incentives in 2007, leads to only a minor loss in potential relative to the Full scenario.

The results for the TRC restricted gross market scenarios are illustrated in Figure 10-3 and Figure 10-4. For the industrial new construction sector, however, the TRC restricted potential estimates are the same as the non-restricted estimates. These graphs illustrate the yearly estimate of TRC restricted market potential from cumulative adoptions from 2007 to 2016.[7]

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6 Naturally occurring potential is estimated for the industrial new construction measures but not for the industrial new construction packages. The new construction measures are individual high efficiency measures which are designed to be installed rather than base measures. The new construction packages are groups of high efficiency measures whose savings and costs are calculated relative to standard building practices. The packages do not allow for the estimation of naturally occurring potential due to their comparison to standard building practices. The individual high efficiency measure potential estimates do incorporate naturally occurring estimates.

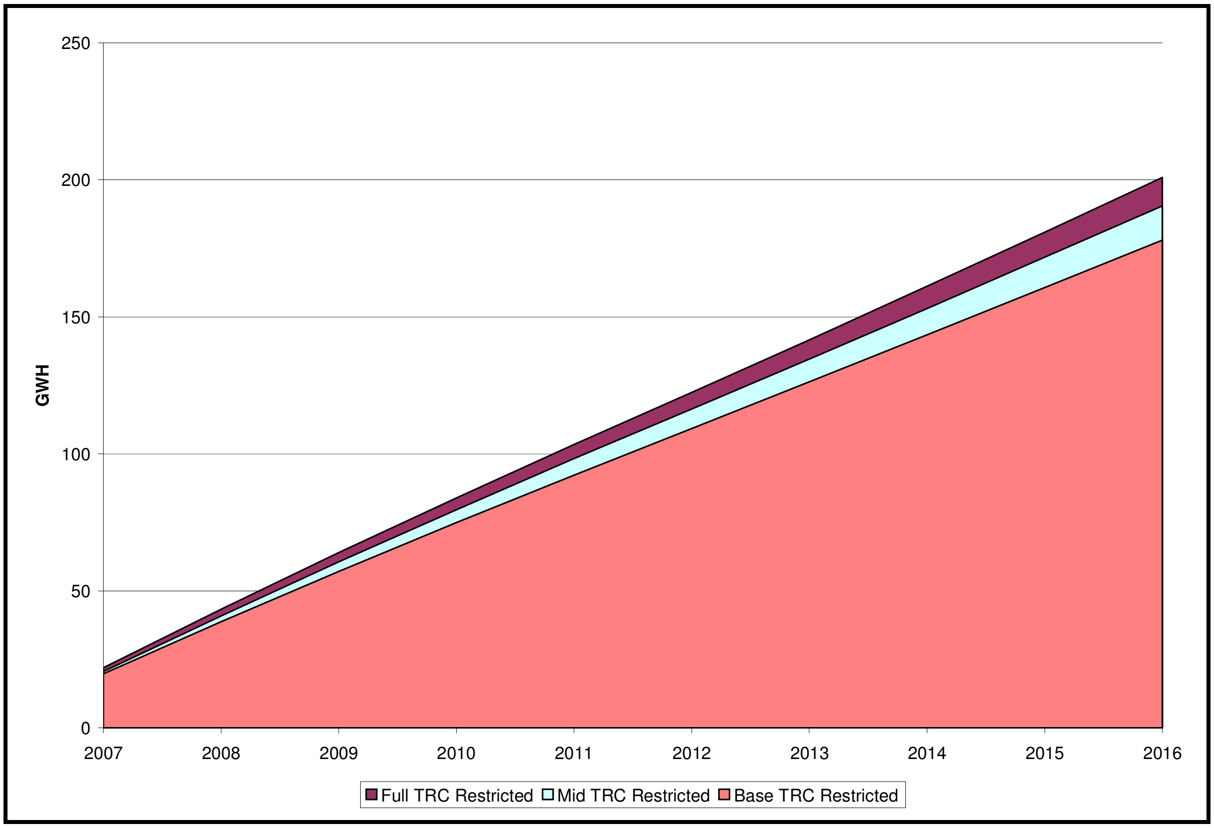
7 The results presented in these figures are gross program savings estimates. The savings estimates have not been reduced by the naturally occurring estimate of savings.

Table 10-3: Estimated California IOU Total Market Potential by Scenario for Industrial New Construction – 2007-2016 and 2007-2026 (GWh and MW)

Scenario	Gross Energy (GWh) - 2016	Naturally Occurring Energy (GWh) - 2016	Coincident Peak Demand (MW) - 2016	Naturally Occurring Coincident Peak Demand (MW) - 2016	Gross Energy (GWh) - 2026	Naturally Occurring Energy (GWh) - 2026	Coincident Peak Demand (MW) - 2026	Naturally Occurring Coincident Peak Demand (MW) - 2026
Base	178	142	28	23	266	205	42	33
Base Restricted	178	142	28	23	266	205	42	33
Mid	191	142	30	23	290	205	45	33
Mid Restricted	191	142	30	23	290	205	45	33
Full	201	142	31	23	304	205	47	33
Full Restricted	201	142	31	23	304	205	47	33
Full Gradual	199	142	31	23	304	205	47	33
Full Restrict Gradual	199	142	31	23	304	205	47	33

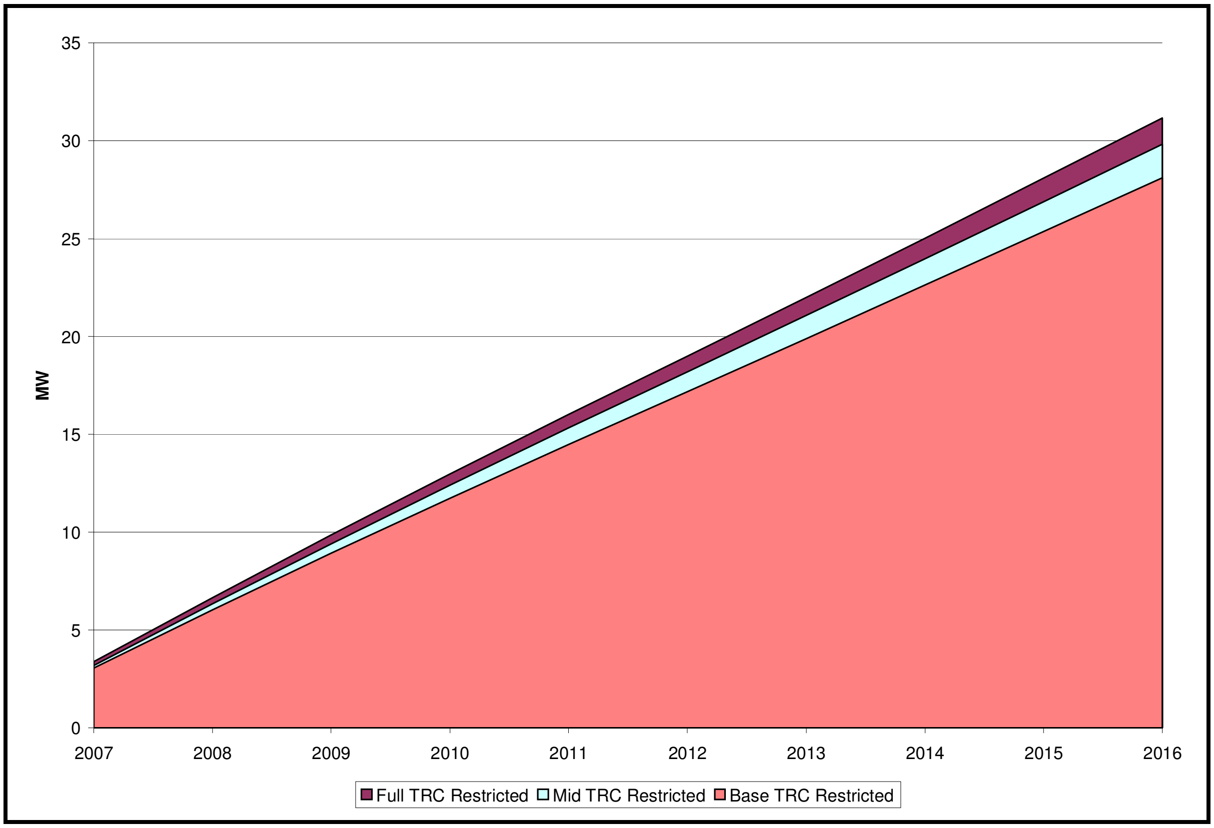
Refer to Table 10-2 for a description of the scenarios.

Figure 10-3: Estimated California IOU Gross Total Energy Market Potential by TRC Restricted Funding Levels for Industrial New Construction – 2007-2016 (GWh)



Refer to Table 10-2 for a description of the scenarios.

Figure 10-4: Estimated California IOU Gross Total Coincident Peak Demand Market Potential by TRC Restricted Funding Levels for Industrial New Construction – 2007-2016 (MW)



Refer to Table 10-2 for a description of the scenarios.

Market and Naturally Occurring Potential with Higher Awareness

Table 10-4 lists the estimated electric savings for the Base, TRC Restricted with Higher Awareness scenario. Comparing the 2007-2016 Base TRC Restricted with Higher Awareness scenario energy potential with the Base TRC Restricted estimates presented in Table 10-3, the gross market energy savings with Higher Awareness is higher by 5 GWh or 2% for 2007-2016 while the Higher Awareness naturally occurring energy savings increased from 142 GWh to 145 GWh through the same period.

Table 10-4: Estimated Total Market Potential for the Base, TRC Restricted with Higher Awareness for Industrial New Construction – 2007-2016 and 2007-2026 (GWh and MW)

	Gross Base TRC Restricted, Higher Awareness - 2016	Naturally Occurring Base TRC Restricted, Higher Awareness - 2016	Gross Base TRC Restricted, Higher Awareness - 2026	Naturally Occurring Base TRC Restricted, Higher Awareness - 2026
GWh	183	145	279	216
MW	29	23	43	34

Refer to Table 10-2 for a description of the scenarios.

Market Potential by Building Type for Industrial New Construction:

Table 10-5 and Table 10-6 summarize the energy market potential estimates by funding level and building type: clean rooms (3674), refrigerated warehouses, electronics manufacturing (sic 36 not 3674) and wastewater treatments plants.

For comparison, technical and economic estimates through 2016 and 2026, are listed in Table 10-7. As shown, the largest contributors to energy savings are wastewater treatments plants with a Base scenario estimated energy savings potential of 72 GWh for 2007-2016 and 107 GWh for 2007-2026. Table 10-8, Table 10-9*,* and Table 10-10 provide similar results for coincident peak demand reduction. In this case, the largest contributors to demand savings are again wastewater treatments plants with a Base scenario savings potential of 14 MW for 2007-2016 and 20 MW for 2007-2026. The potential in wastewater treatment plants is followed by the potential in refrigerated warehouses, with a Base scenario savings potential of 7 MW for 2007-2016 and 11 MW for 2007-2026. Figure 10-5 and Figure 10-6 present the estimated restricted scenario energy and demand savings potential by building type through 2016.

Table 10-5 shows that increasing funding levels to the halfway point between Base scenario and Full incremental cost incentives increases the estimate of impacts from 38 GWh to 44 GWh for 2007-2016 for the clean rooms segment and from 17 GWh to 20 GWh for the electronics manufacturing segment. Further increasing incentives to Full incremental measure cost increases the clean rooms segment's energy market potential to 49 GWh and the electronics manufacturing segment's energy savings potential to 24 GWh for 2007-2016.

Table 10-5: Estimated California IOU Total Gross Market Energy Potential by Funding Level and Building Type for Industrial New Construction – 2007-2016 (GWh)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Clean Rooms (3674)	38	38	26	44	44	49	49	26
Refrigerated Warehouses	51	51	46	52	52	53	53	46
Electronics Manufacturing (SIC 36 not 3674)	17	17	1	20	20	24	24	1
Waste Water Treatments Plants	72	72	68	74	74	75	75	68
Total	178	178	142	191	191	201	201	142

Refer to Table 10-2 for a description of the scenarios.

Table 10-6: Estimated California IOU Total Gross Market Energy Potential by Funding Level and Building Type for Industrial New Construction – 2007-2026 (GWh)

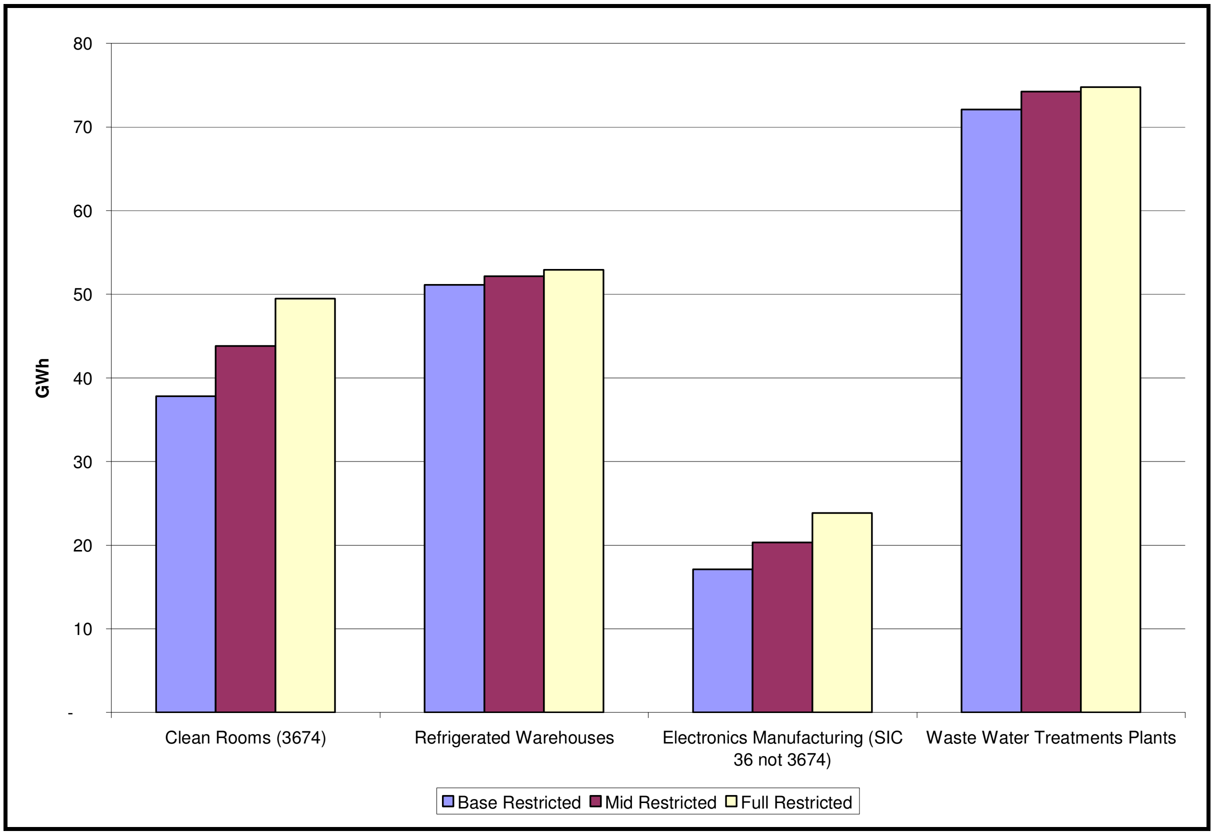
	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Clean Rooms (3674)	57	57	30	71	71	80	80	30
Refrigerated Warehouses	79	79	71	81	81	82	82	71
Electronics Manufacturing (SIC 36 not 3674)	23	23	2	27	27	31	31	2
Waste Water Treatments Plants	107	107	102	110	110	111	111	102
Total	266	266	205	290	290	304	304	205

Refer to Table 10-2 for a description of the scenarios.

Table 10-7: Estimated California IOU Total Technical and Economic Energy Potential by Building Type for Industrial New Construction – 2007-2016 and 2007-2026 (GWh)

	Technical - 2016	Economic - 2016	Technical - 2026	Economic - 2026
Clean Rooms (3674)	100	100	117	117
Refrigerated Warehouses	56	56	86	86
Electronics Manufacturing (SIC 36 not 3674)	66	66	83	83
Waste Water Treatments Plants	76	76	113	113
Total	298	298	399	399

Figure 10-5: Estimated California IOU Total Energy Potential by Building Type for Industrial New Construction – 2007-2016 (GWh)



Refer to Table 10-2 for a description of the scenarios.

The results presented in Table 10-8 show that the contribution of the wastewater treatments plants segment to the total IOU Industrial new construction market coincident peak demand potential under the Base scenario is 14 MW for 2007-2016, 50% of the sector's total potential. The refrigerated warehouses segment's energy savings potential is estimated at 7 MW for 2007-2016, 25% of the sector's total coincident peak demand potential.

Table 10-8: Estimated California IOU Total Gross Market Coincident Peak Demand Potential by Funding Level and Building Type for Industrial New Construction – 2007-2016 (MW)

	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Clean Rooms (3674)	4	4	3	5	5	6	6	3
Refrigerated Warehouses	7	7	7	7	7	8	8	7
Electronics Manufacturing (SIC 36 not 3674)	3	3	0	3	3	4	4	0
Waste Water Treatments Plants	14	14	13	14	14	14	14	13
Total	28	28	23	30	30	31	31	23

Refer to Table 10-2 for a description of the scenarios.

Table 10-9: Estimated California IOU Total Gross Market Coincident Peak Demand Potential by Funding Level and Building Type for Industrial New Construction – 2007-2026 (MW)

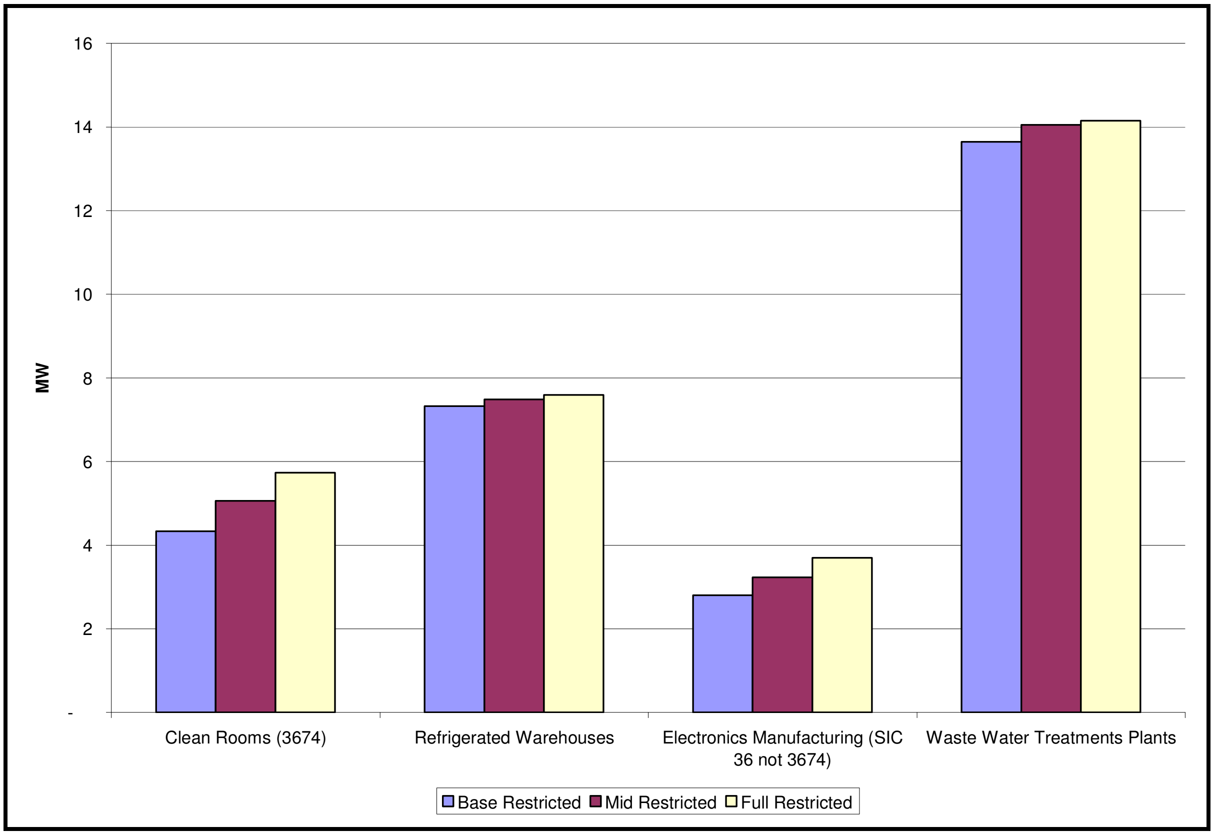
	Base	Base Restricted	Base - Naturally Occurring	Mid	Mid Restricted	Full	Full Restricted	Mid and Full - Naturally Occurring
Clean Rooms (3674)	6	6	3	8	8	9	9	3
Refrigerated Warehouses	11	11	10	12	12	12	12	10
Electronics Manufacturing (SIC 36 not 3674)	4	4	0	4	4	5	5	0
Waste Water Treatments Plants	20	20	19	21	21	21	21	19
Total	42	42	33	45	45	47	47	33

Refer to Table 10-2 for a description of the scenarios.

Table 10-10: Estimated California IOU Total Technical and Economic Coincident Peak Demand Potential by Building Type for Industrial New Construction – 2007-2016 and 2007-2026 (MW)

	Technical - 2016	Economic - 2016	Technical - 2026	Economic - 2026
Clean Rooms (3674)	11	11	13	13
Refrigerated Warehouses	8	8	12	12
Electronics Manufacturing (SIC 36 not 3674)	11	11	13	13
Waste Water Treatments Plants	14	14	21	21
Total	44	44	60	60

Figure 10-6: Estimated California IOU Total Coincident Peak Demand Potential by End Use for Industrial New Construction – 2007-2016 (MW)



Refer to Table 10-2 for a description of the scenarios.

10.2.2 Industrial New Construction Utility-Level Potential

PG&E Potential Energy Savings Forecasts for Industrial New Construction

The results in Table 10-11 list the energy savings potential from industrial new construction in PG&E's service territory, while Figure 10-7 illustrates the savings estimates.

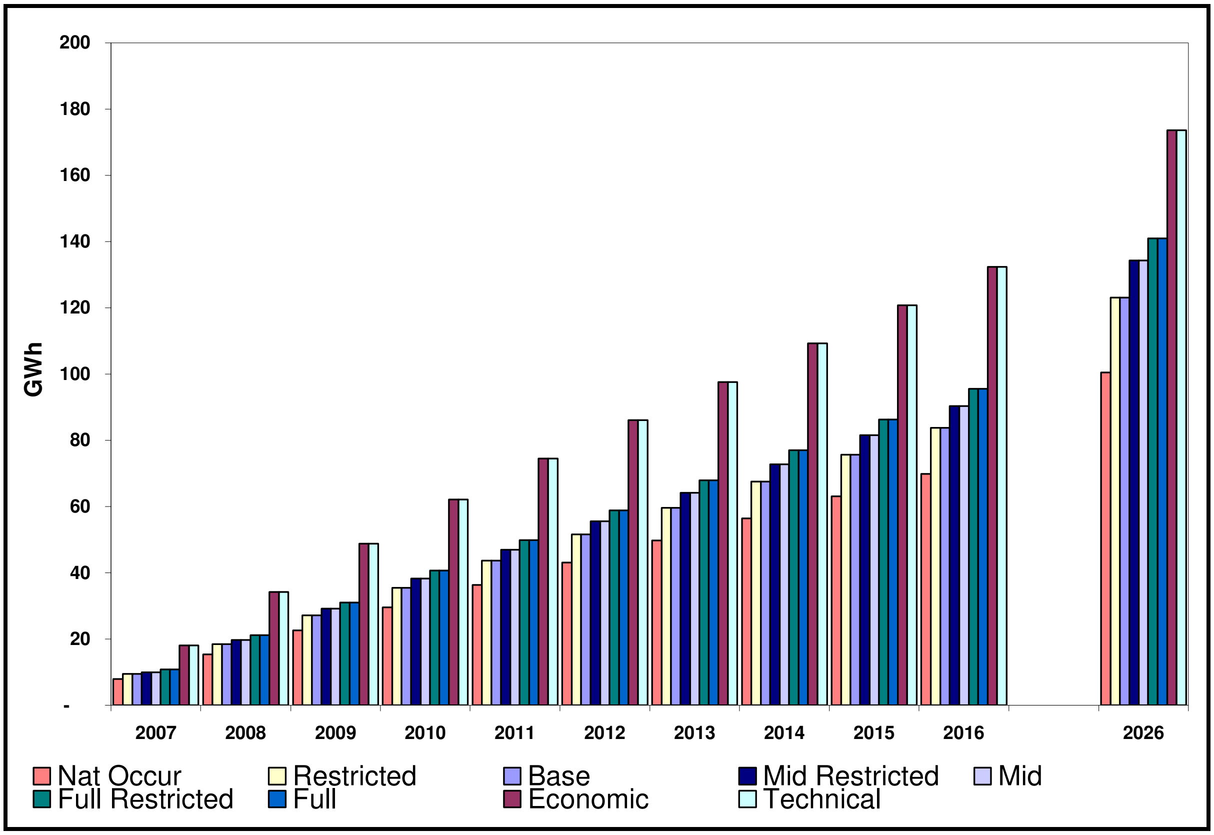
Estimated gross market savings potential under Base scenario incentives are 84 GWh for 2007-2016 and 123 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and Full incremental measure costs (Mid incentives scenario), increases the estimate of savings to 90 GWh for 2007-2016 and 134 GWh for 2007-2026. Increasing incentives to Full incremental measure cost increases potential savings to 96 GWh for 2007-2016 and 141 GWh for 2007-2026. Restricting incentivized measures to those that are cost-effective causes no change in the Base, Mid or Full scenario, since all measures analyzed are cost-effective.

Table 10-11: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Industrial New Construction Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	18	18	9	9	8	9	8	10	10	11	11	10	10	8
2008	34	34	18	18	15	19	16	20	20	21	21	20	20	15
2009	49	49	27	27	23	27	23	29	29	31	31	30	30	23
2010	62	62	35	35	30	36	30	38	38	41	41	39	39	30
2011	74	74	44	44	36	44	37	47	47	50	50	48	48	36
2012	86	86	52	52	43	52	44	56	56	59	59	57	57	43
2013	98	98	60	60	50	60	51	64	64	68	68	66	66	50
2014	109	109	68	68	56	69	58	73	73	77	77	76	76	56
2015	121	121	76	76	63	77	64	81	81	86	86	85	85	63
2016	132	132	84	84	70	85	71	90	90	96	96	94	94	70
2026	174	174	123	123	100	127	105	134	134	141	141	141	141	100

Refer to Table 10-2 for a description of the scenarios.

Figure 10-7: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Energy Potential for Industrial New Construction – 2007-2016, 2026 (GWh)



Refer to Table 10-2 for a description of the scenarios.

SCE Potential Energy Savings Forecasts for Industrial New Construction

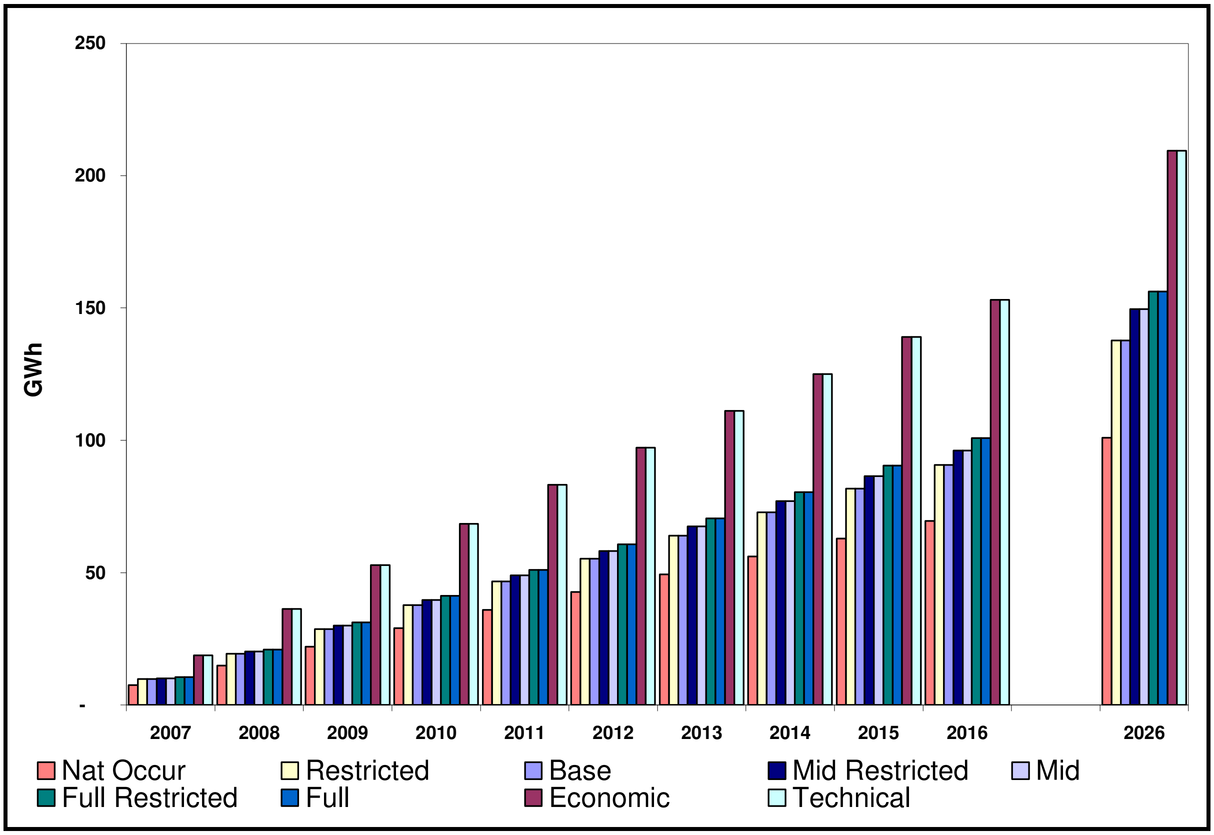
The results in Table 10-12 list the energy savings potential from industrial new construction in SCE's service territory, while Figure 10-8 illustrates the savings estimates. Estimated gross market savings potential under Base scenario incentives are 91 GWh for 2007-2016 and138 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and Full incremental measure costs (Mid incentives scenario), increases the gross estimate of savings to 96 GWh for 2007-2016 and 150 GWh for 2007-2026. Increasing incentives to full incremental measure cost increases gross potential savings to 101 GWh for 2007-2016 and 156 GWh for 2007-2026.

Table 10-12: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Industrial New Construction Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	19	19	10	10	8	10	8	10	10	11	11	10	10	8
2008	36	36	19	19	15	20	15	20	20	21	21	20	20	15
2009	53	53	29	29	22	29	22	30	30	31	31	30	30	22
2010	68	68	38	38	29	38	30	40	40	41	41	41	41	29
2011	83	83	47	47	36	47	37	49	49	51	51	50	50	36
2012	97	97	55	55	43	56	44	58	58	61	61	60	60	43
2013	111	111	64	64	49	66	51	68	68	70	70	70	70	49
2014	125	125	73	73	56	75	58	77	77	80	80	80	80	56
2015	139	139	82	82	63	84	65	87	87	91	91	90	90	63
2016	153	153	91	91	70	94	72	96	96	101	101	100	100	70
2026	209	209	138	138	101	147	108	150	150	156	156	156	156	101

Refer to Table 10-2 for a description of the scenarios.

Figure 10-8: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Energy Potential for Industrial New Construction – 2007-2016 and 2026 (GWh)



Refer to Table 10-2 for a description of the scenarios.

SDG&E Potential Energy Savings Forecasts for Industrial New Construction

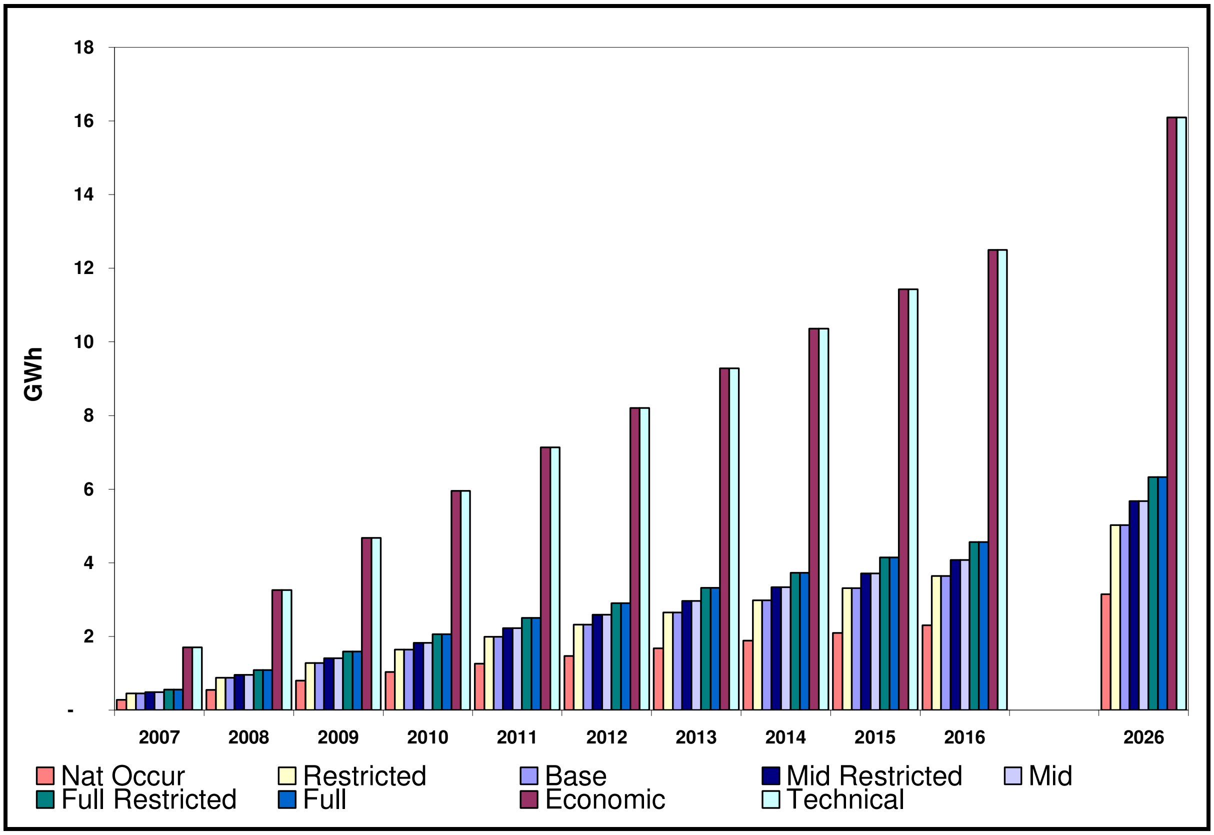
The results listed in Table 10-13 present the energy savings from industrial new construction in SDG&E's service territory. Figure 10-9 illustrates SDG&E's energy savings by scenario. Estimated gross savings potential under Base scenario are 3.6 GWh for 2007-2016 and increase to 5 GWh for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (Mid scenario) increases forecast potential savings to 4.1 GWh for 2007-2016. Through 2026, the Mid scenario's total gross market potential is 5.7 GWh and further increasing incentives for measures to their Full incremental cost increases the potential savings to 4.6 GWh for 2007-2016 and 6.3 GWh for 2007-2026.

Table 10-13: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Potential by Scenario for the Industrial New Construction Sector – 2007-2016 and 2026 (GWh)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict with Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	1.7	1.7	0.5	0.5	0.3	0.5	0.3	0.5	0.5	0.6	0.6	0.5	0.5	0.3
2008	3.3	3.3	0.9	0.9	0.5	0.9	0.6	1.0	1.0	1.1	1.1	1.0	1.0	0.5
2009	4.7	4.7	1.3	1.3	0.8	1.3	0.8	1.4	1.4	1.6	1.6	1.4	1.4	0.8
2010	6.0	6.0	1.6	1.6	1.0	1.7	1.0	1.8	1.8	2.1	2.1	1.9	1.9	1.0
2011	7.1	7.1	2.0	2.0	1.3	2.0	1.3	2.2	2.2	2.5	2.5	2.4	2.4	1.3
2012	8.2	8.2	2.3	2.3	1.5	2.4	1.5	2.6	2.6	2.9	2.9	2.8	2.8	1.5
2013	9.3	9.3	2.7	2.7	1.7	2.7	1.7	3.0	3.0	3.3	3.3	3.2	3.2	1.7
2014	10.4	10.4	3.0	3.0	1.9	3.0	1.9	3.3	3.3	3.7	3.7	3.6	3.6	1.9
2015	11.4	11.4	3.3	3.3	2.1	3.4	2.1	3.7	3.7	4.1	4.1	4.0	4.0	2.1
2016	12.5	12.5	3.6	3.6	2.3	3.7	2.4	4.1	4.1	4.6	4.6	4.4	4.4	2.3
2026	16.1	16.1	5.0	5.0	3.1	5.1	3.3	5.7	5.7	6.3	6.3	6.3	6.3	3.1

Refer to Table 10-2 for a description of the scenarios.

Figure 10-9: SDG&E Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Energy Potential for Industrial New Construction – 2007-2016



Refer to Table 10-2 for a description of the scenarios.

PG&E Potential Demand Savings Forecasts for Industrial New Construction

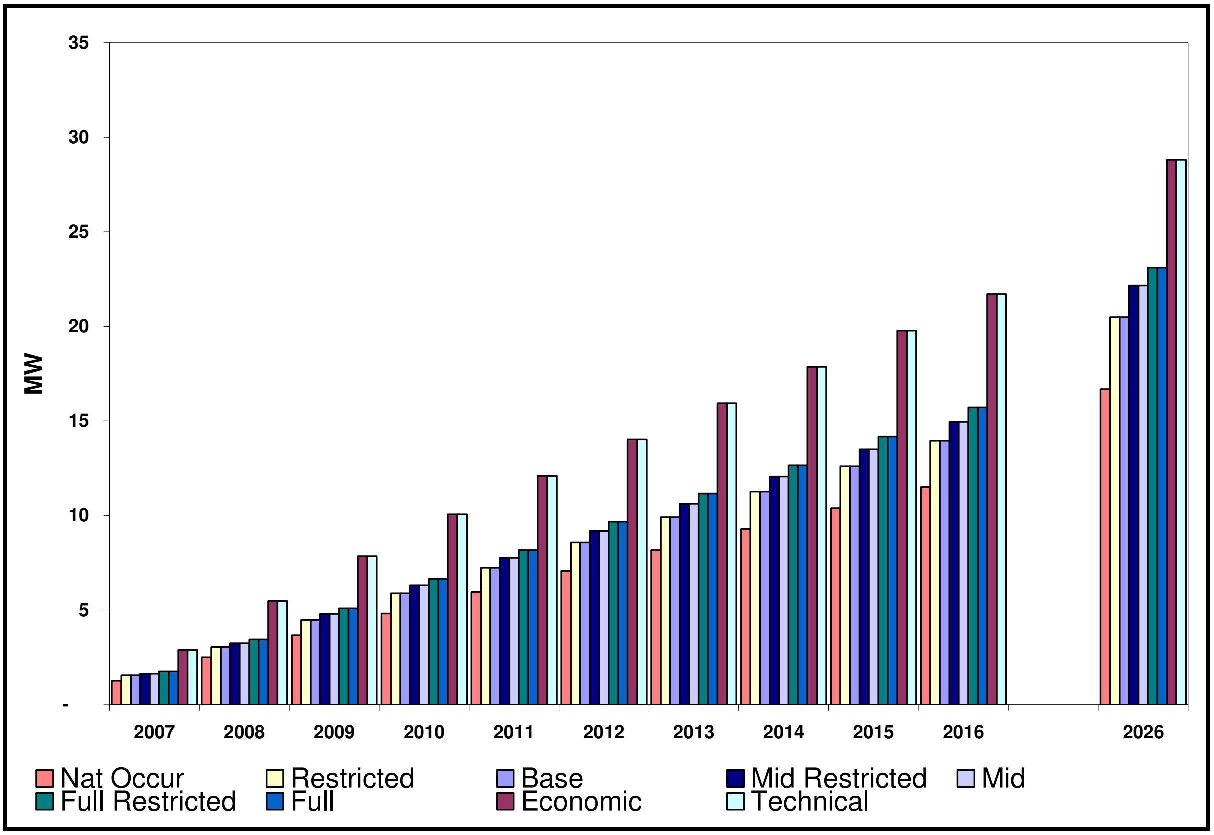
The results in Table 10-14 list the coincident peak demand savings from industrial new construction in PG&E's service territory, while Figure 10-10 illustrates these estimates. The estimated coincident peak demand savings potential under the Base scenario is 14 MW for 2007-2016 and 20 MW for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs (the Mid scenario), increases the estimate of coincident peak demand savings to 15 MW for 2007-2016 and 22 MW for 2007-2026.

Table 10-14: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Industrial New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	3	3	2	2	1	2	1	2	2	2	2	2	2	1
2008	5	5	3	3	2	3	3	3	3	3	3	3	3	2
2009	8	8	4	4	4	5	4	5	5	5	5	5	5	4
2010	10	10	6	6	5	6	5	6	6	7	7	6	6	5
2011	12	12	7	7	6	7	6	8	8	8	8	8	8	6
2012	14	14	9	9	7	9	7	9	9	10	10	9	9	7
2013	16	16	10	10	8	10	8	11	11	11	11	11	11	8
2014	18	18	11	11	9	11	9	12	12	13	13	12	12	9
2015	20	20	13	13	10	13	11	14	14	14	14	14	14	10
2016	22	22	14	14	12	14	12	15	15	16	16	16	16	12
2026	29	29	20	20	17	21	17	22	22	23	23	23	23	17

Refer to Table 10-2 for a description of the scenarios.

Figure 10-10: PG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Industrial New Construction – 2007-2016 and 2026 (MW)



Refer to Table 10-2 for a description of the scenarios.

SCE Potential Demand Savings Forecasts for Industrial New Construction

The results in Table 10-15 list the end-use peak demand savings from industrial new construction in SCE's service territory. The estimated gross demand savings potential under Base scenario incentives is 14 MW for 2007-2016 and 20 MW for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs increases the gross savings forecast for 2007-2016 to 14 MW and for 2007-2026 to 22 MW. Increasing incentives to Full incremental measure cost increases gross demand potential savings to 15 MW for 2007-2016 and 23 MW for 2007-2026.

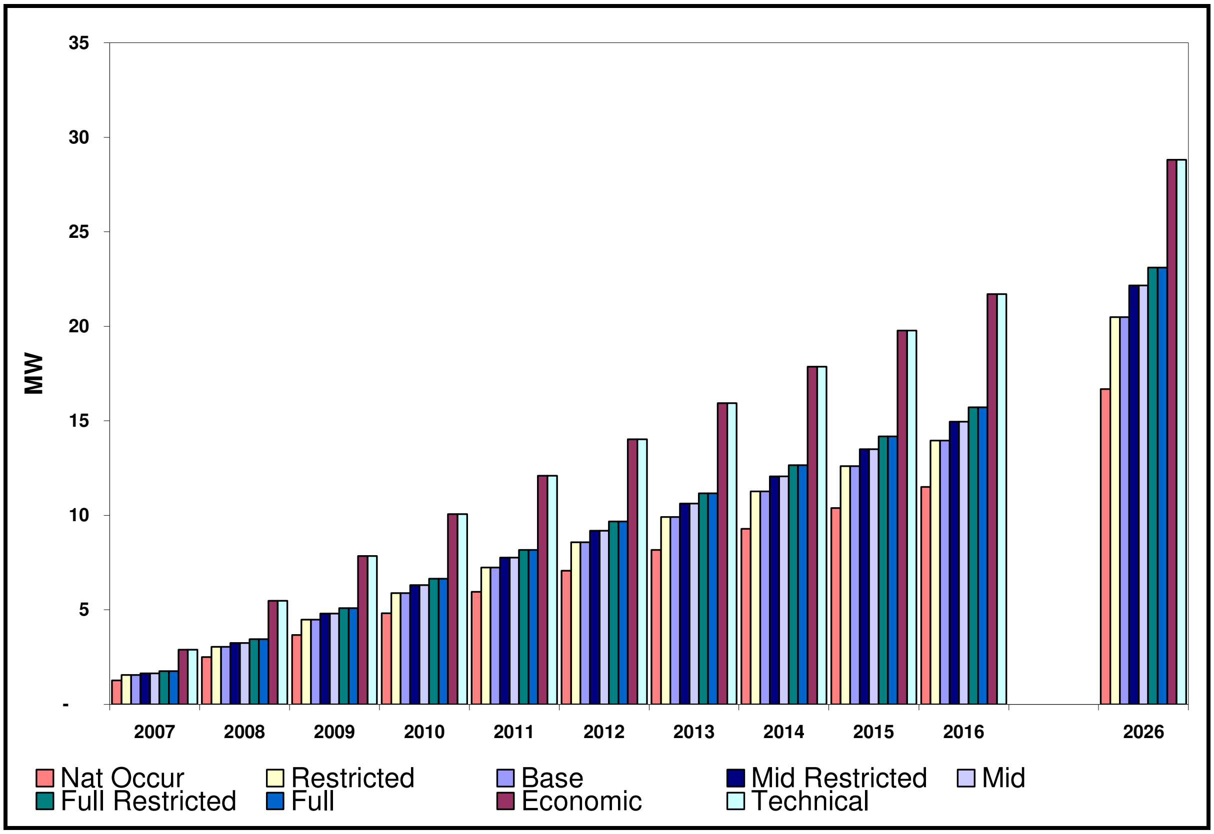
Table 10-15: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Industrial New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict with Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	2.5	2.5	1.4	1.4	1.1	1.4	1.1	1.5	1.5	1.5	1.5	1.5	1.5	1.1
2008	4.8	4.8	2.8	2.8	2.3	2.8	2.3	2.9	2.9	3.0	3.0	2.9	2.9	2.3
2009	7.0	7.0	4.2	4.2	3.4	4.2	3.4	4.4	4.4	4.5	4.5	4.4	4.4	3.4
2010	9.1	9.1	5.6	5.6	4.5	5.6	4.5	5.8	5.8	6.0	6.0	5.9	5.9	4.5
2011	11.1	11.1	6.9	6.9	5.5	7.0	5.6	7.2	7.2	7.4	7.4	7.3	7.3	5.5
2012	13.0	13.0	8.2	8.2	6.6	8.3	6.7	8.6	8.6	8.8	8.8	8.7	8.7	6.6
2013	15.0	15.0	9.5	9.5	7.7	9.7	7.8	9.9	9.9	10.3	10.3	10.2	10.2	7.7
2014	16.9	16.9	10.8	10.8	8.7	11.0	8.9	11.3	11.3	11.7	11.7	11.6	11.6	8.7
2015	18.8	18.8	12.2	12.2	9.8	12.4	10.0	12.7	12.7	13.2	13.2	13.1	13.1	9.8
2016	20.7	20.7	13.5	13.5	10.8	13.8	11.1	14.2	14.2	14.7	14.7	14.6	14.6	10.8
2026	28.9	28.9	20.4	20.4	15.9	21.4	16.7	21.8	21.8	22.6	22.6	22.6	22.6	15.9

Refer to Table 10-2 for a description of the scenarios.

Figure 10-11 presents the potential coincident peak demand savings for the market scenarios and the economic and technical potential estimates for SCE.

Figure 10-11: SCE Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential for Industrial New Construction – 2007-2016 and 2026 (MW)



Refer to Table 10-2 for a description of the scenarios.

SDG&E Potential Demand Savings Forecasts for Industrial New Construction

The results in Table 10-16 list the coincident peak demand savings from industrial new construction in SDG&E's service territory. The estimated gross coincident peak demand savings potential under the Base scenario (2006 incentive levels) is 0.6 MW for 2007-2016 and 0.9 MW for 2007-2026. Increasing incentives to the average between Base scenario incentives and full incremental measure costs, increases forecast coincident peak demand potential to 0.7 MW for 2007-2016 and 0.97 MW for 2007-2026. Increasing incentives to Full incremental measure cost increases demand potential savings to 0.8 MW for 2007-2016 and 1.1 MW for 2007-2026.

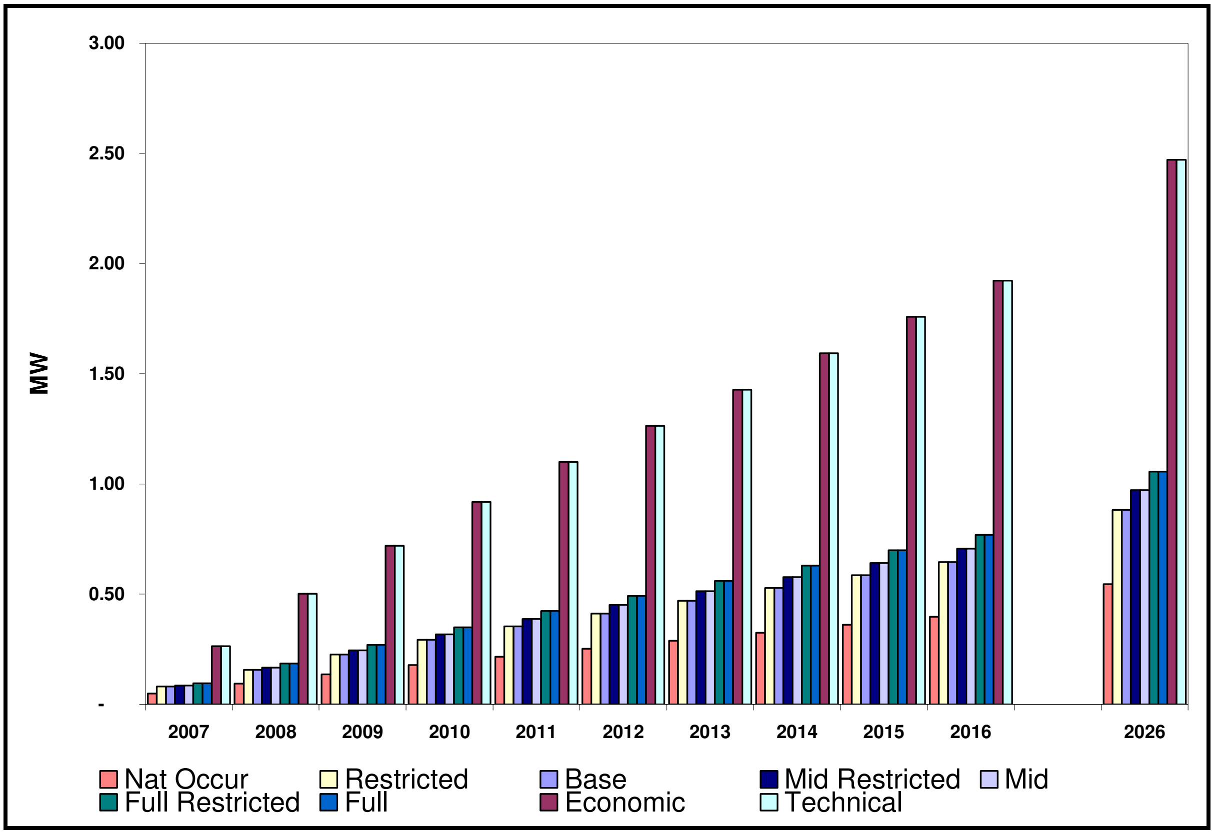
Table 10-16: SDG&E Estimated Total Technical, Economic, Gross Market and Naturally Occurring Coincident Peak Demand Potential by Scenario for the Industrial New Construction Sector – 2007-2016 and 2026 (MW)

Year	Technical	Economic	Base	Base Restrict	Base Naturally Occurring	Base Restrict with Higher Awareness	Higher Naturally Occurring	Mid	Mid Restrict	Full	Full Restrict	Full Gradual	Full Restrict Gradual	Mid and Full Naturally Occurring
2007	0.26	0.26	0.08	0.08	0.05	0.08	0.05	0.08	0.08	0.09	0.09	0.09	0.09	0.05
2008	0.50	0.50	0.16	0.16	0.09	0.16	0.09	0.17	0.17	0.18	0.18	0.17	0.17	0.09
2009	0.72	0.72	0.23	0.23	0.14	0.23	0.14	0.24	0.24	0.27	0.27	0.25	0.25	0.14
2010	0.92	0.92	0.29	0.29	0.18	0.30	0.18	0.32	0.32	0.35	0.35	0.33	0.33	0.18
2011	1.10	1.10	0.35	0.35	0.22	0.36	0.22	0.39	0.39	0.42	0.42	0.40	0.40	0.22
2012	1.26	1.26	0.41	0.41	0.25	0.42	0.26	0.45	0.45	0.49	0.49	0.47	0.47	0.25
2013	1.43	1.43	0.47	0.47	0.29	0.48	0.29	0.51	0.51	0.56	0.56	0.54	0.54	0.29
2014	1.59	1.59	0.53	0.53	0.32	0.53	0.33	0.58	0.58	0.63	0.63	0.61	0.61	0.32
2015	1.76	1.76	0.59	0.59	0.36	0.59	0.37	0.64	0.64	0.70	0.70	0.68	0.68	0.36
2016	1.92	1.92	0.64	0.64	0.40	0.65	0.40	0.71	0.71	0.77	0.77	0.75	0.75	0.40
2026	2.47	2.47	0.88	0.88	0.54	0.89	0.56	0.97	0.97	1.06	1.06	1.06	1.06	0.54

Refer to Table 10-2 for a description of the scenarios.

Figure 7-12 illustrates SDG&E's potential coincident peak demand savings associated with technical, economic, and market scenarios.

Figure 10-12: SDG&E Estimated Total Technical, Economic, Gross Market, and Naturally Occurring Coincident Peak Demand Potential for Industrial New Construction – 2007-2016 and 2026 (MW)



Refer to Table 10-2 for a description of the market funding scenarios.

10.3 Costs and Benefits for the Industrial New Construction Program

This section presents the cost and benefit from the electric and gas industrial new construction estimates, creating an aggregate California IOU sum of costs, benefits, and benefit-to-cost ratios.

Table 10-17: Summary of the California IOU Costs and Benefits by Scenario for the Industrial New Construction Sector – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	12	12	32	55
Net Measure Costs	5	5	9	12
Gross Program Costs	10	10	11	11
Net Avoided Cost Benefits	29	29	45	55
TRC	1.95	1.95	2.24	2.40

Refer to Table 10-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

The TRC test indicates that estimates at all funding levels are cost-effective

Utility-Specific Cost and Benefits for Industrial New Construction

The utility-specific costs, benefits, and total resource cost ratios are presented in Table 10-18, Table 10-19 and Table 10-20. The forecast shows that under the Base scenario estimates, all three utilities offer cost-effective industrial new construction programs. For PG&E, the Base scenario benefit-to-cost ratio is 1.56; for SCE the ratio is 2.31 and for SDG&E it is 2.47. If funding is increased to the Mid incentive level, the TRCs for all three utilities rise, with the industrial programs of PG&E, SCE, and SDG&E, all remaining cost-effective. Further increasing funding to the Full funding level, all three utilities continue to be cost-effective with a TRC above one. The increase in the TRC values with increased funding indicates that the marginal increase in benefits, with each increase in funding, exceeds the marginal increase in costs.

Given the cost-effectiveness of all measures analyzed in the industrial new construction sector, restricting the utilities' portfolios to measures with a TRC > 0.85 for all three funding levels causes the benefit to cost ratio to remain unchanged

Table 10-18: Summary of PG&E Electric Market Potential Cost and Benefits by Scenario for Industrial New Construction – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	4	4	14	26
Net Measure Costs	2	2	4	6
Gross Program Costs	5	5	6	6
Net Avoided Cost Benefits	11	11	19	25
TRC	1.56	1.56	1.93	2.14

Refer to Table 10-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 10-19: Summary of SCE Market Potential Cost and Benefits by Scenario for Industrial New Construction – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	7	7	17	28
Net Measure Costs	3	3	5	6
Gross Program Costs	4	4	5	5
Net Avoided Cost Benefits	17	17	24	29
TRC	2.31	2.31	2.53	2.64

Refer to Table 10-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

Table 10-20: Summary of SDG&E Market Potential Cost and Benefits by Scenario for Industrial New Construction – 2007-2026

Costs and Benefits are in $1,000,000	Base Scenario 2026	Base Restrict Scenario 2026	Mid Restrict Scenario 2026	Full Restrict Scenario 2026
Gross Incentives	0.25	0.25	0.78	1.48
Net Measure Costs	0.14	0.14	0.31	0.48
Gross Program Costs	0.15	0.15	0.17	0.19
Net Avoided Cost Benefits	0.72	0.72	1.26	1.83
TRC	2.47	2.47	2.60	2.73

Refer to Table 10-2 for a description of the scenarios. PDV net measure costs is the present discounted value of gross measure costs minus the naturally occurring measure costs. PDV gross program costs are the present discounted value of non-incentive program costs.

10.4 Key Industrial New Construction Results

The statewide market potential for electric energy efficiency at the Base scenario level is 178 gross GWh and 36 net GWh over a 10-year period. Increasing incentives to a level equal to the Mid-point between Base scenario incentives and full incremental costs (Mid scenario), is estimated to lead to energy savings of 191 GWh for 2007-2016, a 7% increase. Further ramping up incentives to cover Full incremental measure costs increases gross electric energy potential to 201 GWh for 2007-2016.

The Base scenario gross market potential for coincident peak demand reduction is 28 MW over a 10-year period, while the net Base scenario potential is 5 MW. Increasing incentives to cover Full incremental costs increases the gross coincident peak demand potential to 31 MW and the net potential to 8 MW for 2007-2016. Restricting the Base scenario to measures which are nearly cost-effective leads to no decline the gross market potential because all of the measures analyzed in the industrial new construction sector are cost-effective.

TRC results for the industrial new construction electric programs under the Base, Mid, and Full market scenarios showed that each of these incentive levels is cost-effective. Specifically, the Base scenario incentive program resulted in a California IOU benefit-cost ratio of 1.95, while the Full incremental cost incentive program TRC was 2.4 and the California IOU Mid scenario-level incentive program estimated TRC was 2.24.

11

Comparison of California Statewide Potential Studies

Since the mid-1970s, California has invested publicly funded energy efficiency programs designed to encourage the replacement of existing technologies with high efficiency technologies. These efforts have been quite successful, resulting in savings of about 9 GW, 34,000 GWh and 2 billion Therms between 1976 and 2000.[1] While these programs have been very successful, substantial potential for energy savings is believed to remain. In 2002 and 2003, a comprehensive analysis of California's remaining energy efficiency potential in the existing residential and commercial sectors was undertaken by KEMA-Xenergy.[2] The results from the KEMA 2002/2003 study were among the inputs used to design energy efficiency goals for 2004-2013 for the IOU.

The 2006 Itron potential study was carried out to help determine where and how much energy efficiency remained following the 2000-2001 energy crisis.[3] The objective of the 2006 study was to provide the IOUs with detailed information that would be used to aid them in the design and implementation of their significantly expanding energy efficiency programs. The IOU energy efficiency programs were expanding rapidly to attempt to satisfy the ambitious energy efficiency savings goals established by the CPUC. The CPUC goals cover program years 2004-2013. The 2006 study was calibrated to the program savings from the 2004 program year, the first year of the new, higher energy efficiency goals.

The current study's objectives are to expand on the results from the Itron 2006 study, refresh the input saving and cost information, update the forecasts of economic growth, estimate all sector-level potential under a single model (the ASSET model), and calibrate the model to the average yearly program savings from the 2004/2005 program cycle. The study results will be used to help inform the IOUs of possible design and implementation changes needed to help them expanded their energy efficiency effort. The results are also likely to be used as

1 KEMA-Xenergy, Inc. *California Statewide Residential Sector Energy Efficiency Potential Study*. April 2003. www.calmac.org.

2 Xenergy, Inc. *California Statewide Commercial Sector Energy Efficiency Potential Study* (July 2002) and KEMA-Xenergy, Inc. *California Statewide Residential Sector Energy Efficiency Potential Study.* April 2003. www.calmac.org.

3 Itron, Inc. *California Energy Efficiency Potential Study.* May 2006.

preliminary inputs into the energy savings goals update and the analysis of the cost of greenhouse gas reductions.

In this report, Itron re-examined California's remaining energy efficiency potential in the existing and new residential, commercial, and industrial sectors. These results can be compared with the Itron 2006 analysis of these six sectors and KEMA's analysis in 2002/2003 of the existing residential and commercial sectors.

This section will briefly discuss some of the similarities and differences between the KEMA 2002/2003 residential and commercial study, the Itron 2006 statewide potential study, and this study (Itron 2008 study). The section will touch on the data sources used as inputs for the analyses and how these data impact the potential forecasts. The primary focus will be to illustrate the different forecasts of California's remaining energy efficiency potential, highlighting their similarities and differences, and to provide a brief explanation for their different forecasts of the remaining energy efficiency potential.

11.1 Background

The scope of the three studies differed, as did the questions driving the analysis. The KEMA 2002/2003 study was charged with determining the remaining energy efficiency potential in California to ascertain whether publicly funded efforts to promote energy efficiency were adequately funded. This was the first comprehensive study of energy efficiency potential in California since the mid-1990s. Changes in technologies, utility programs, and other important variables warranted that the state undertake an analysis of the remaining energy efficiency potential. This study was undertaken as the California energy crisis began to unfold, making the results very timely for public policy discussions. The results from the 2002/2003 study were used by the CPUC to help establish new, aggressive goals for electricity and natural gas savings for the state IOUs' energy efficiency promoting efforts for 2004-2013.[4]

The Itron 2006 study re-examined the remaining potential in the existing residential and commercial sectors and expanded the analysis into the existing industrial, new residential, commercial, and industrial sectors, and into new technologies in an emerging technologies analysis. The study was charged with determining the remaining energy efficiency potential in California in the wake of the significantly larger savings obtained in 2000-2001 and the increased public support for and financing of energy efficiency programs. With the previous set of KEMA studies having answered the issue of appropriate public funding, the 2006 study was used to help determine how to optimize program offerings across utilities, market

[4] See the California Energy Commission's report *California Energy Demand 2006-2016 Staff Energy Demand Forecast*, September 2005, for the IOU savings goals.

segments, and end uses. The findings from the 2006 study were to be used by program planners to guide their program's offerings and their customer targeting. The findings were to be used to help the utilities meet the aggressive goals set by the CPUC.

The Itron 2008 study re-examined the potential in the existing and new residential, commercial, and industrial sectors. These six sectors were also examined in the Itron 2006 study. While the 2008 study incorporates a very limited set of technologies not currently in the IOU programs, it does not focus attention on the potential associated with a set of emerging technologies. The study was charged with producing up-to-date estimates of potential using the most current data and information. The potential estimates were to be used to help make adjustments in order to maximize the savings from future energy efficiency programs, to support the development of the CEC Integrated Energy Policy Report, and to help guide the CPUC development of future energy savings goals.

The different contexts under which these three studies were carried out limit the direct comparability of the results. The rest of this chapter addresses the key differences between these efforts that affect comparison of their results as well as the results themselves.

11.2 Data Issues and Results

Energy efficiency potential forecasts have complex and extensive data needs. In general, a more accurate characterization of the current state of energy efficiency equipment saturations, impacts, costs, and IOU program accomplishments will lead to more accurate forecasts of the remaining technical, economic, and market potentials. Collecting these data is the first and most time-consuming step in any potential analysis.

All three studies faced significant data requirements associated with collecting the input datasets. First, a list of energy efficiency technologies was developed. All three studies turned to the Database of Energy Efficient Resources (DEER), the energy efficiency program filings of the major IOUs, and discussions with utility PACs to help determine the high efficiency technologies to be included in each study.[5,6,7] The KEMA 2002/2003 study analyzed 69 commercial measures and 41 residential measures; the Itron 2006 analysis looked at 161 industrial measures, 82 commercial measures and 65 residential measures; and the 2008 study looked at the same 161 industrial measures, as well as 105 commercial

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5 Xenergy, Inc. *2001 DEER (Database for Energy Efficient Resources) Update Study.* Prepared for the California Energy Commission. August 2001.

6 Itron, Inc. *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study: Final Report.* Prepared for Southern California Edison. December 2005.

7 The discussion of the measures list for the 2006 study is found in "*WP #1: California Statewide Energy Efficiency Summary Study: Review of Existing Forecasts and Data Inputs*" by Itron, Inc, August 2004.

measures, and 66 residential measures.[8] Once the list of measures was determined, data had to be collected on measure saturations, technology densities, incremental energy savings and costs, utility program accomplishments and costs, and forecasts of future housing stocks, commercial building floor space, industrial consumption, utility rates, and avoided costs.[9,10,11,12]

All three forecasts employed the most recent data on technology densities, technology saturations, impacts, and costs. The 2002/2003 forecast used data from multiple sources including, but not limited to, the 1999 California Baseline Lighting Efficiency Technology Report, the Statewide Survey of Multifamily Common Area Buildings, utility-specific commercial end-use surveys for 1992 to 1998, the 2001 DEER, IOU quarterly filings from 1996-2000, and CEC forecasts of saturations, floor space, electric and natural gas customer rates, and avoided costs.[13,14,15,16]

The 2006 analysis benefited from recent statewide studies in both the residential and commercial sectors. The 2006 analysis used data from the California Statewide Residential Appliance Saturation Study (RASS), the 2006 Commercial End-Use Survey (CEUS), the 2001 and 2005 DEER, 2004 Avoided Costs and Externality Adders, 2004 IOU quarterly filings, and forecasts of the housing stock and commercial building floor space provided by the CEC.[17,18,19,20,21]

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[8] For the list of commercial and residential measures for the 2002/2003 study, see Volume 2, Appendix A in KEMA July 2002 and April 2003. For the list of commercial and residential measures for the 2006 study, see chapters 3 and 4 of this report. The increase in number of measures is largely due to finer distinctions in the residential and commercial lighting analyses for this report. For a list of the commercial, residential, and industrial measures in the report see chapters 4, 5, and 6 of this report.

[9] Data courtesy of Chris Kavalec, California Energy Commission, in April 2007.

[10] Data courtesy of Chris Kavalec, California Energy Commission, in April 2007.

[11] The industrial forecast used in the analysis of existing industrial potential is the forecast used for the Itron 2006 study. Data courtesy of Fred Coito.

[12] For this analysis, the avoided cost was derived from *A Forecast of Cost-Effectiveness Avoided Costs and Externality Adders* by Energy and Environmental Economics, Inc., March 2006.

[13] Heschong Mahone Group. *Lighting Efficiency Technology Report, Volume III: Market Barriers Report.* Prepared for the California Energy Commission. http://www.energy.ea.gov/efficiency/lighting/lighting_reports.html. 1999.

[14] ADM Associates, Inc. and TekMRKT Works, LLC. *Final Report: Statewide Survey of Multi-Family Common Area Building Owners Market: Volume 1: Apartment Complexes.* Prepared for Southern California Edison. June 2000.

[15] Xenergy, Inc. *2001 DEER (Database for Energy Efficient Resources) Update Study.* Prepared for the California Energy Commission. August 2001.

[16] KEMA July 2002 and April 2003 op. cit.

[17] KEMA-Xenergy, Inc. *California Statewide Residential Appliance Saturation Study.* Prepared for the California Energy Commission. June 2004.

The 2008 analysis used many of the same input data sources used in the 2006 analysis. The 2008 analysis used data from RASS, the California Lighting Appliance Saturation Survey of 2005 (CLASS), CEUS, the 2005 DEER, 2006 Avoided Costs and Externality Adders, 2004 and 2005 IOU quarterly filings, and forecasts of the housing stock and commercial building floor space provided by the CEC.[22,23,24,25,26]

These data allowed the 2008 forecast to estimate the remaining potential with more recent information on technology density and the saturation of high efficiency measures. These data also enabled the 2006 and 2008 studies to analyze the remaining potential savings with increased measure and climate zone disaggregation relative to the 2002/2003 study. The increase in the number of climate zones analyzed allowed for climate zone-specific avoided costs and climate zone-specific impact data for weather-sensitive measures. The increased climate zone and measure disaggregation apparent in the 2006 study was one of the objectives of the analysis and was largely carried forward in the 2008 analysis. The increase in disaggregation helps program planners to focus their efforts on specific climate zones and measures with substantial remaining potential savings.

The increase in the disaggregation of the 2006 and 2008 results, relative to the 2002/2003 results, does not come without costs. The 2006 and 2008 effort required more highly disaggregated data, leading to higher complexity and costs, and a longer completion time. In the end, all three analyses use utility-level accomplishments to calibrate their estimates. The increased disaggregation of the 2006 and 2008 forecasts cut the estimates into more measure and climate zone groupings, but all three models are calibrated by program accomplishments that are not climate zone- or building type-specific.

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18 Itron, Inc. *California Commercial End-Use Survey.* CEC-400-2006-005. Prepared for the California Energy Commission. March 2006.

19 Xenergy 2001 DEER, op. cit.

20 Itron 2004-2005 DEER, op. cit.

21 Energy and Environmental Economics, Inc. *A Forecast of Cost-Effectiveness Avoided Costs and Externality Adders.* Prepared for the California Public Utilities Commission, Energy Division. January 2004.

22 KEMA-Xenergy, Inc. *California Statewide Residential Appliance Saturation Study.* Prepared for the California Energy Commission. June 2004.

23 RLW, Inc. *2005 California Statewide Residential Lighting and Appliance Efficiency Saturation Study*, August 2005.

24 Itron, Inc. *California Commercial End-Use Survey.* CEC-400-2006-005. Prepared for the California Energy Commission. March 2006.

25 Itron 2004-2005 DEER, op. cit.

26 Energy and Environmental Economics, Inc. *A Forecast of Cost-Effectiveness Avoided Costs and Externality Adders.* Prepared for the California Public Utilities Commission, Energy Division. March 2006.

The key differences in the data used are detailed in the sections that follow. When possible, a discussion on how they may have affected the results and the differences with the previous studies' results is also provided.

Residential Data and Results

The 2008 residential forecast benefited from new residential data, updated impact information, and its use of the 2004-2005 IOU quarterly filings. The IOU quarterly filings for 2004-2005 present the savings for the first program year of the CPUC's new aggressive energy efficiency program funding and energy savings goals. Using the IOUs' 2004-2005 program accomplishments allowed Itron to incorporate recent changes in utility residential programs undertaken to help achieve the CPUC energy savings goals.

Electric Residential Potential

Figure 11-1 and Figure 11-2 illustrate the gross estimates from the three studies of the energy efficiency in the existing residential sector.[27] Comparing the residential energy potential savings estimates, the gross market forecasts of potential are slightly higher for the 2006 study than the 2008 or 2002/2003 studies. The differences in the market forecast are largest when comparing the base or current market estimates. The 2006 estimate of current market energy potential is more than twice as large as the 2002/2003 estimate and about 35% higher than the 2008 estimate.

The 2006 energy potential estimates are higher than the 2002/2003 estimate, due in large part to the significantly higher calibration targets for the 2006 analysis. The 2006 study was calibrated to the 2004 program accomplishments while the 2002/2003 study was calibrated to the average of the 1996-2000 program accomplishments. The 2004 residential program accomplishment is approximately two-and-a-half times larger than the 2000 residential program accomplishments. In 2004, the utility programs placed a new emphasis on residential programs. The increase in the residential program accomplishments was mainly due to a substantial increase in energy savings from the residential lighting program. The IOUs also changed their residential lighting program in 2004, implementing a program of upstream residential lighting rebates. The upstream rebate, in combination with a decline in manufacturing costs, significantly reduced the price paid by consumers. The new program design contributed to the increase in the residential lighting program accomplishments; approximately 70% of the energy savings from the residential energy efficiency programs was due to residential lighting programs.

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[27] The 2002/2003 and 2008 studies include estimates for the naturally occurring potential. The 2006 study did not estimate naturally occurring potential. The results of the 2002/2003 study estimated both gross and naturally occurring and presented net and naturally occurring. To determine the gross it is necessary to add the naturally occurring to the net.

The 2006 study base market results are larger than the base market estimates for the 2008 study due to the longer forecast period, code changes, adjustments to per unit savings values, changes in the measures analyzed, feasibility, and the use of interactive multipliers for the 2008 analysis. The 2006 study was a 13-year forecast while the 2008 study produced both a 10- and 20-year forecast of potential. The results in Figure 11-1 and Figure 11-2 compare the 13-year 2006 forecast to the 10-year 2008 forecast. The longer forecast period for the 2006 study should lead to larger market potential, all else being held constant.

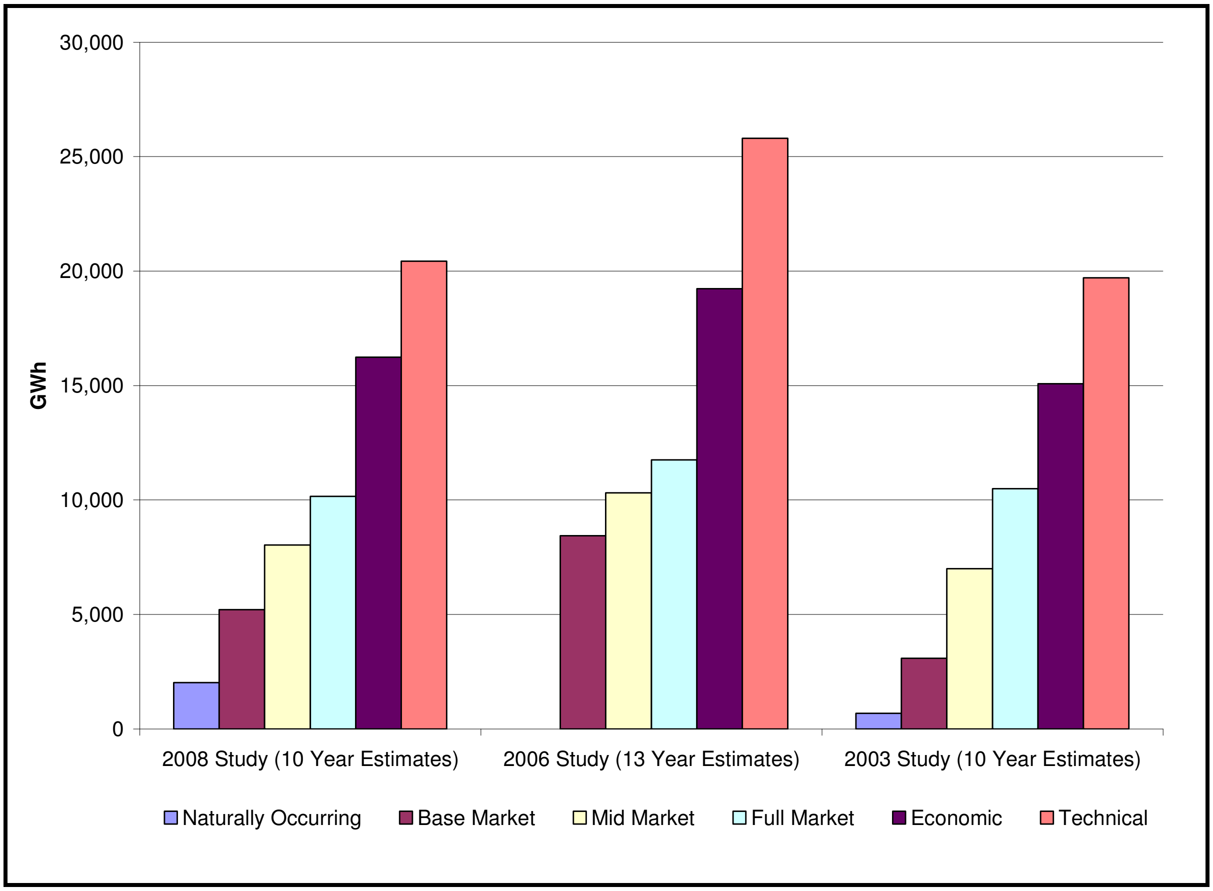
The increase in the base standard for residential central air conditioning from a SEER 10 to a SEER 13 was included in both the 2006 and the 2008 studies but was not incorporated into the 2002/2003 study. The 2008 study, however, also included changes in the base standard for pool pumps and clothes washers that were not included in either the 2006 or 2002/2003 studies.

The 2008 study used the 2004 RASS and the 2005 DEER to determine incremental savings for most measures. For the 2008 study, the HVAC incremental measure savings used the RASS UEC from the 2004 study, with the 2005 RASS Adjustments, and incorporated the 2005 DEER high efficiency savings percentages to calculate segment and climate zone specific savings inputs. This method calibrated the savings estimates to actual usage calculations from the most recent RASS. The 2006 study used the 2001 DEER to determine incremental measure savings for HVAC measures. The adjustments made to HVAC incremental savings in the 2008 study reduced some savings while increasing others.

The 2006 study included evaporative coolers, while the 2008 study did not estimate their potential. Evaporative coolers do not provide the same energy service as central air conditioners (CACs) and were eliminated from the analysis due to this concern. The potential savings from evaporative coolers is associated with the replacement of CACs with evaporative coolers. If evaporative coolers do not provide the same service, the assumed replacement is inappropriate within the ASSET modeling framework and will lead to too large an estimate of technical and economic energy savings potential

The 2008 and the 2002/2003 studies used interactive multipliers to adjust the incremental measure savings for the installation of multiple measures within an end use. For example, if a household installs insulation and a high efficiency CAC, the total household energy savings will be less than the sum of the insulation and CAC savings separately. The 2008 and 2002/2003 studies incorporate the reduction in savings associated with the installation of multiple measures. The 2006 study did not account for this reduction in total household savings and is likely to over-estimate savings due to this oversight.

Figure 11-1: Residential Sector Remaining Energy Savings Forecast for the 2002/2003, 2006 and 2008 Potential Analyses

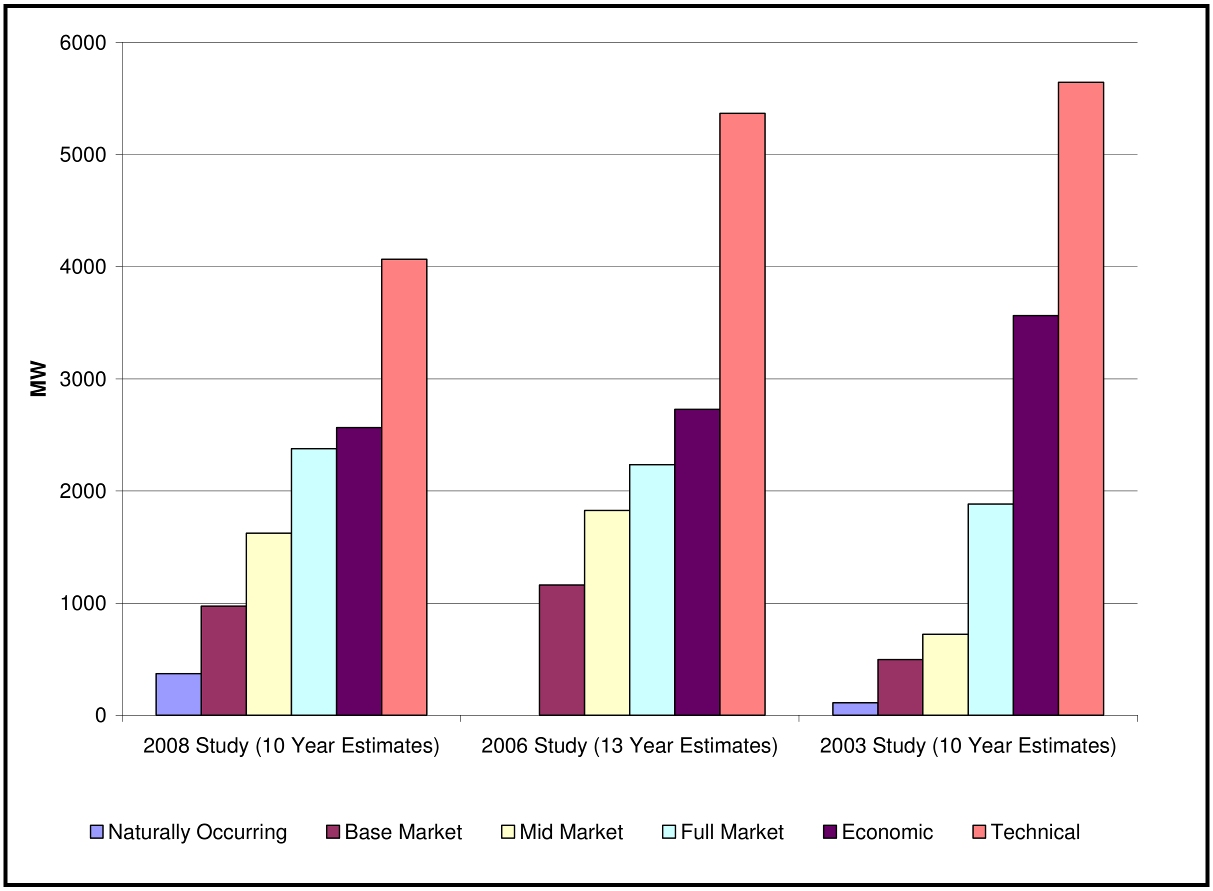


The full market gross energy efficiency potential estimates are very similar across the three studies. The full market potential for the two Itron studies reflects the market potential associated with increasing rebates to the full increment cost level. The full market potential for the KEMA 2002/2003 study is the market potential associated with KEMA's maximum achievable scenario. The maximum achievable scenario is assumed to incorporate full incremental cost incentives with a full direct install program.

The estimate of naturally occurring potential is much larger in the Itron 2008 study than in the KEMA 2002/2003 study.[28] The ongoing nature of energy efficiency programs has increased the general level of awareness in the population and likely increased the normal level that would occur in the absence of program incentives.

[28] The Itron 2006 study did not estimate naturally occurring potential.

Figure 11-2: Residential Sector Remaining Coincident Peak Demand Savings Forecast for the 2002/2003, 2006, and 2008 Potential Forecast



The forecast of the technical and economic demand potential is lower in the 2006 and 2008 forecasts than the 2002/2003 forecast. Much of this decline is due to changes in federal SEER standards for CACs and heat pumps and the elimination of some HVAC measures from the 2006 and 2008 analyses. Federal SEER standards for CACs and heat pumps required manufacturers to stop the production of all units below a 13 SEER in 2006. To accommodate these changes, the base measure for high efficiency air conditioning and heat pumps changes from 10 SEER to 13 SEER in 2007. This change in the base measure's energy savings and costs significantly reduces both the remaining technical and the economic potential demand savings.

The 2002/2003 residential potential forecast included many HVAC measures not included in the 2006 or 2008 analyses. HVAC measures in the 2002/2003 analysis, but not in 2006 or 2008 analyses, include programmable thermostats, R0-R19 ceiling insulation, ceiling fans, attic venting, and floor insulation. Many of these measures were eliminated from the 2006 and 2008 analyses due to new research that significantly reduced the savings impacts associated with the measures or that implied that the remaining non-saturated market was very small. The 2008 study also eliminated evaporative coolers, further reducing the coincident peak demand potential when compared to the 2006 analysis.

The elimination of several HVAC measures and the change in the federal baseline SEER for residential air conditioning led to a sizable reduction in the forecast of economic and technical energy savings and to a significant reduction in the forecast of demand savings when comparing the 2002/2003 residential results to the 2006 and 2008 findings. The 2008 coincident peak demand technical estimates are smaller than the 2006 estimates due the elimination of additional measures and the shorter forecast period. The reduced forecast period will lead to a larger reduction in potential for replace-on-burnout measures with a larger expected useful life (like CACs and heat pumps).

Natural Gas Residential Potential

Figure 11-3 illustrates the gross estimated natural gas savings potential for the 2002/2003, 2006, and 2008 residential analyses.[29] The market estimates of potential are very similar across the three studies. The market estimates of natural gas potential are slightly lower in the 2002/2003 analysis than those in the 2008 analysis. This difference is largely due to TRC restrictions associated with the market estimates. The 2002/2003 analysis restricted its estimates of market potential to those measures that pass or nearly pass a measure-level TRC test. The market estimates for the 2006 study are not restricted by a TRC test. The 2008 study produced market estimates that were TRC restricted and market estimates that are not TRC restricted. The estimates presented in this chapter are not TRC restricted. If the 2008 TRC restricted full potential estimates are compared to the TRC restricted full estimates from the 2002/2003 study, the 2002/2003 estimates are approximately twice as large as the 2008 estimates.

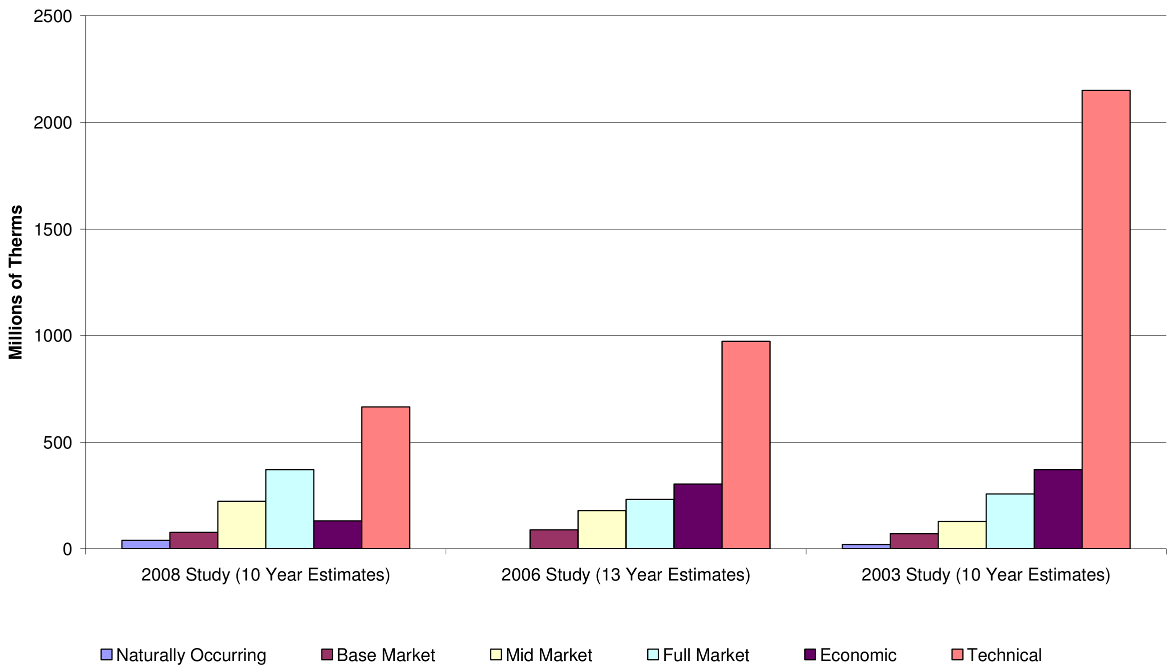
The technical and economic potential estimates from the 2002/2003 analysis are higher than either those from the 2006 or the 2008 analyses. The differences in the technical and economic potential estimates are largely due to the high efficiency measures analyzed, changes in federal and state energy efficiency standards, and changes in high efficiency measure savings.

[29] The 2006 analysis produced gross estimates of the remaining potential. The 2002/2003 and the 2008 analyses produced both gross and naturally occurring estimates of potential.

The 2002/2003 residential sector potential analysis estimated the potential remaining from solar water heaters. The 2002/2003 analysis forecast that solar water heaters had over 800 million therms of remaining technical potential. The 2006 analysis chose not to include solar water heaters in the high efficiency measure list. In 2004, no California IOU was offering residential rebates for solar hot water heaters. The 2008 analysis included solar water heaters, but the per unit measure savings were substantially lower than in the 2002/2003 analysis, they were only analyzed in the single family segment, and the feasibility was reduced from the assumptions used in the 2002/2003 analysis. This study forecast that the remaining technical potential in solar water heaters was about 73 million therms.

The 2002/2003 analysis also included several smaller measures not analyzed in the 2006 or 2008 studies. These measures include programmable thermostats, floor insulation, and HVAC testing and repair. The 2006 and 2008 analyses did not analyze programmable thermostats because all of the California IOUs have chosen to eliminate this measure from their residential energy efficiency program offerings. The 2006 analysis included HVAC testing in the electric model of energy efficiency potential but chose not to include it in the gas model due to potential savings overlap with duct repair. Examination of the HVAC testing and repair measure in the 2001 residential DEER indicated that this measure could be broken into two measures, limiting the HVAC testing to an electric measure and duct repair to an electric and gas measure. Breaking the HVAC testing and repair measure into two distinct measures eliminated the possibility of double counting the duct repair associated with HVAC testing and repair. The 2008 analysis did not include HVAC testing in either the electric or the gas potential.

Figure 11-3: Residential Sector Natural Gas Savings Potential for the 2002/2003, 2006, and 2008 Potential Studies



The 2002/2003 analysis estimates show that the technical potential for high efficiency gas clothes washers exceeds 300 million therms, while the 2006 analysis estimated the remaining technical potential at approximately 100 million therms. The 2008 estimate of the 10-year technical potential was 70 million therms

The 2002/2003 analysis of clothes washers was undertaken before the recent changes in the federal rating standards. Prior to January 1, 2004, clothes washers were rated based on an energy factor (EF). The new federal standard is based on a modified energy factor (MEF). The 2002/2003 analysis used the EF rating system while the 2006 analysis used the MEF. The federal standards in place in 2000 required an EF = 1.18, which is approximately equal to an MEF of 0.817.[30] The federal standards applicable in 2006 is an MEF = 1.04. The increase in the federal minimum standards works to reduce the remaining technical potential for gas clothes washers.

The 2002/2003 analysis of clothes washers also estimates the technical potential associated with clothes washers in multifamily common area laundry settings. The 2006 analysis of

30 Consortium for Energy Efficiency. *Residential Clothes Washer Initiative Program Description*, 1996. Revised 2002.

clothes washers limited the estimate of potential to clothes washers in multifamily units but did not analyze the potential of units in common areas.

The 2008 analysis of clothes washers was also limited to those in actual housing units, and no common area clothes washers were analyzed. The 2008 study also incorporated additional code changes associated with residential clothes washers (the MEF was increased from 1.04 to 1.26) and changed the incremental savings to be consistent with the RASS estimates of California's yearly segment-specific clothes washer cycles. The RASS cycle adjustment led to a fall in incremental savings relative to DOE estimates of clothes washer savings.

The estimate of technical potential associated with wall insulation exceeded 325 million therms in the 2006 analysis and was estimated to be approximately 175 million therms in the 2002/2003 analysis. The technical estimates from the current study are 127 million therms. An update in the measure inputs associated with classification of data from the 2004 RASS led to the reduction in potential between the 2006 and 2008 reports.

The 2008 economic potential was less than the economic potential in the 2006 analysis due to the code changes for clothes washers, the fall in wall insulation potential, the significant fall in potential for boiler controllers, and the elimination of infiltration control and water heater wrap from the 2008 measure list. The per unit savings associated with boiler controls were reduced by 80% due to a recent impact evaluation of boiler controllers. Water heater blankets were dropped from the analysis due to changes in water heater construction standards that no longer require or recommend water heater blankets. Infiltration control was eliminated because it is not currently part of residential IOU programs.

Changes in the measure list, code updates, and the new RASS saturation data help to explain major differences in the 2002/2003, 2006, and 2008 estimates of the remaining natural gas potential. Additional in-depth research is needed to help eliminate remaining uncertainties about the saturation of measures in residential housing.

Commercial Data and Results

The 2006 CEUS database provided the 2006 and 2008 studies with recent statewide data gathered from an in-depth on-site survey of commercial building equipment and characteristics. Prior to the completion of this database, data on commercial measure saturation were utility-specific and limited to data collected for utility-specific commercial end-use surveys from 1992 through 1998.

Electric Commercial Potential

Detailed data on the current saturation of high efficiency measures are particularly important in the California commercial sector. California has been rebating high efficiency measures in the commercial sector for over 30 years. In recent history, energy savings for nonresidential energy efficiency programs has typically represented 70 to 80% of energy savings from all of the California IOU energy efficiency programs.[31] Figure 11-4 and Figure 11-5 illustrate energy efficiency program accomplishments from 2000-2004 data for the four California IOUs.

Figure 11-4: First-Year GWh Savings from 2000-2004 for Energy Efficiency Programs

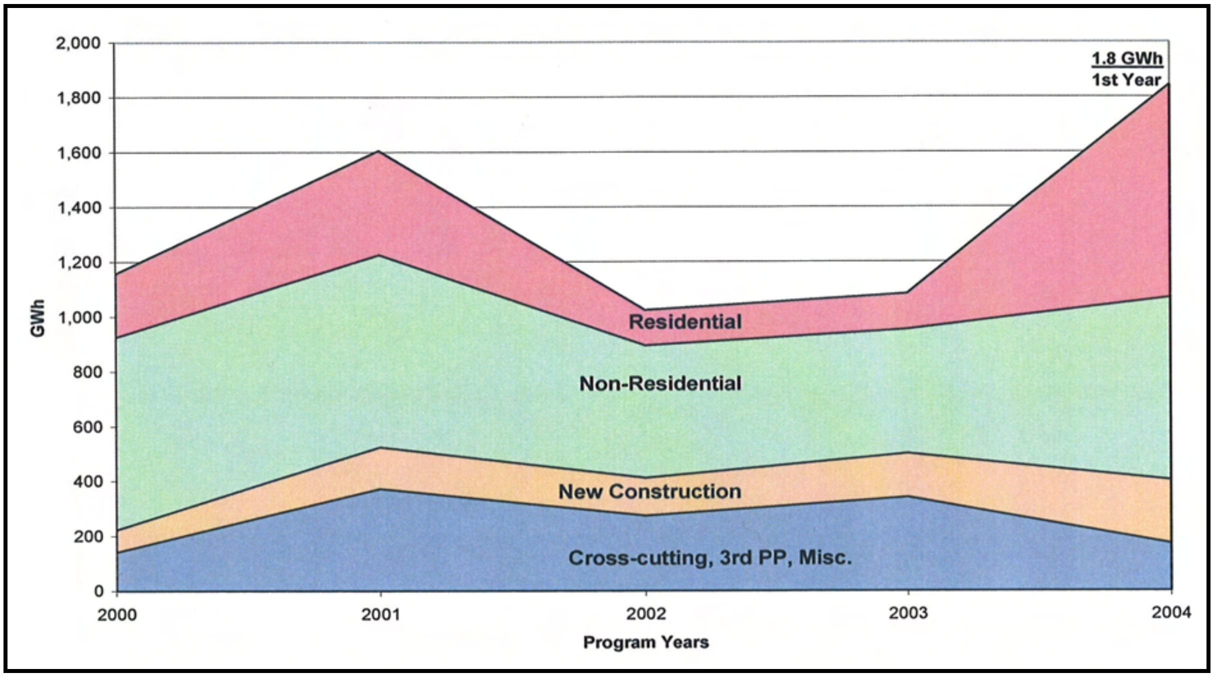
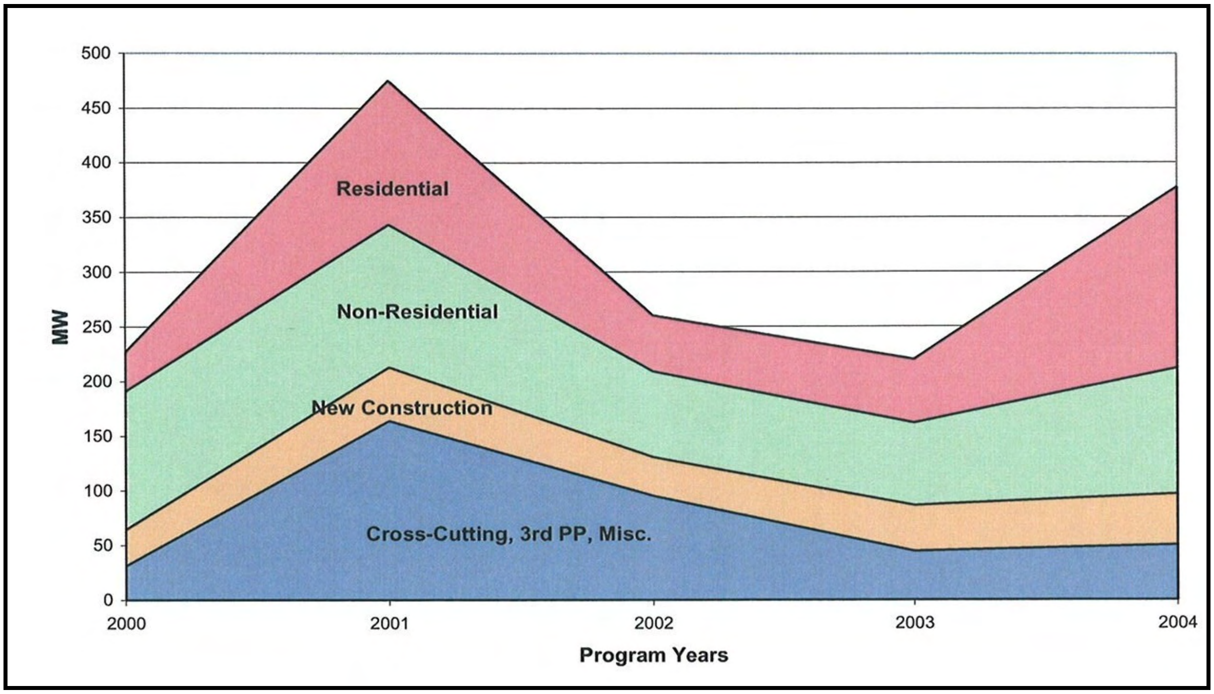


Table courtesy of the CEC. *Funding and Energy Savings from Investor-Owned Utility Energy Efficiency Programs in California for Program Years 2000 through 2004.* Cynthia Rogers, Mike Messenger, and Sylvia Bender. August 2005

[31] KEMA July 2002 op. cit.

Figure 11-5: First-Year MW Savings from 2000-2004 for Energy Efficiency Programs



Data courtesy of the CEC: *Funding and Energy Savings from Investor-Owned Utility Energy Efficiency Programs in California for Program Years 2000 through 2004,* August 2005. This figure is a reproduction of Figure 6 in the CEC report.

Figure 11-4 and Figure 11-5 illustrate California's emphasis during 2000-2003 on nonresidential energy efficiency programs. These programs have resulted in significant energy savings and a substantial increase in the saturation of high efficiency measures in the nonresidential sector. For example, the 2002/2003 analysis stated that the "current saturation levels for T8 lamp/electronic ballast and compact fluorescent lamps are high but are uncertain." The average saturation of T8s in the 2002/2003 study ranged from 55% for four-foot T8s in large commercial establishments to 11% for eight-foot T8s in small commercial establishments.[32] The saturation of four-foot T8 lamps in the 2006 and 2008 studies was derived from the recent 2006 CEUS and ranged from 91% to 19%, with a mean of 62%. The significant penetration of high efficiency T8 lamps helps illustrate the success of past commercial energy efficiency program and limits the remaining energy savings potential of future programs in the area of commercial lighting.

The recent CEUS data enabled the 2006 and 2008 forecasts to measure the saturation of high efficiency commercial lighting, and other commercial measures, with less uncertainty than

[32] Ibid. The uncertainty surrounding the saturation of lamps and other equipment in the 2002 commercial analysis stemmed, at least in part, from the age of the commercial saturation data, in combination with the long-standing and successful nature of California's commercial energy efficiency programs.

the 2002/2003 forecast. These types of recent data on measure saturation are necessary for an accurate forecast of the remaining energy efficiency potential, and the importance of these data increases in sectors with long-standing mature programs.

Figure 11-6 illustrates the timing of savings from the 2004/2005 nonresidential energy efficiency programs. The results indicate that the nonresidential programs were slow to achieve savings, with substantially more savings occurring in 2005 than in 2004. The timing of nonresidential program savings has implications for the 2006 and 2008 Itron potential studies. The 2006 study was calibrated to the 2004 program year accomplishments while the 2008 study was calibrated to the average of the first-year savings in 2004 and 2005. Using the average of the 2004-2005 program accomplishment increases the calibration total, and all else equal, will lead to a larger market potential forecast.

Figure 11-6: Nonresidential 2004-2005 First Year Program Savings

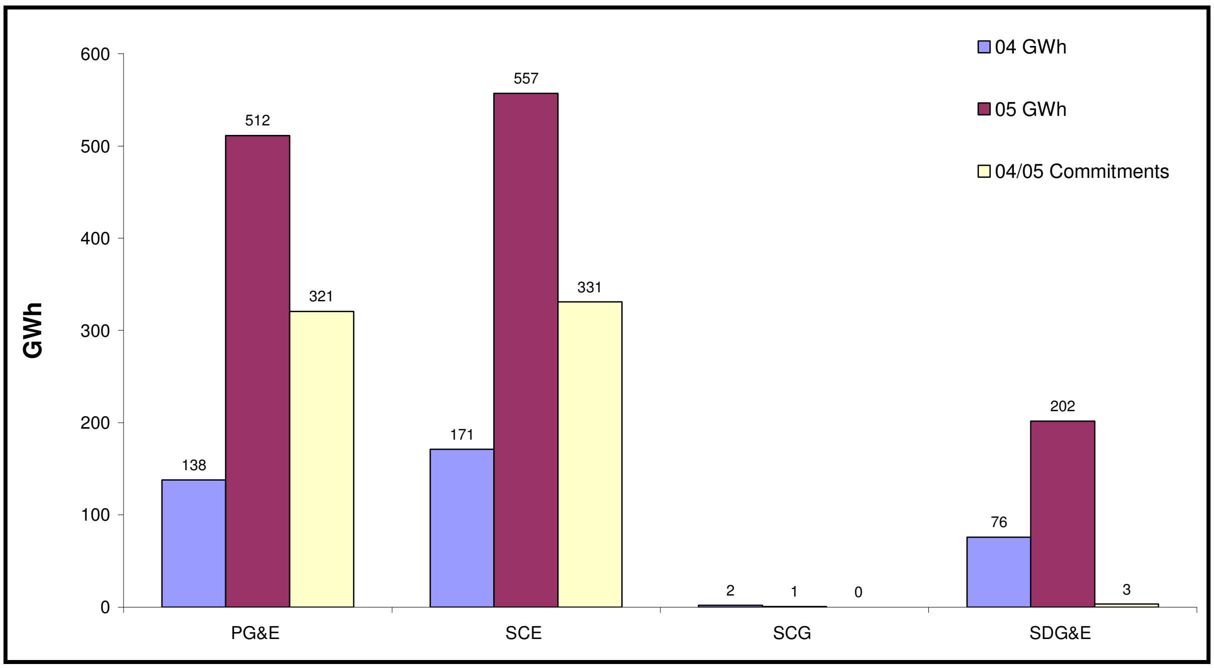
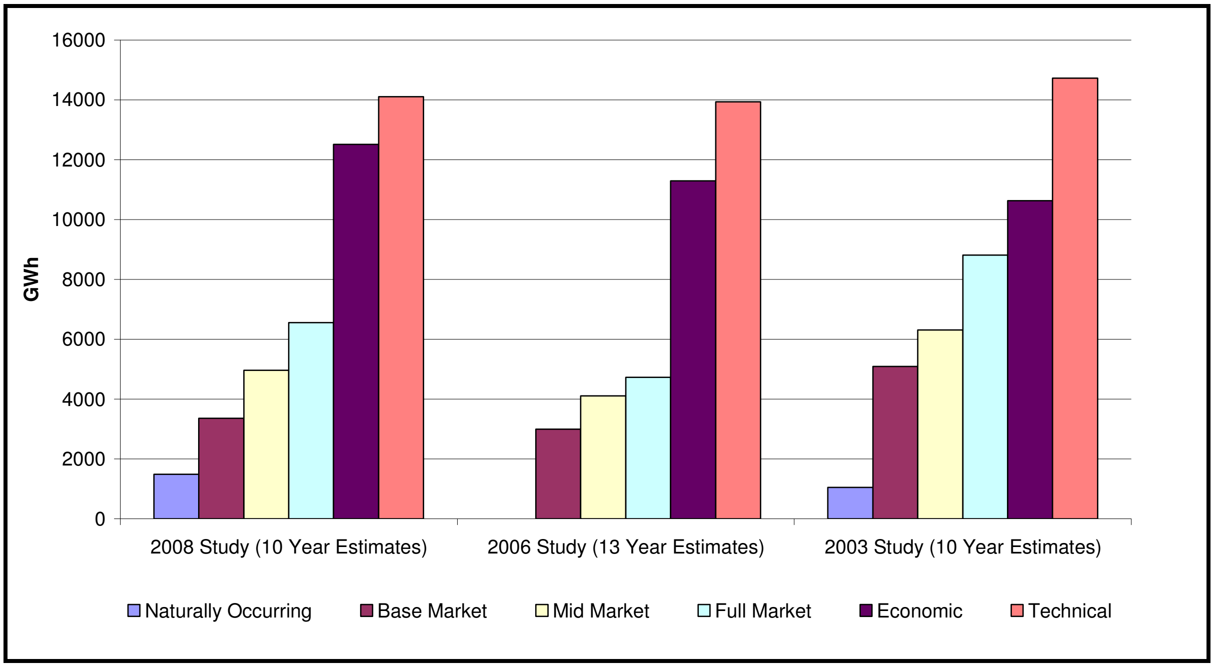


Figure 11-7 and Figure 11-8 illustrate the commercial energy and demand savings potential forecast from the 2002/2203, 2006, and 2008 studies.[33] The 2002/2003 and 2008 studies results are a forecast of energy savings over a 10-year period, while the 2006 results are a forecast over a 13-year period.

[33] The 2006 study did not calculate a net forecast of the remaining potential. To facilitate comparison to the study results, the figures present gross savings estimates, and the 2002/2003 and the 2008 forecast present naturally occurring estimates.

Figure 11-7: Commercial Sector Gross Energy Forecasts from the 2002/2003, 2006, and 2008 Potential Studies



The technical energy savings forecast across the three scenarios are very similar, while the economic forecast is slightly higher in the 2008 forecast than in either of the two previous analyses. The market forecast of potential, however is lower in the 2006 and the 2008 forecasts than in the 2002/2003 analysis.

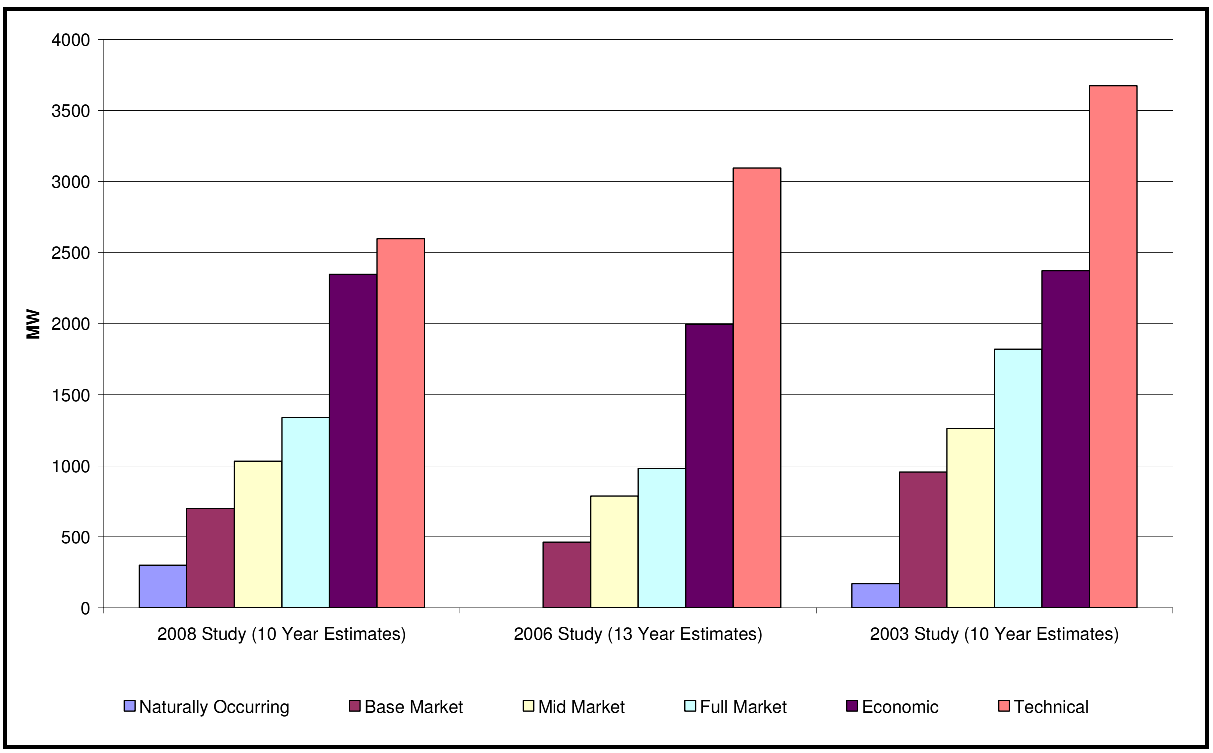
The decline in the market forecast of energy efficiency potential between the 2002/2003 and the 2006 analyses is due to many factors, including a reduction in the commercial program accomplishments in 2004 relative to 2000, a different measure mix, new measure impacts, changes in federal and California's energy efficiency standards, and the new technology saturation data from CEUS. The 2008 forecast of market potential is larger than the 2006 forecast, due, at least in part, to the higher calibration targets associated with the higher average 2004-2005 commercial program accomplishments when compared to the 2004 commercial program accomplishment.

The technical demand savings forecasts have declined with each iteration of the potential study, with the 2002/2003 study having the highest technical demand potential. The economic potential in the 2008 forecast, however, is similar to the economic forecasts for the other two studies. The market forecast of demand potential is highest in 2002/2003 and lowest in the 2006 study.

The changes in the demand forecast of energy efficiency potential are due to many factors, including an increase in avoided cost benefits, an increase in the commercial program accomplishment between 2004 and 2005, a different mix of measures, new standards, new technology saturations, and new TOU periods and definition of system peak for the 2008 study.

The 2002/2003 study and the 2006 study use a stylized TOU period, using the same TOU periods for each of the three electric IOUs. The 2008 study used each utility's TOU structure. The TOU periods for a given IOU could be very different from the stylized TOU periods used in the previous analysis, including different months for the system peak period, different hours for the peak period, and different numbers of TOU periods. There was also a change in the definition of the system peak between the earlier studies and the current analysis. In the 2002/2003 and 2006 analyses, the system peak was defined as the hour with the maximum usage. In the 2008 analysis, the system peak was calculated as the average of the three highest consecutive hours.

Figure 11-8: Commercial Sector Coincident Peak Demand Forecasts from the 2002/2003, 2006, and 2008 Potential Studies



The 2002/2003 study analyzed 69 commercial high efficiency measures while the 2008 study analyzed 100 measures. The increased number of measures analyzed in this study is largely a result of an increase in the number of lighting measures analyzed.

While the increased number of lighting measures, relative to the 2002/2003 study, might lead to an increase in the estimate of potential savings, many factors in the 2006 and 2008 analyses restrain the forecast of the remaining lighting potential. These factors include the current higher saturation of efficient lighting; a reduction between 2001 and 2005 in the DEER hours of lighting operation, which decreases the saving impacts for lighting; and the implementation of new federal standards for commercial lighting.

The recent CEUS database helps to eliminate many of the uncertainties that were present in the 2002/2003 potential study concerning the saturation and technology density of lighting in commercial buildings. The saturation data from the 2006 CEUS database shows that many commercial buildings have converted their T8 and T12 lighting measures to high efficiency measures, lending supporting data to the effectiveness of previous commercial energy efficiency programs while limiting the remaining potential available with existing high efficiency lighting measures. The combination of changes in DEER hours of operation and improved information on the technology saturation of high efficiency lighting works to reduce the estimate of the remaining potential associated with T8s from approximately 3500 GWh in the 2002/2003 analysis to 1380 GWh in the 2006 analysis.[34]

The 2008 potential study made adjustments to the T8 measures available in the analysis, changed the calculation of T12/T8 lighting base share, technology density, and the definition of T12 delamping. In the 2008 study, T12 fixtures could convert to T8 first-generation fixtures or T8 second-generation fixtures. The 2008 model, however, did not allow T8 first-generation fixtures to convert to T8 second-generation fixtures. The utilities do not currently rebate a retrofit from a T8 first-generation to a T8 higher generation. The T12 delamping measure was updated in the 2008 study to be consistent with the new program delamping definition that requires delamping of T12s to a T8. The total T8-related technical potential in the 2008 analysis is approximately 1,700 GWh.

In the 2002/2003 commercial potential forecast, the perimeter lighting dimming measures contributed approximately 1700 GWh to technical potential. For the 2006 analysis, perimeter dimming only added 333 GWh to technical potential and approximately only 235 GWh of potential in the 2008 analysis. The primary source of the difference in these estimates appears to be a result of significant differences in the applicability assigned by the studies. The 2002/2003 analysis assumed that perimeter dimming was applicable to the perimeter and to areas with skylights. The 2006 analysis assumed that the measure was applicable to the perimeter where window glass constitutes 20% of the wall area. This restriction eliminates several building types from the analysis, including grocery stores, lodging, retail, restaurants, and schools.

[34] The T8 potential comparisons are technical potential and include the potential associated with delamping T12s but do not include the potential from high output, highbay T5s.

The CEUS database also helps to eliminate some of the uncertainties associated with the technology saturations and the portion of floorspace using high efficiency chillers for cooling. The 2002/2003 analysis used data on the portion of floorspace cooled by chillers from 1992-1996 CEUS databases and professional judgment.[35] In the 2006 and 2008 analyses, the portion of floorspace cooled by chillers is determined by the current CEUS database. The CEUS data indicate that the 2002/2003 analysis generally assumed that too much floorspace was cooled by chillers and too little floorspace was cooled by direct expansion units (DX). These findings help to explain why the 2002/2003 study forecasts that high efficiency chillers have a remaining demand potential of approximately 300 MW while the 2006 study estimates the remaining demand potential of only 47 MW. The remaining demand potential with the 2008 study is 73 MW. The differences between the 2006 and 2008 studies are largely explained by differences in incremental savings assumptions and load profile inputs. The load profile inputs were changed between the 2006 and 2008 studies due to differing TOU periods and a change in the definition of system peak.

Recent changes in federal standards also restrict manufacturers from producing 10 SEER packaged air conditioning units after 2005, increasing the base efficiency level for packaged units to 13 SEER. The 2002/2003 study assumed that a 10 SEER unit was the base unit, enabling this study to forecast the remaining potential associated with the implementation of a 12 SEER air conditioner. In the 2006 and 2008 analyses, the forecasts eliminate the 10 SEER base after 2006 and estimate the potential associated with replacing a 13 SEER air conditioner with a 14 or a 15 SEER unit.[36] The improved energy efficiency of the base air conditioning unit reduces demand and usage savings for the higher efficiency 14 and 15 SEER air conditioners, significantly increasing the measure payback period. Changing the base efficiency for packaged air conditioners works to reduce the remaining market and economic demand potential in the 2006 and 2008 forecasts relative to the 2002 forecast.[37]

The 2006 and 2002/2003 analyses also incorporated programmable thermostats in their analyses. This measure has been dropped from the IOU energy efficiency programs due to the uncertainty associated with the per unit measure savings. This measure was eliminated from the 2008 study. In addition, the 2008 analysis dramatically reduced the per unit savings associated with RCA or HVAC tune-ups and dropped the feasibility of the measure. In the 2006 study, the DX tune-up measure accounted for approximately 30% of the HVAC energy

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[35] KEMA July 2002, op. cit. See Appendix A.

[36] In the 2006 analysis both a 14 and a 15 SEER measure was available while in the 2008 analysis, only the 15 SEER measure was modeled.

[37] Using colleges in climate zone 10 as an example, replacing a 10 SEER unit with a 13 SEER unit saves 2,578 kWh per thousand square feet. Replacing a 13 SEER unit with a 14 SEER unit saves only 463 kWh per thousand square feet. Changing the base dramatically reduces the incremental savings associated with high efficiency air conditioning measures.

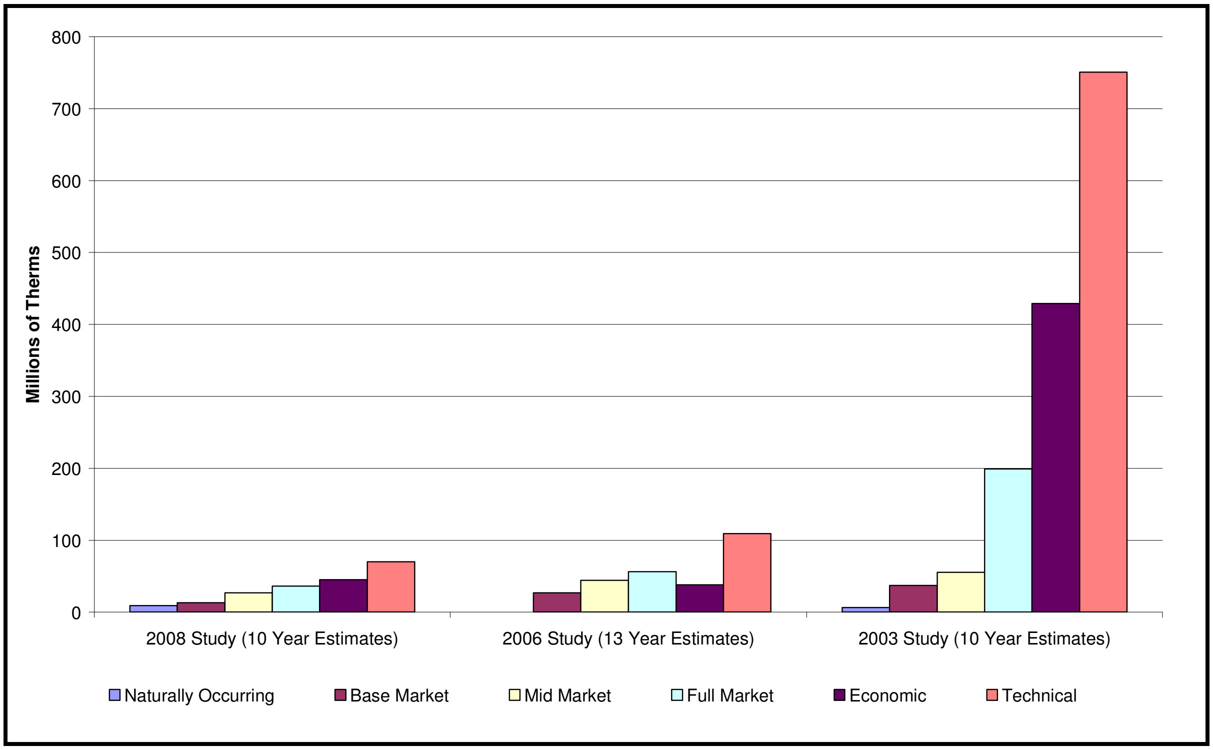
savings potential; in the 2008 study, the DX tune-up measure's potential is only about 10% of the HVAC energy savings potential.

The recent on-site building data provided by the CEUS database, in combination with changing federal standards and long-standing commercial energy efficiency programs, have worked to reduce the forecast of remaining potential relative to the 2002/2003 forecast.

Natural Gas Commercial Potential

Figure 11-9 illustrates the remaining potential for natural gas savings as forecast by the 2002/2003, 2006, and 2008 analyses.[38] Clearly, the technical, economic, and full incremental measure cost forecasts are significantly larger for the 2002/2003 analysis than for the 2008 study. Much of the difference in the technical and economic natural gas commercial potential savings is due to the high efficiency measures analyzed, federal standards, and the new measure saturations and technology densities implemented in the 2006 and 2008 analyses.

Figure 11-9: Commercial Sector Therms Forecast for the 2002/2003, 2006, and 2008 Potential Studies



[38] The 2006 analysis produced only gross estimates. The 2003 study and the 2008 study results are presented as gross estimates to facilitate comparison.

The 2002/2003 analysis included commercial solar hot water heaters. This measure was forecast to have a technical potential of 184 million therms. This measure was not included in the 2006 analysis, and none of the three gas IOUs currently incentivizes commercial solar water heaters. When the high efficiency measure list was chosen for the analysis, none of the IOUs expressed an interest in estimating technical or economic potential.

Solar water heating was included in the 2008 study. The energy savings potential from the 2008 study is only 7 million therms. The energy savings potential associated with solar water heating is highly uncertain and very dependent on the input assumptions. The 2008 study modeled solar water heating as only applicable to tank water heating systems. The incremental energy savings were set equal to 1.5 times the DEER savings from an instantaneous water heater. It is likely that the solar water heating technical potential in the 2008 study understates the actual technical potential and that the technical potential estimates from the 2002/2003 analysis overstate the actual technical potential

End-use share allocations of gas consumption undertaken by the CEUS study determined that the water heating commercial natural gas consumption for the three California gas IOUs in 2004 was approximately 400 million therms. Additional unpublished research undertaken for the CEC found that tank water heating systems account for 60% of commercial water heating consumption while 34% is water heating boilers and 6% is pool heating. These statistics are supportive of the hypothesis that KEMA's estimate of solar water heating potential is likely too high and the results from this study are likely too low. The savings potential and the costs of residential and commercial water heating need further analysis and metering to help reduce the uncertainty associated with this measure.

There is a large difference in the technical potential savings estimated between the KEMA analysis and the two Itron studies for high efficiency space-heating boilers. In the 2002/2003 analysis, the forecast of potential technical savings for a condensing high efficiency space-heating boiler with 95% efficiency was 103 million therms. In the 2006 analysis, Itron estimated the remaining technical potential savings for a high efficiency space-heating boiler with 85% efficiency.[39] The estimated technical potential from the 2006 analysis was 14 million therms. The technical potential for space-heating boilers in the 2008 analysis was about 7 million therms. The 2008 analysis used technology density information from the CEUS analysis and incremental savings estimates from the 2005 DEER.

There are several differences in the 2002/2003 and the 2008 analyses of potential savings from space-heating boilers. First, the 2002/2003 analysis assumed that the high efficiency boiler saved 18% of usage. Given the current CEUS estimate of space-heating natural gas consumption (about 465 million therms), this would lead to a potential savings of about 84

[39] The high efficiency boiler analyzed in the 2005 DEER database has an efficiency of 85%.

million therms. This is slightly less than the potential estimates from the 2002/2003 analysis, but this is likely due to the technology saturation and usage data available at the time of the analysis.

The 2008 analysis used savings estimates derived from the DEER database. This study used the DEER information to determine the savings associated with replacing an 80% efficiency space-heating boiler with an 85% efficiency boiler. Given that the 2008 study modeled an 85% and a 95% efficiency boiler, the DEER savings associated with an 85% efficiency boiler were multiplied by 1.5 to arrive at the incremental savings associated with a 95% boiler.

Several other gas high efficiency measures from the 2002/2003 study had substantially less estimated technical and economic potential in the 2006 and 2008 analyses. The decline in savings potential may be due to reductions in savings impacts, different measure descriptions, or changes in technology saturations and densities. For example, the 2002/2003 analysis determined that infrared gas fryers had a technical potential of 61 million therms while the 2006 analysis estimated the remaining technical potential at 8.6 million therms and the 2008 estimate was 8.8 million therms.[40]

Changes in California appliance standards between the 2002/2003 analysis and the 2006 and 2008 studies reduced the remaining energy efficiency potential for high efficiency gas water heaters. The 2002/2003 study assumed that high efficiency gas water heaters have an energy savings fraction of 25%. The implementation of the new California appliance standards changed the base efficiency for a gas hot water heater from an EF = 0.54 to EF = 0.6. Changes in the minimum or base energy efficiency factor have reduced the energy savings fraction used in the 2005 DEER, and for this study, to 5%.[41] The decline in energy savings associated with high efficiency hot water heaters and the new CEUS technology density and saturation data have contributed to a dramatic decline in the technical potential for hot water heaters from 97 million therms in the 2002/2003 analysis to 5.2 million therms in the 2006 analysis.

Changes in the high efficiency measure list, including the elimination of boiler tune-ups and boiler pipe insulation, combined with changes in standards, usage of DEER savings values, and changes in technology densities and saturations, help to explain the significant decline in commercial natural gas technical potential between the 2002/2003 study and the 2008 analysis. Incremental savings and the savings potential in the commercial sector need additional analysis to help clarify several uncertainties associated with measure-level incremental savings and their total savings potential.

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[40] The CEUS estimate of the cooking end use natural gas consumption is about 289 million therms.
[41] Data from Itron 2004-2005 DEER, op. cit.

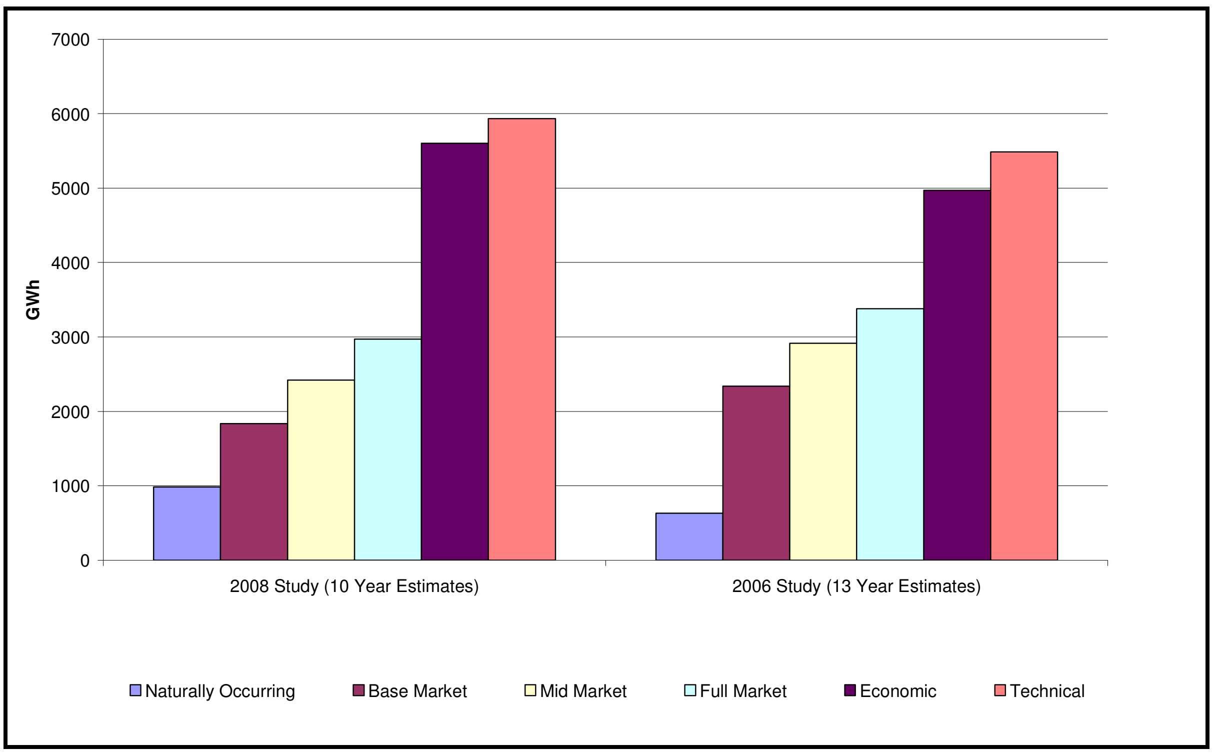
Industrial Data and Results

The data used in the 2006 and 2008 study were identical. Within the industrial sector, the objective of the 2008 study was to transfer the data used in 2006 in the KEMA ASSYST model to the Itron ASSET model. The input information available for the industrial sector has not been updated between these two analyses. New information on the existing saturation of base and high efficiency measures and the technology density within the industrial sector is not currently available. However, it is likely that new data will be available for the next potential study, given the ongoing IEUS study.

Electric Industrial Potential

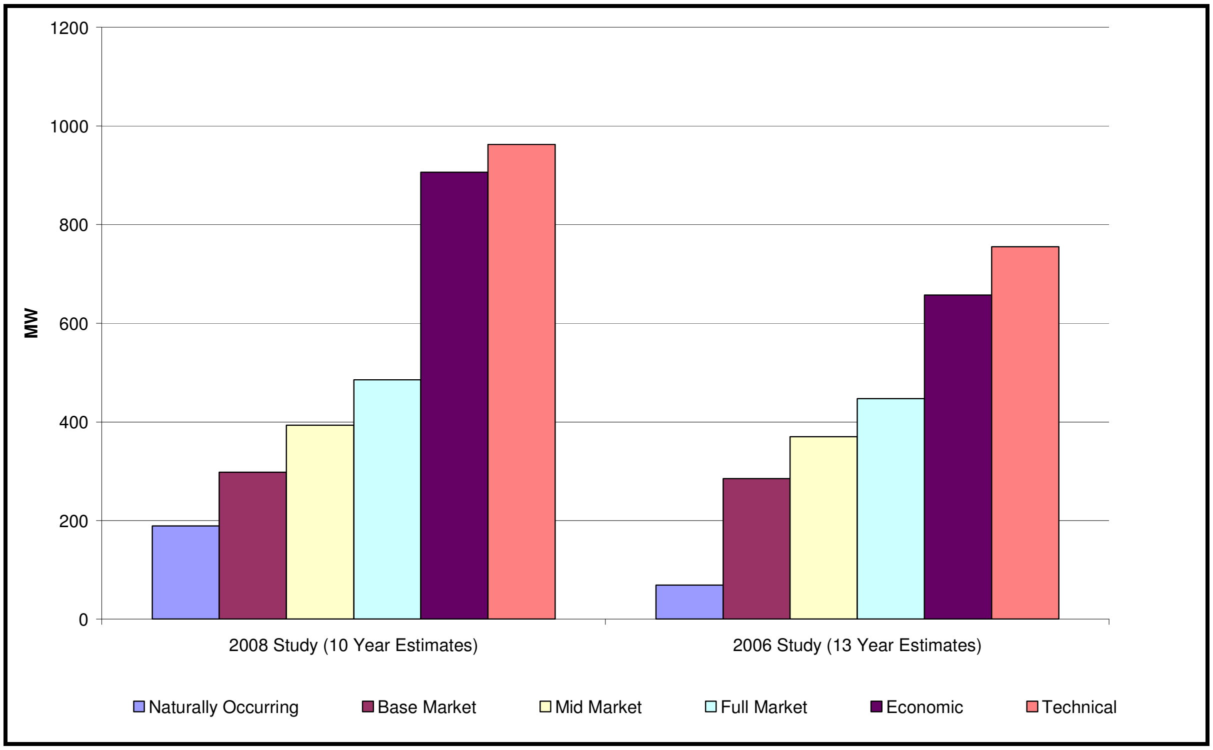
Figure 11-10 and Figure 11-11 illustrate the energy and coincident demand potential estimates from the 2006 and the 2008 analyses. The potential estimates are very similar. The market forecasts for the 2006 study are slightly higher than for the 2008 study. The difference between the two market forecasts is largely due to the 13-year time scope of the 2006 study and the 10-year estimates presented for the 2008 study.

Figure 11-10: Industrial Sector Energy Efficiency Forecast for the 2006 and 2008 Potential Studies



The naturally occurring forecast for the 2008 study is higher than the naturally occurring estimate of potential for the 2006 analysis. The higher naturally occurring estimate in the 2008 and the 2006 studies are consistent with the information available at the time. The higher 2008 estimate of naturally occurring potential simply indicates that current research indicates that the net-to-gross ratio is lower in the existing industrial sector than previous estimates.

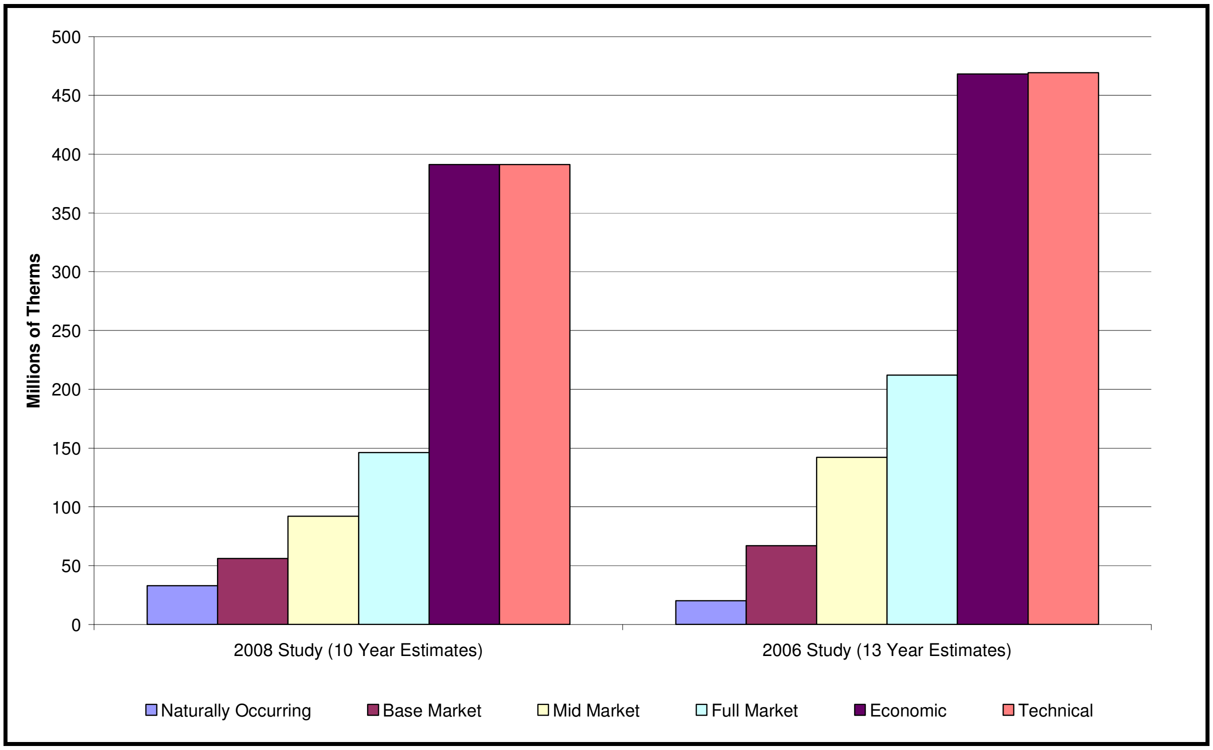
Figure 11-11: Industrial Sector Coincident Peak Demand Forecast for the 2006 and 2008 Potential Studies



<u>Natural Gas Industrial Potential</u>

The natural gas estimates presented in Figure 11-12 indicate that the 2006 study produced higher savings potential estimates than the 2008 study. These differences are due to the length of the forecast period. The 2006 study forecast potential from 2004-2016 while the 2008 study's 10-year forecast covers 2007-2016. The technical, economic, and market forecasts are higher in the earlier study due to the longer forecast period. The length of the forecast period had a larger influence on the natural gas potential than the electric potential due to the longer expected useful life of some of the natural gas measures.

Figure 11-12: Industrial Sector Natural Gas Forecasts for the 2006 and 2008 Potential Studies



Residential New Construction Data and Results

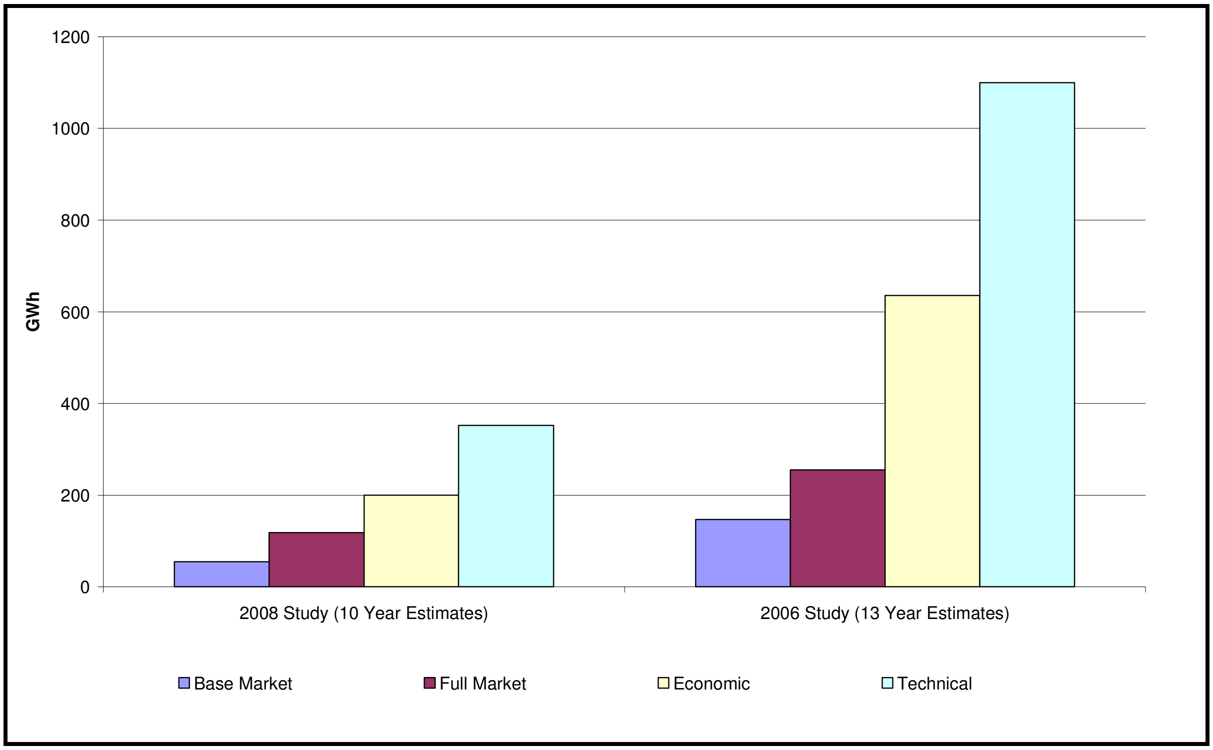
The residential new construction potential studies in 2006 and 2008 used many of the same inputs. The 2006 residential new construction study developed least cost packages to reach 10 and 15% above standards. These packages were used in the 2008 study. The 2008 study updated the utility tariffs and the cost of residential air conditioning. The most influential change between the 2006 and 2008 new construction forecasts is an update to the CEC new construction forecast. In April 2007, the CEC provided Itron with a new housing start forecast that is significantly lower than the previous forecast.

Electric Residential New Construction Potential

Figure 11-13 and Figure 11-14 illustrate the net electric residential new construction potential. The new construction potential is presented in net terms because the energy savings for the new construction packages were determined relative to as-built consumption of baseline non-participant homes.

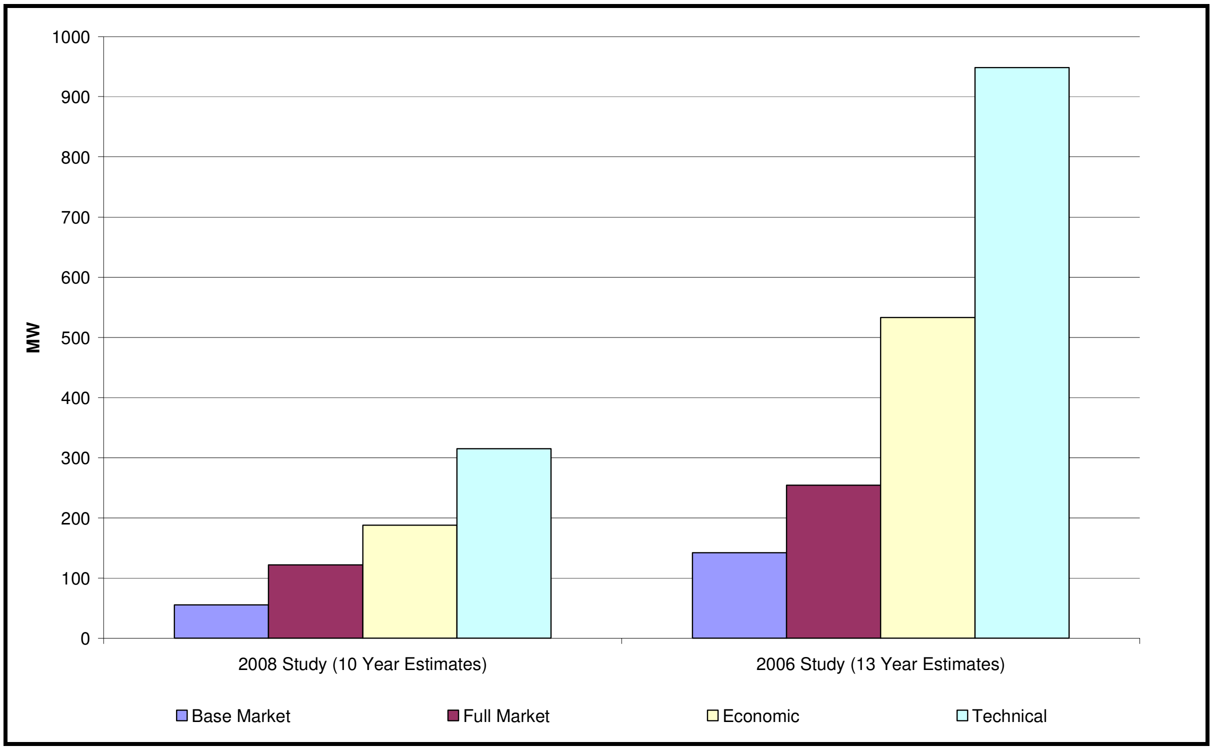
The technical, economic, and market potential estimated in the 2006 study is substantially higher than the estimates from the 2008 analysis. Some of the difference is attributable to the 13-year scope of the 2006 study and the 10-year timeframe of the 2008 results presented below. Examination of the average yearly potential across the two studies, however, supports the conclusion that most of the differences presented in the graphs are due to a significantly smaller new construction forecast.[42]

Figure 11-13: Residential New Construction Electric Potential Forecasts for the 2006 and 2008 Potential Studies



42 The average yearly base market forecast was 11.3 GWh for the 2006 study and 5.5 GWh for the 2008 study.

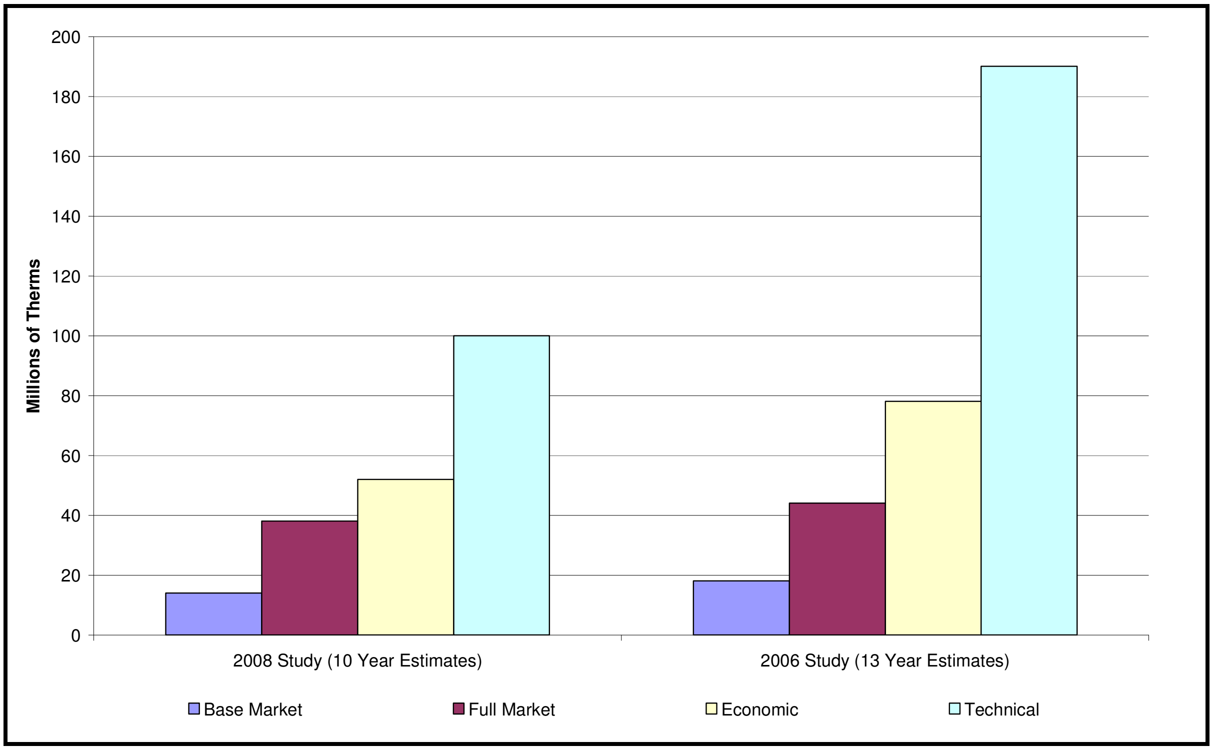
Figure 11-14: Residential New Construction Coincident Peak Demand Potential Forecasts for the 2006 and 2008 Potential Studies



<u>Natural Gas Residential New Construction Potential</u>

Figure 11-15 illustrates the residential new construction net natural gas potential from the 2006 and 2008 potential studies. As with the residential new construction electric potential, the gas potential is significantly less in the 2008 analysis than in the 2006 study. The reduction is largely due to lower new housing start forecasts provided by the CEC and the 10-year timeframe of the 2008 forecast presented below.

Figure 11-15: Residential New Construction Gas Potential Forecasts for the 2006 and 2008 Potential Studies



Commercial New Construction Data and Results

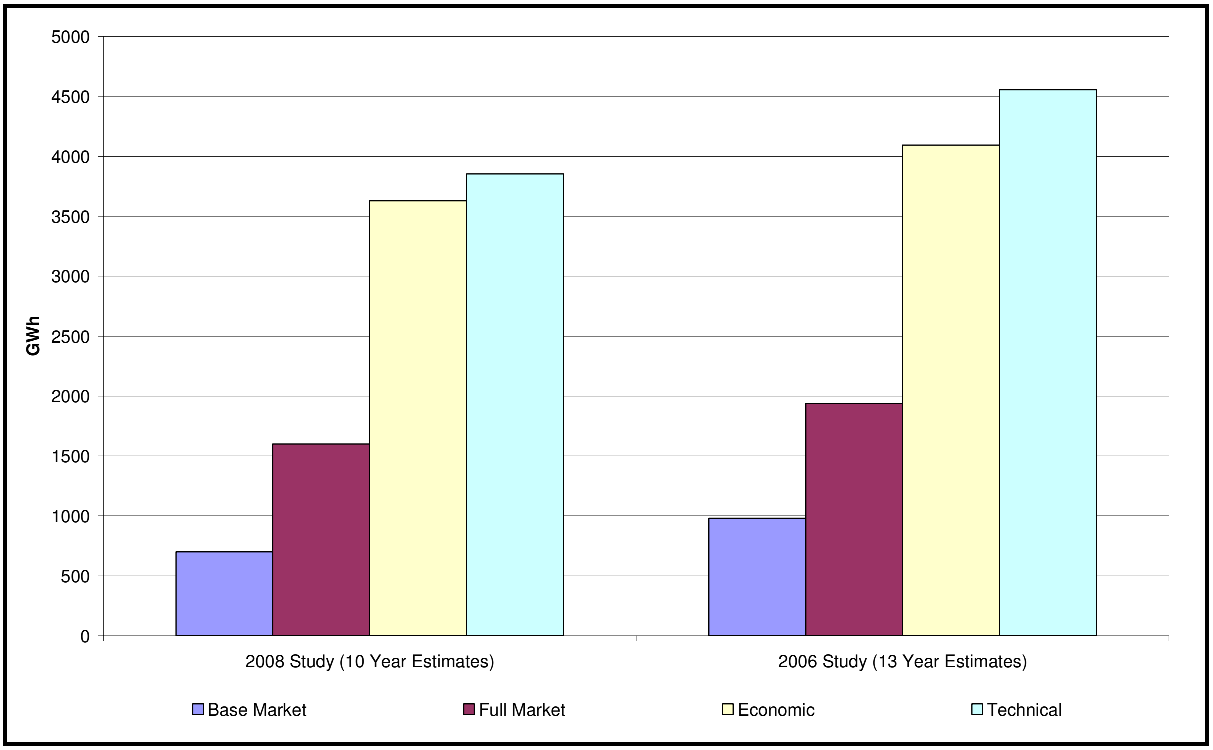
The commercial new construction potential studies in 2006 and 2008 used many of the same inputs. The 2006 commercial new construction study developed least cost packages to reach 10% and 15% above standards. These packages were used in the 2008 study. The 2008 study updated the utility tariffs and the floor stock forecast. The most influential change between the 2006 and the 2008 new construction forecasts is the update to the CEC new construction forecast. In April 2007, the CEC provided Itron with a new floor stock forecast that is lower than the previous forecast. The decline in the commercial new construction forecast, however, is not as large as the fall in the residential new construction housing starts forecast.

Electric Commercial New Construction Potential

Figure 11-16 and Figure 11-17 illustrate the net electric commercial new construction potential. The new construction potential is presented in net terms because the energy savings for the new construction packages were determined relative to as-built consumption of baseline non-participant buildings.

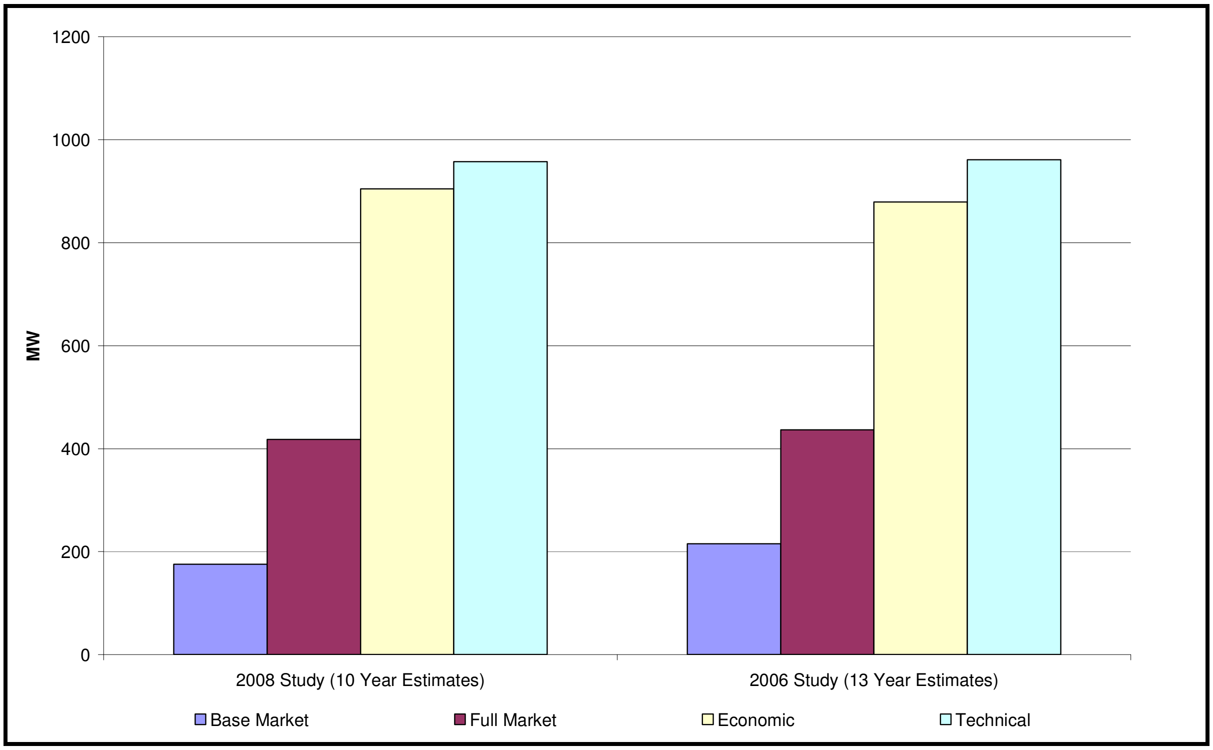
The technical, economic, and market potential estimated in the 2006 study is higher than the estimates from the 2008 analysis. Much of the difference is attributable to the 13-year scope of the 2006 study and the 10-year timeframe of the 2008 results presented below. Examination of the average yearly potential across the two studies, however, also supports the conclusion that some of the differences presented in the graphs are due to a slightly smaller new construction forecast.[43]

Figure 11-16: Commercial New Construction Electric Energy Efficiency Potential Forecasts for the 2006 and 2008 Potential Studies



[43] The average yearly base market forecast was 75 GWh for the 2006 study and 70 GWh for the 2008 study.

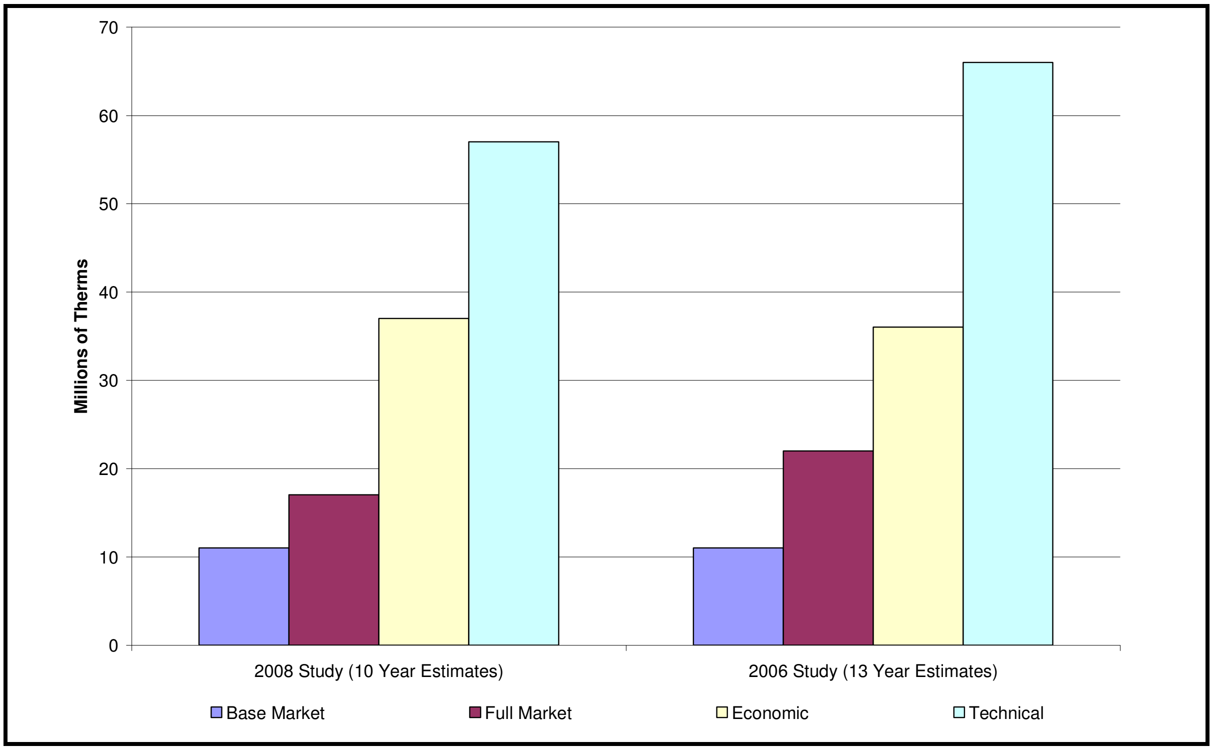
Figure 11-17: Commercial New Construction Coincident Peak Demand Potential Forecasts for the 2006 and 2008 Potential Studies



Natural Gas Commercial New Construction Potential

Figure 11-18 illustrates the commercial new construction net natural gas potential from the 2006 and 2008 potential studies. The commercial new construction gas potential forecast from the 2006 and the 2008 analyses are nearly identical. The increase in natural gas tariffs counteracts the slight decline in the floor stock forecast.

Figure 11-18: Commercial New Construction Natural Gas Potential Forecasts for the 2006 and 2008 Potential Studies



11.3 Conclusion

Incorporating the changes in the IOUs' baseline accomplishments, changes in federal and state standards, and new input data are the most important differences between the KEMA 2002/2003, Itron 2006 studies, and the Itron 2008 study. The 2002/2003 study was calibrated to a general average of four years' (1996-2000) worth of utility program accomplishments. This enabled the study to capture measures that may be missing from a single program year and averages out short-term fluctuations in funding. The 2006 analysis was calibrated to the 2004 program accomplishments. This enabled the 2006 study to capture recent increases in the residential program and reductions in the commercial program. The 2008 study is calibrated to the average of the 2004-2005 program accomplishments. Calibrating to the average of the 2004-2005 program cycle increased the relative importance of the commercial sector and reduced the relative size of the residential sector. The adjustments to these two sectors between the 2006 and 2008 studies were due to the longer start up time for commercial projects. The start up time led to fewer commercial accomplishments in the single year calibration of the 2006 study and more commercial accomplishments in the two year average calibration of the 2008 study.

Calibrating the 2006 and 2008 study to the newer program accomplishments from the 2004-2005 program cycle helps to explain the prominence of lighting potential. The current lighting programs are highly dependent on lighting end use savings. The savings potential calculated from these studies is highly reliant on lighting because the programs are currently finding a high level of market acceptance for these measures.

The three studies analyzed different lists of high efficiency measures. The 2002/2003 analysis included some measures eliminated from the 2006 and 2008 analyses due to changes in federal and state energy efficiency standards. Changes in federal and state standards improve the efficiency of base measure choices, reducing the remaining energy efficiency potential. The 2002/2003 study did not attempt to incorporate the 2005 changes in codes and standards. The 2006 analysis results are estimates net of the 2005 changes in codes and standards, whereas the results from the 2002/2003 study do not net out these effects. The 2008 study also incorporated new code changes in residential and commercial clothes washers and residential pool pumps. It is well accepted that codes and standards have made a significant contribution to the adoption and savings from high-efficiency measures.

The 2002/2003 analysis also included some very high efficiency measures not analyzed in the 2006 or 2008 study. These measures include, but are not limited to, programmable thermostats and R0-R19 insulation. Including these measures in the 2002/2003 analysis works to increase the technical and full incremental cost market forecast relative to the 2006 and 2008 estimates.

The three analyses differ in the savings impact, technology density, and saturation data used in the models. The newly released RASS (2004), DEER (2005), and CEUS (2006) data allowed the 2006 and 2008 studies to update technology saturations, eliminating many uncertainties from the 2002/2003 study. The 2006 and 2008 analyses use technology saturation data, which include the tremendous increase in energy efficiency measures following the 2000-2001 energy crisis. The increase in high efficiency measure saturations following the energy crisis works to reduce the remaining energy efficiency potential in the 2006 and 2008 studies relative the 2002/2003 study.

Summary and Conclusions

1. Introduction

Overview

This report summarizes the findings of the California Energy Efficiency Potential Study (Itron 2008 study). The primary focus of the study is the gross and net potential for electricity and gas savings in the existing and new residential, commercial, and industrial sectors. The results presented in the study are for generation level savings. The user-level savings are available in IOU databases. The study forecasts the short- and mid-term gross and net market potential resulting from the installation of energy efficiency measures funded through publicly funded energy efficiency programs.

Study Objectives and Scope

The primary objective of the work underlying this report was to produce estimates of remaining potential energy savings that might be obtainable in the near (2007-2016) and foreseeable (2017-2026) future through publicly funded energy efficiency programs in the existing and new residential, industrial, and commercial sectors. The results will help determine where potential savings remain and which technologies offer the most efficient opportunities for energy savings. The results from this study will also help the utilities assess and, to the extent possible, meet the energy saving goals set by the CPUC. The CPUC has established aggressive energy saving goals for electric and natural gas savings for the four state IOUs over the years 2004-2013. The results will also help to inform the CPUC and the CEC. The CPUC's reassessment of the future IOU energy savings goals will be informed by the types and levels of energy savings potential forecast by this analysis. The CPUC's reassessment builds upon the potential savings estimates from this project, analyzing additional sources of potential savings that were outside the scope of this project.

Market Potential Scenarios

Given that the primary purpose of this study is to assist the IOUs and their program planners, the study focuses on the remaining market energy efficiency potential for the four California IOUs. Market potential denotes the energy savings that can be expected to result from specific scenarios relating to program designs and market conditions. For this study, market potential was estimated under 10 scenarios relating to incentive levels, market awareness, cost-effectiveness, and the base lighting technology.

The Base program scenario reflects the continuation of the incentives in effect during 2006.[1] The results for this scenario were calibrated to the average of actual program accomplishments for the 2004-2005 program cycle.[2] The Full incremental cost market potential estimates were derived on the assumption that incentives are increased to cover full incremental measure costs. For the implementation of the Full scenario, it was also assumed that the higher incentive levels would be associated with a more extensive marketing campaign, which would lead to a higher level of awareness than under the Base scenario. A third set of estimates, the Mid scenario, was developed to reflect a scenario in which incentives are equal to the average between current (2006) incentives and full incremental costs. The assumed marketing and awareness level for the Mid scenario is between the Base and the Full levels.

The Full incremental cost and Mid scenario-level rebates are implemented beginning in 2007. The three market scenarios were also re-estimated (scenarios 4-6) restricting individual measures to those with a TRC ≥ 0.85. A seventh and eighth set of estimates reflect scenarios in which the incentives are increased over a four-year period from the 2006 incentive level to full incremental cost incentives. The ninth scenario models the impact of increased levels of general population awareness and willingness to adopt high efficiency technologies. This scenario adapts the Base TRC Restricted scenario to the possibility that higher levels of IOU marketing and general awareness of greenhouse gases and global warming may lead to a higher level of naturally occurring adoptions of energy efficiency measures. The tenth scenario modifies the potential estimates associated with lighting technologies to simulate the remaining potential if incandescents are eliminated and compact fluorescent lamps (CFLs) become the base lighting technology in both the residential and commercial sectors. This scenario is intended to reflect a simplified estimate of the potential remaining given the recently signed AB 1109, or Huffman Bill.

2. Uncertainty

Numerous and significant elements of uncertainty pervade all potential studies. These uncertainties should be carefully considered when reviewing the point estimates output from any forecasting model. The point estimates should be viewed as the likely values in a possible range of foreseeable potential estimates.

1 The potential estimates are calibrated to the average of 2004-2005 program accomplishments. Incentives from 2005 were used during the calibration period.

2 Program accomplishments were extracted from the IOUs' 2006 Q1 reports for measures in their 2004 and 2005 programs. For programs with non-specific measure savings, the team attempted to obtain additional information on end use and measure from the IOUs and third party implementers. These savings were allocated to measures and end uses to the best of the team's ability.

The uncertainty associated with potential studies begins with the uncertainty that accompanies the baseline distribution of equipment, the energy usage of existing equipment, and the expected savings and costs associated with high efficiency measures. Some of these uncertainties have been reduced with the recent California RASS (2004), the CEUS (2006), and the ongoing update of the DEER database.

A second, and potentially more important source of uncertainty associated with potential studies is the forecast's assumptions concerning consumer behavior when utilities adopt aggressive incentives and marketing campaigns. The current forecasting models lack empirical data to determine adoption parameters under such campaigns. The models also have only limited information on the level of current consumer awareness and willingness to adopt high efficiency measures, let alone how this awareness will be impacted by aggressive utility marketing campaigns. This lack of information leads to significant increases in uncertainty when increases in program incentives and marketing attempt to move program potential toward economic potential.

The calibration process works to reduce the uncertainty of the short-term forecast, tying the estimates to the recent program activity (2004-2005 program year). This process allows the model to estimate how changes in incentive levels, rates, and customer awareness will impact customer adoption behavior. The calibration process, however, can introduce uncertainty if future programs differ substantially in their delivery mechanism or if the public's underlying acceptance of energy efficiency or their concern about the environment changes. The calibration process ensures that the model reflects our current understanding of likely future events, if input assumptions change suddenly, the calibrated model will not anticipate these changes.

Additional uncertainty is added to the analysis when net savings estimates are presented. Determination of the naturally occurring savings in the market requires the researcher to determine if multi-year market effects are included or excluded in the estimates of the potential that would be naturally occurring in the market place without utility programs. The findings reported in this study generally do not include the ongoing market effect associated with the continuation of IOU programs beyond 2006. A scenario is presented in the body of the report, however, that assumes that the continuation of IOU programs leads to a higher level of awareness in the general population, leading to a higher level of naturally occurring potential.

These and other uncertainties increase the need for careful scenario analyses to assess the importance of alternative assumptions and to provide a range of potential estimates. The results presented in this report are the product of several meetings with the PAC to determine the measure list to be analyzed, to discuss measure savings and costs, and to determine the scenarios that would help reduce uncertainties and frame the range of energy and demand savings potential available to the IOUs with technologies that are currently available in the market place.

3. Summary of Results

Table 1, Table 2, and Table 3 summarize the results of the study. These results are further illustrated in Figure 1 through Figure 6. The results presented in the conclusion represent total annual market savings obtained by 2016 from measure adoptions through 2016.[3] The first reporting year for the potential estimates is 2007. The analysis is calibrated to the average of the 2004/2005 IOU program accomplishments, including committed savings. Savings are presented in both gross and net form. The savings estimates presented in the tables are gross estimates in the sense that they are not adjusted for naturally occurring adoptions. Naturally occurring market savings are presented for the current incentive and the Mid and Full incentive analysis.[4] Net savings potential can be determined by subtracting the naturally occurring market savings from the gross savings potential. Savings estimates illustrated in the figures are net savings values.

Electric Energy Potential

Table 1 and Figure 1 present the estimates of the electric energy potential in 2016. The results listed in Table 1 illustrate that continuing current IOU programs is estimated to lead to a market savings potential of 11,346 GWh by 2016. Of this, 4,634 GWh is naturally occurring potential, leading to a net current market savings potential of 6,712 GWh by 2016. If incentives increase to halfway between 2006 levels and full incremental costs (the Mid scenario), total market gross potential would increase to 16,747 GWh by 2016, resulting in 12,032 GWh of net energy potential. Under the most aggressive scenario, in which incentives cover the full incremental cost of measures, gross total market potential is 21,610 GWh and net total market potential is 16,895 GWh by 2016.

Table 1 also presents results for scenarios restricted to measures with a TRC $\geq$ 0.85. Implementing this restriction is intended to approximate the rule that the IOUs implement

3 The results through 2026 are presented in the body of the report. These results are not the focus of the executive summary due to the higher level of uncertainty associated with a mid-term forecast relative to the shorter 10-year forecast.

4 The naturally occurring savings for the Mid and Full incentive analyses can be higher than the naturally occurring for the current estimates if additional measures not in the IOU programs were added to the Mid and Full scenarios. Additional measures were added to the existing residential and commercial sectors to determine the savings potential associated with measures likely to be included in future programs. The naturally occurring savings estimate for the residential and commercial new construction sectors is zero due to the design of the new construction packages and their claimed savings. These packages, and their claimed savings, were designed based upon baseline studies that determined as-built characteristics.

cost-effective portfolios of energy-efficient measures.[5] Restricting measures to those that are nearly cost-effective reduces the estimates of potential for all sectors except commercial and industrial new construction. The TRC restrictions lead to the largest reduction in potential in the existing residential sector. TRC restrictions work to eliminate residential high efficiency air conditioning measures that are not cost-effective with current prices and codes and standard rules.

[5] The TRC restriction implemented in this analysis was set at 0.85 to reflect the fact that ASSET implements the TRC restriction at the measure while the actual cost-effectiveness rule is at the portfolio level. The IOUs may want to incentivize measures that are not yet cost-effective in hopes of moving the market and to enable them to install nearly cost-effective measures while they are at a site installing other devices.

Table 1: Total Market Electric Energy Potential by Sector–2016 (GWh)

	Gross Base Incentive	Naturally Occurring Base	Gross Base Incentive, TRC Restricted	Gross Mid Incentive	Gross Mid Incentive, TRC Restricted	Gross Full Incentive	Gross Full Incentive, TRC Restricted	Naturally Occurring Mid and Full
Residential Existing 2007-2016	5,205	2,024	4,908	8,034	6,828	10,165	7,976	2,077
Commercial Existing 2007-2016	3,357	1,486	3,321	4,961	4,675	6,552	5,891	1,513
Industrial Existing 2007-2016	1,846	986	1,802	2,419	2,276	2,972	2,771	986
Residential New Construction 2007-2016	55	NA	34	80	51	118	74	NA
Commercial New Construction 2007-2016	699	NA	699	1,059	1,059	1,597	1,597	NA
Industrial New Construction 2007-2016	184	139	184	194	194	205	205	139
Total	11,346	4,634	10,949	16,747	15,082	21,610	18,514	4,715

Commercial and residential new construction savings were determined relative to a baseline study of as-built homes and buildings. This method leads to a determination of *net*, not *gross* savings. For reporting purposes, we have listed these savings in the gross column and listed NA in the naturally occurring savings columns, since the naturally occurring savings are incorporated into the as-built savings calculations.

Figure 1 illustrates the distribution of net market total electric energy potential in 2016 by sector. Under each scenario, the potential in the existing residential sector is larger than the potential in any other sectors. The quantity of potential in the existing and new residential sectors, however, is more sensitive to the TRC restriction than the potential in any other sectors. In particular, the gross existing residential potential is reduced by over 2,000 GWh (22%) when the TRC restrictions are applied to the Full incremental cost scenario. The potential in the residential new construction sector is reduced by approximately 40 GWh (37%) due to the TRC restrictions. In comparison, the existing commercial potential is reduced by approximately 600 GWh (10%) when the TRC restrictions are applied to the Full scenario. The sector-dependent impacts of the TRC restrictions reinforce the importance of the run-time assumptions for commercial and residential sectors. The longer run times in the commercial sector make several air conditioning measures cost-effective in the commercial sector that are not cost-effective in the residential sector.

Figure 1: Total Net Market Energy Potential by Sector–2016 (GWh)

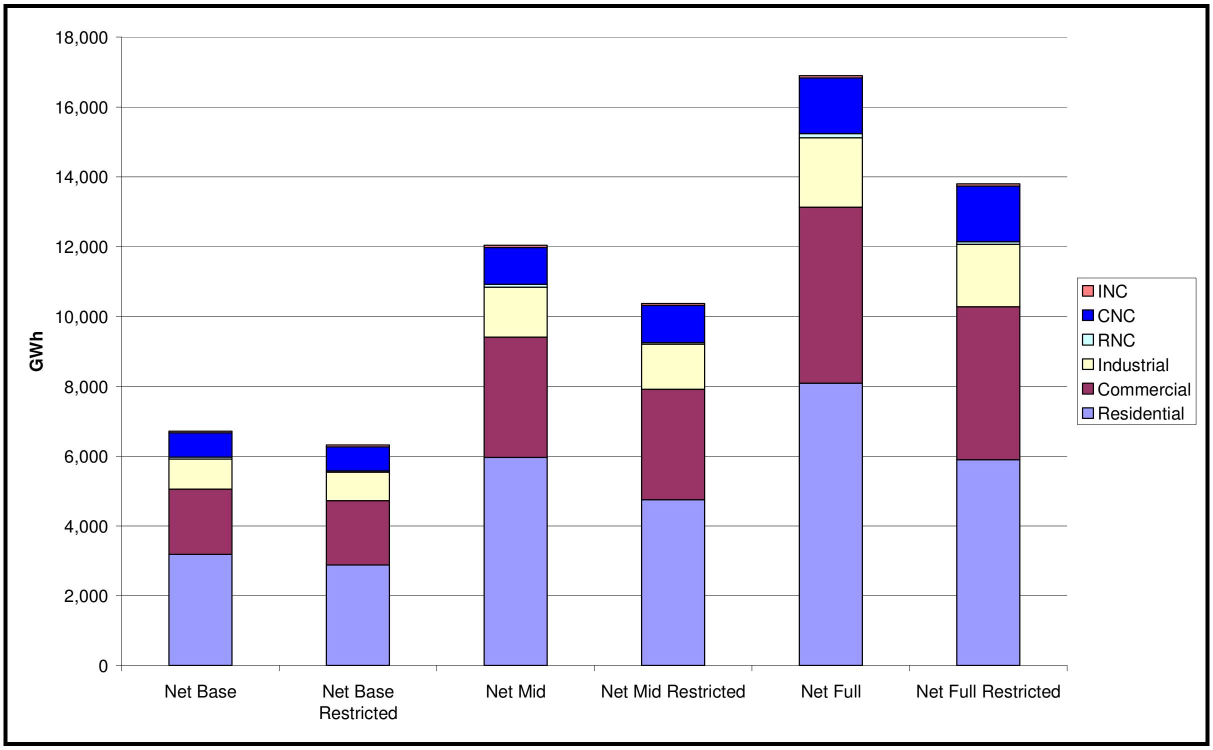
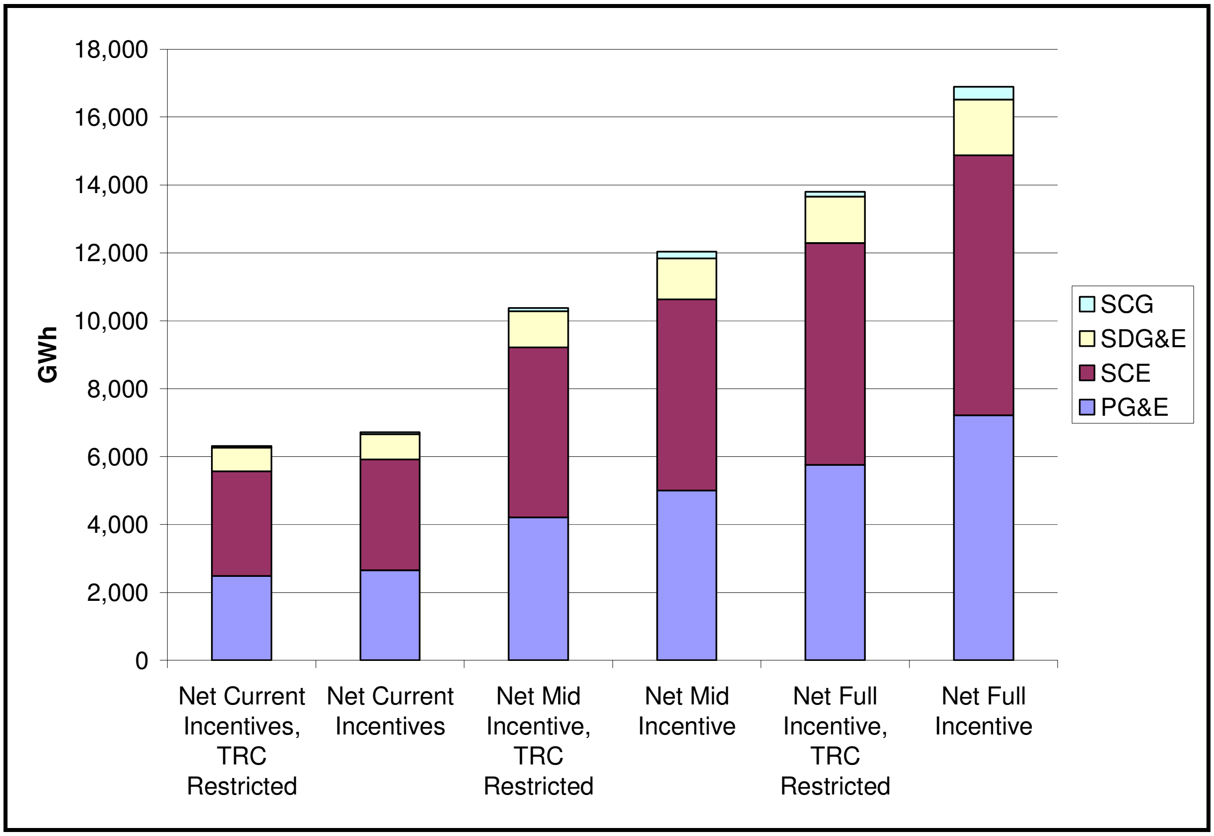


Figure 2 illustrates the distribution of net market total electric energy potential in 2016 by IOU. If current incentives and programs are continued, SCE would account for slightly less than 50% of the electric energy potential (3,265 GWh), while PG&E's program accomplishments would account for approximately 40% (2,652 GWh) and SDG&E 10% (738 GWh). Increasing incentives to full incremental costs and expanding the measures covered by the programs increases PG&E's share of potential to 43% (7,217 GWh) and reduces SCE's share to 45% (7,655 GWh). With full incentives, SDG&E's share remains at approximately 10% (1,639 GWh). SCG's electric energy potential with full incentives is approximately 2% (385 GWh). SCG's electric savings potential is associated with residential measures that are largely gas savings devices that also provide limited electric savings.[6]

Figure 2: Total Net Market Energy Potential by IOU–2016 (GWh)



Peak Demand Potential

Table 2 and Figure 3 present the peak demand savings potential estimates in 2016. As shown, the total gross market potential for peak demand reductions if the current incentives and programs are continued is 2,232 MW. The corresponding net market potential is 1382 MW. Increasing program incentives to full incremental measure costs and increasing the measures covered by the programs leads to a gross market peak demand potential of 4,771 MW and a net market potential of 3,912 MW.

6 The two largest gas savings measures, which also contribute to electric savings, are insulation and dishwashers.

Table 2: Total Market Peak Demand Potential by Sector–2016 (MW)

	Gross Base Incentive	Naturally Occurring Base	Gross Base Incentive, TRC Restricted	Gross Mid Incentive	Gross Mid Incentive, TRC Restricted	Gross Full Incentive	Gross Full Incentive, TRC Restricted	Naturally Occurring Mid and Full
Residential Existing 2007-2016	974	369	862	1,623	1,172	2,377	1,396	375
Commercial Existing 2007-2016	700	301	696	1,032	980	1,338	1,244	305
Industrial Existing 2007-2016	298	157	291	393	369	485	450	157
Residential New Construction 2007-2016	55	NA	39	83	60	122	88	NA
Commercial New Construction 2007-2016	175	NA	175	269	269	418	418	NA
Industrial New Construction 2007-2016	29	22	29	30	30	32	32	22
Total	2,232	850	2,093	3,430	2,879	4,771	3,627	859

Commercial and residential new construction savings were determined relative to a baseline study of as-built homes and buildings. This method leads to a determination of *net*, not *gross* savings. For reporting purposes, we have listed these savings in the gross column and listed NA in the naturally occurring savings columns, since the naturally occurring savings are incorporated in the as-built savings calculations.

Figure 3 illustrates the total net coincident peak demand potential by sector. For all scenarios, the coincident peak demand potential in the existing residential sector is larger than the demand potential in any other sector. The existing residential gross demand potential under Full incentives is approximately 1000 MW larger than the existing commercial gross demand potential. The Full Restricted gross demand potential for the existing residential and commercial sectors differs by only 150 MW. The measure-level TRC restrictions significantly reduce the existing residential demand potential while having only a minor impact on the existing commercial demand potential. TRC restrictions eliminated most of the residential HVAC measures, leading to a substantial reduction in demand potential when compared to the residential Mid and Full incentive scenarios.

Figure 3: Total Net Coincident Peak Demand Potential by Sector–2016 (MW)

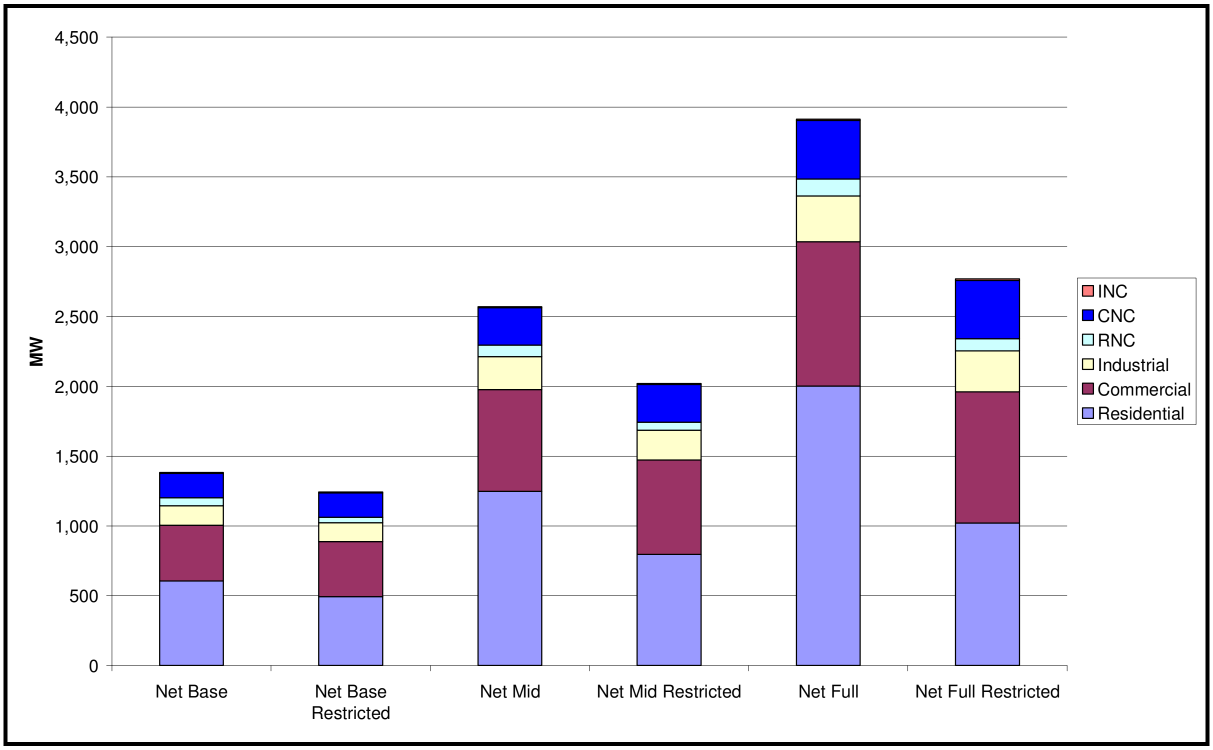
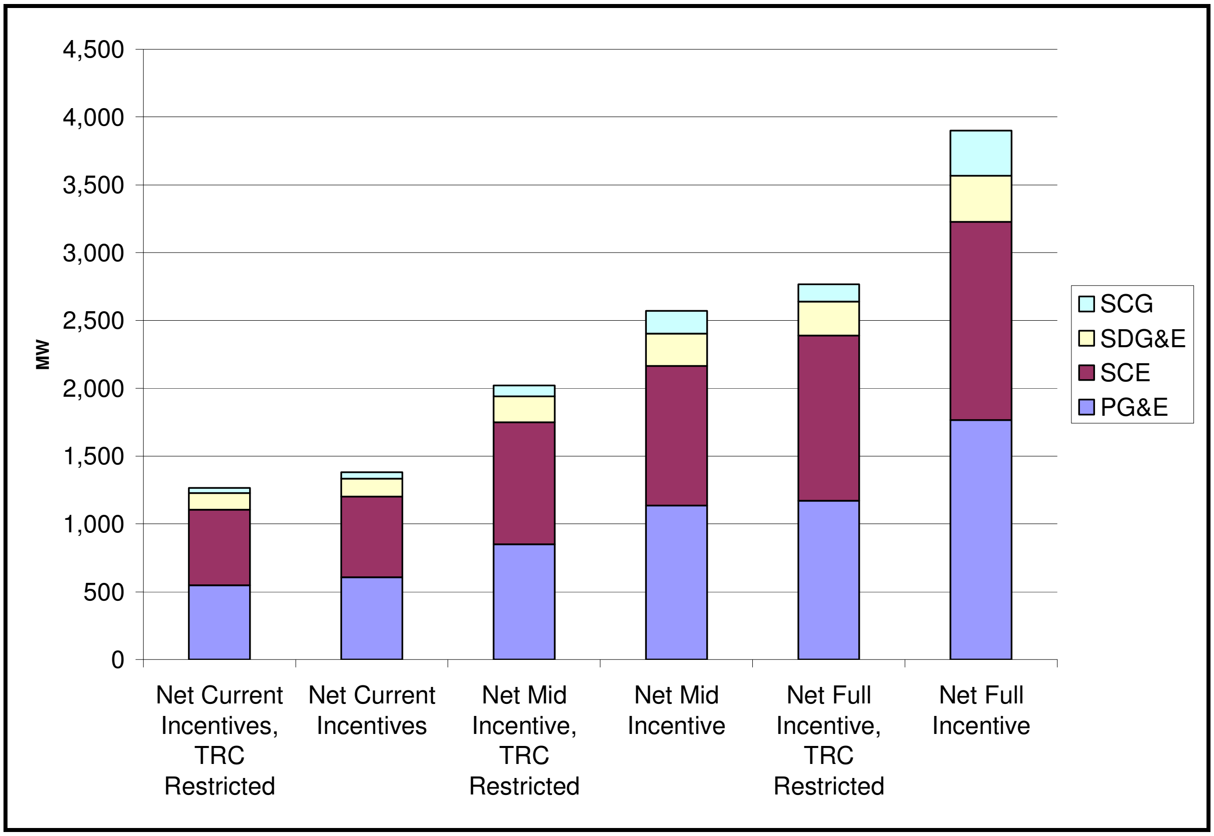


Figure 4 illustrates the total net market peak demand potential by IOU. If the current incentives and programs are continued, PG&E is estimated to contribute 44% of the total peak demand potential (607 MW), closely followed by SCE at 43% (596 MW). SDG&E's estimate of current market peak demand potential is 133 MW or 10% of the total peak demand potential. Increasing incentives to full incremental costs increases PG&E's potential to 1,767 MW or 45% of the total IOU peak demand potential. SCE's full incremental cost peak demand potential is 1,461 MW (37% of the total), SDG&E's full peak demand potential is 341 MW, and SCG's full peak demand potential is 331 MW.

Figure 4: Net Market Electric Peak Demand Potential by IOU–2016 (MW)



Natural Gas Potential

Table 3, Figure 5, and Figure 6 depict the potential for natural gas savings by 2016. As shown, the total gross current market potential for annual gas savings is 171 million therms by 2016 while the total net current market potential is 89 million therms. Of the gross potential, 153 million therms of annual savings pass a TRC test of 0.85 or higher. The gross full market potential for natural gas savings by 2016 is 607 million therms while the TRC restricted potential is 327 million therms. The large reduction in full market potential between the non-restricted and the TRC restricted scenarios is due to a significant reduction in the residential potential.

Table 3: Total Market Natural Gas Potential by Sector–2016 (Millions of Therms)

	Gross Base Incentive	Naturally Occurring Base	Gross Base Incentive, TRC Restricted	Gross Mid Incentive	Gross Mid Incentive, TRC Restricted	Gross Full Incentive	Gross Full Incentive, TRC Restricted	Naturally Occurring Mid and Full
Residential Existing 2007-2016	76	39	62	222	93	371	117	44
Commercial Existing 2007-2016	13	9	12	27	15	36	17	10
Industrial Existing 2007-2016	56	33	56	92	92	146	146	33
Residential New Construction 2007-2016	14	0	12	24	19	38	29	0
Commercial New Construction 2007-2016	11	0	11	18	18	17	17	0
Industrial New Construction 2007-2016	0	0	0	0	0	0	0	0
Total	171	82	153	383	237	607	327	87

Figure 5 illustrates the net natural gas potential in 2016 by sector. The importance of the measure-level TRC restrictions within the residential sector is clearly illustrated by the results. The existing residential potential is larger than the existing industrial potential in the Base, Mid, and Full scenarios. The existing industrial potential, however, is higher than the existing residential potential in the TRC Restricted Base, Mid, and Full scenarios. The longer run times of the industrial sector have led to much higher cost-effectiveness than in the residential sector.

Figure 5: Total Net Natural Gas Potential by Sector–2016 (Millions of Therms)

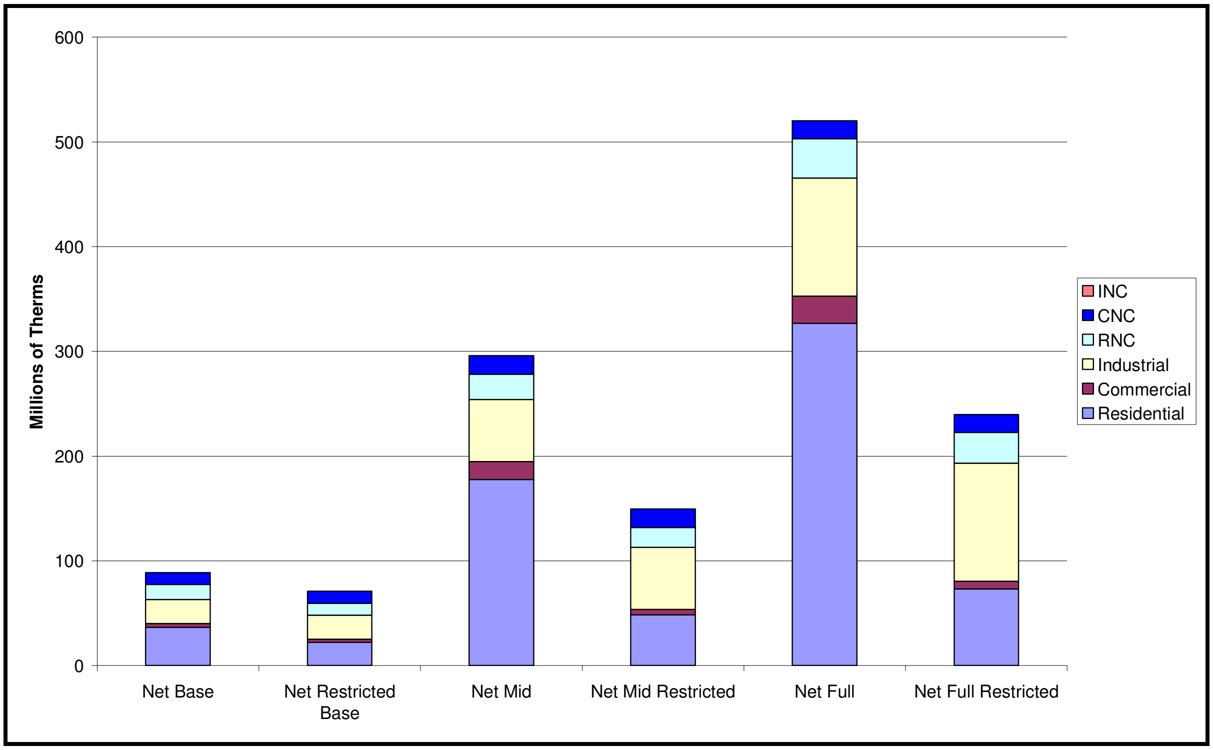
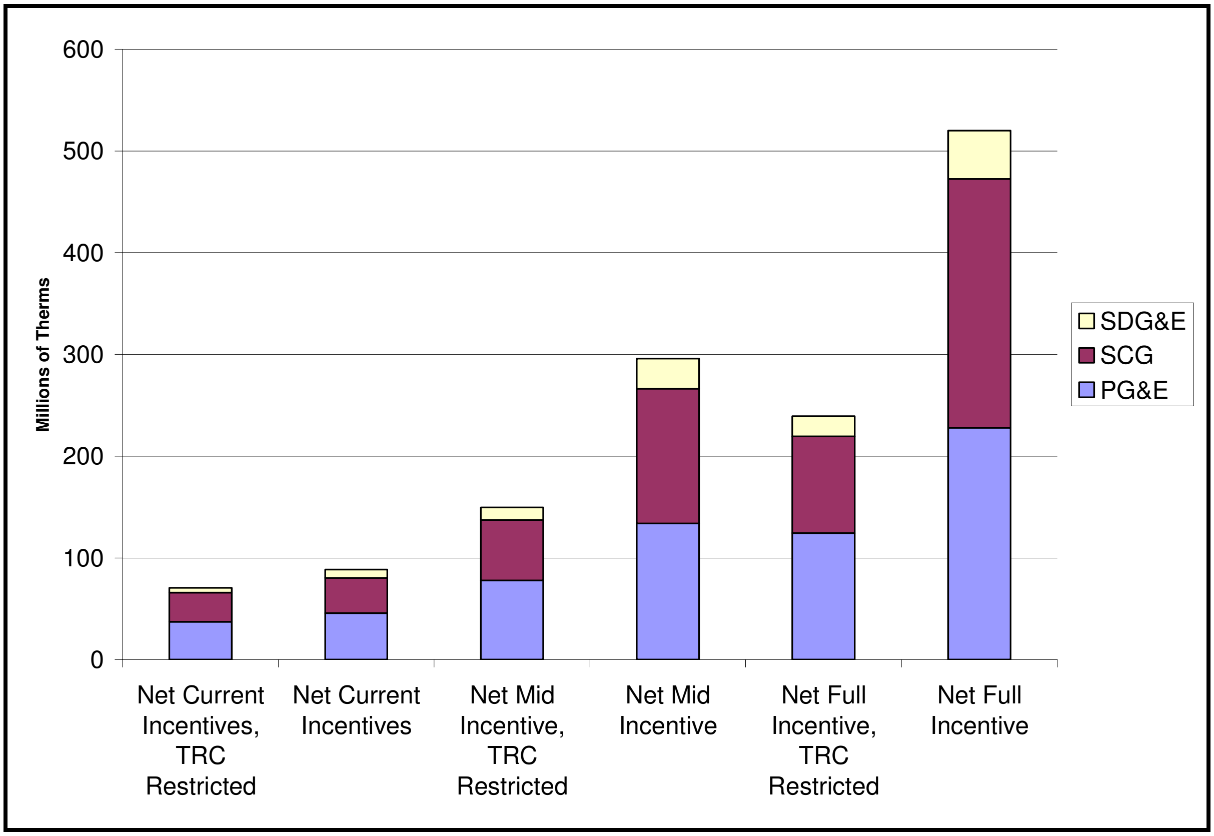


Figure 6 illustrates the IOU natural gas potential in 2016. If the IOUs continue their current incentives and programs, the TRC restricted natural gas potential estimates indicate that PG&E has 53% (37 million therms) of the remaining potential while SCG has 40% (29 million therms) and SDG&E has 7% (5 million therms). Increasing incentives to cover full incremental measure costs and expanding the measures list leads to PG&E's estimate of TRC restricted full potential rising to 125 million therms, SCG's potential rising to 95 million therms, and SDG&E's potential rising to 20 million therms.

Figure 6: Net Market Natural Gas Potential by IOU–2016 (Millions of Therms)



4. Caveats

Any study of this nature is subject to a number of caveats. Several important caveats affecting this study follow.

Scenario Simulations Rather than Forecasts. Each of the simulations of market potential presented in this report reflects a specific set of assumptions about incentive levels. None of these scenario-specific simulations should be considered a forecast of what is likely to occur over time, since program designs, incentive levels, rates, and rebated measures are constantly evolving and adapting to the existing context. The estimated accomplishments of the scenario models presented here are based on the best available information for key input variables, along with key assumptions concerning program design, floor space growth, and rates, which may not be borne out by reality over time. In a sense, energy efficiency markets in California can be expected to be a blend of the various scenarios, and energy efficiency accomplishments can be expected to reflect elements of each of the scenario simulations. Given the blending of these various elements and the major increase in program budgets in the 2006-2008 period, we can probably expect program accomplishments over these years to resemble the simulated results of the average incentives or full incentives scenarios, rather than the current incentives scenario.

Market Saturation and Diminishing Program Accomplishments. One of the primary findings of this study is that the simulated total annual program accomplishments under each of the scenarios tend to diminish over time as the markets for energy efficiency measures mature. For some measures, markets may become relatively saturated, leaving little additional new market potential for the measures in question.[7] Program goals—both those set by policy makers as well as those set by program planners and resource planners—should be set taking this into account. For instance, it should be recognized that running more aggressive programs in one year diminishes the amount of new potential left for subsequent years and may ultimately lead to reduced program accomplishments. At the same time, while this phenomenon has important implications for program planning, it is *partly* an artifact of the primary focus on existing measures. It should be recognized that new measures will emerge over time and others will decrease in price, which will reduce barriers to adoption. The promotion of these measures through utility and third-party programs will provide new sources of program accomplishments. One way to interpret the results of this study in this area is that the maintenance of high levels of annual program accomplishments will necessitate enhancements in the mix of measures offered by these programs over time.

Sensitivity of Simulations to Program Activity. Comparisons of the various market potential scenarios provide indications of the sensitivity of program accomplishments to the level of program activity. As indicated by the titles of the market potential scenarios, the aggressiveness of program designs is represented by the levels of incentives. This aspect of the analysis is subject to two important caveats. First, relatively little empirical work has been done to estimated customer responses to variations in incentive levels, so the results are subject to a significant degree of uncertainty. More research needs to be conducted on this point. Second, program interventions go far beyond financial incentives, and undoubtedly affect awareness of energy efficiency options as well as willingness to purchase those options at a given incentive level. The models have assumed that higher levels of incentives are accompanied by higher levels of awareness and willingness to purchase. The assumed increases in the growth of awareness and willingness, however, are ad-hoc adjustments that are subject to uncertainty. As a result, the differences across the market scenarios may understate or overstate the impacts of increased program activities, depending on the adequacy of the awareness and willingness adjustments. It should be recognized, however, that increases in customer awareness to more aggressive programs might largely reflect

[7] To reach some of the remaining markets it may be necessary to change program designs to include integrated solutions (e.g., building retrocommissioning). Changes in program designs could lead to synergies that could postpone the onset of diminishing returns. Program design changes, including the implementation of integrated solutions, were not modeled in this analysis.

timing effects, since the more rapid realization of potential under an aggressive scenario can be expected to diminish the incremental potential for future programs. Aggressive programs lead to a rapid realization of potential for currently available measures, leaving incremental future potential dependent upon new measures not analyzed in this study.

General Market Conditions. All of the market potential scenarios depicted in this report assume a given set of future market conditions (other than incentive rates). Obviously, key market conditions like retail rates, avoided costs, and technology costs may follow a very different path than assumed for the purposes of this study. As these conditions change, simulations will need to be revisited. Ongoing attempts to use the estimates of this study to determine the impact of high generation prices or to analyze the possible impacts of carbon charges associated with greenhouse gas reduction plans, need to remember that this study used utility rates and avoided costs from 2006. The adoption of higher rates or avoided costs will change both the economic and the market potentials. To assess the numerical impact of higher rates and avoided costs, additional scenario analysis would be required.

Comparisons with Previous Studies. A comparison of this study with the previous studies done by KEMA-Xenergy (2002/2003) and Itron (2006) is not straightforward or completely possible. These comparisons reflect a variety of factors, including different periods (most importantly different starting points), availability of different data on key factors (e.g., current saturations of energy efficiency technologies, or end-use load shapes), different emphases, calibration to different program results, changing policy and/or program goals, modeling assumptions, etc. In general, once we control for these factors, the results of this study are generally consistent with those presented in earlier reports covering California's market for energy efficiency. A limited comparison of potential estimates across these three studies was provided in Section 11 of this report.

5. Issues and Areas for Future Study

The completion of an analysis of this size and depth often leads to suggestions for future research.

Economic Conditions. All of the scenarios depicted in this report assume a given set of future market conditions. Obviously, key market conditions like retail rates, avoided costs, technology costs, and floor space may follow a very different path than assumed for the purposes of this study. Future studies may want to rethink the combination of measures, climate zones, and market conditions analyzed. This study analyzed numerous measures and climate zones under one set of economic assumptions.[8] These were the scenarios chosen by

[8] This study used a measure of avoided costs that varied by climate zone and through time. The analysis, however, did not analyze the impact of multiple sets of avoided costs that varied by climate zone and time.

the PAC. In the future researchers may want to implement sensitivity analysis to key economic assumptions.

Recent increases in energy prices have contributed to increases in retail rates and avoided costs. The relative size of these price increases, and the possibility that retail rates and avoided costs may remain at historically high levels for the near term (two to four years), has increased interest in knowing the sensitivity of potential estimates to price changes. The current analysis assumed that the real value of utility rates was constant over the forecast period and that the avoided costs were consistent with the 2006 California estimates of avoided costs. The real value of the 2006 estimates of future avoided costs in California rise over the short term, fall over the mid term, prior to rising in the long-term. Given current concerns about greenhouse gases and the possibility of a future carbon tax or cap and trade system, future studies should address the sensitivity of the results to higher rates and avoided costs.

The market scenarios chosen for this report were likely driven, in part, by the IOUs' desire to better understand the incentive levels necessary to reach their savings goals. Estimating the impact of higher avoided costs would increase the economic and TRC restricted potentials while having no impact on the non-TRC restricted market potential. Estimating the impact of higher utility rates would reduce the payback period and likely lead to higher forecasts of market potential. Analyzing the possible impacts of higher rates, however, maybe problematic for the IOUs as it may signal the likelihood of a future rate increase, a move that would be unpopular with their customers. It may be necessary for a third party, perhaps a regulatory group, to request an analysis of the impact of increased rates on the estimate of market potential savings

Impact of Standards. The estimates of the remaining energy efficiency potential presented in this report are net of the known changes in Federal and California home and appliance standards. Netting out the changes in standards works to reduce the remaining potential when compared to estimates, which do not incorporate standards changes.

Changes in standards have contributed substantially to energy and demand savings associated with high efficiency measures. It is possible to use the ASSET model to estimate the energy and demand savings associated with likely future change in standards. Using the model to determine the energy and demand savings from possible changes in standards would provide the utilities and the CPUC with an estimate of the energy savings associated with non-voluntary standards induced changes.

Market and Economic Potential. For many of the sectors presented in this report, the full incremental cost market potential is less than the economic potential. This result implies that with current program and measure designs, it would not be possible to encourage all individuals to install all the cost-effective high efficiency measures even if the measures were provided at a cost equal to the standard efficiency measure.

This pattern of results is due to negative measure and/or program non-economic attributes or perceptions for some high efficiency measures. For example, CFLs are almost always cost-effective, yet the full market potential is less than the economic potential. Consumers have chosen to restrict their installation of these measures to less than the cost-effective, feasible applications. Giving these lights away would not lead all households to eliminate all of their applicable incandescent lights.

To encourage more customers to adopt such a cost-effective high efficiency measure, it may be necessary to change more than the measure's incentive. It may be necessary to work to change the program, the measure, or customers' perception of the measure and the measure's non-market benefits to increase adoption behavior. Utilities may want to examine measures whose full market potential is substantially less than the economic potential to determine if changes in program delivery, implementation, or information may significantly change adoption behavior. Even with program changes, however, there will be cost-effective measures that consumers choose not to adopt due to perceived or actual quality issues.

Gas High Efficiency Potential. One of the first steps in an energy efficiency potential study is the determination of which measures to include in the base and high efficiency measure list. The measure list for this study was informed by measures currently included in the utility portfolios, measures in recent potential studies, and measures in the DEER database. Fewer gas measures were included in the analysis than electric measures. This reflects that fewer gas measures are currently included in the IOU portfolios.

The estimates of energy savings potential associated with gas measures is closely related to the incremental energy savings associated with each measure, the underlying fuel shares, and the underlying saturations of base and high efficiency measures. In general, there is currently a higher degree of uncertainty surrounding these values for gas measures than for electric measures.

Additional research needs to be undertaken to further explore possible energy efficient gas measures to be included in the measure list and to clarify appropriate incremental savings estimates. A study focused exclusively on high efficiency gas measures may help to ensure that these measures receive the added attention necessary to help reduce the uncertainty associated with the gas savings potential estimates.

Economic Parameters. Estimates of market potential depend on the calculated influence of measure cost, incentives, incremental energy savings, and retail rates on adoption behavior. The influence of existing economic variables on adoption behavior can be determined using professional judgment or empirical analysis. When the value of economic variables, including incentives, reaches a level not previously observed, additional assumptions about those variables' influence on behavior are necessary.

The ASSET model employs economic inputs to calculate measure specific payback periods or life cycle costs.[9] The influence of payback length or the life cycle costs on adoption behavior is determined by the model parameters. The economic parameters were empirically calculated from analysis performed in the Midwest and were adjusted using professional judgment and information on the adoption of measures within California. Given the importance of these parameters on market forecasts of potential, we feel that additional research should be undertaken to determine the current influence of economic inputs on Californian's market energy efficiency potential.

The economic parameters could be determined using several different types of research. Given the long-standing nature of California's energy efficiency programs, a time-series analysis of adoptions, incentives, measure costs, and retail rates could be used to determine the historic relationship between economic variables and adoption behavior. Alternatively, a conjoint or double-bounded survey of adoption behavior could be undertaken to determine the influence of alternative incentive levels on adoption behavior.

[9] Payback was used for all high efficiency measures other than CFLs. Life cycle costs were used for competition groups including CFLs. CFLs and incandescents have very different expected useful lives, life cycle costs are a better economic variable for the comparison of measures with different life times.

Appendix A

Measure Descriptions for the Existing Building Residential, Commercial, and Industrial Sectors

This appendix briefly describes the measures that were simulated for *existing buildings* in the residential, commercial, and industrial sector ASSET models. This appendix does not contain detailed descriptions of the actual modeling approach and assumptions that were used for each measure. By sector, for each measure, a brief description of the measure and a summary of the primary ASSET model measure identifiers are provided. Sections of this appendix are as follows:

- General description of the information provided for each measure
- Residential measures
- Commercial measures
- Industrial measures

New construction measures are described in Appendices E, F, and G, respectively.

A.1 General Description of Measure Information

A summary of the ASSET model measure identifiers and a brief description of each measure group—including the decision type—are provided for each measure. Measure descriptions are discussed in brief paragraphs under the end use topic areas like HVAC, lighting, water heating, and miscellaneous.

Measure Identifiers for the ASSET Model. Regarding the ASSET model measure identifiers, these are summarized in a table such as that shown in Table A-1.

Table A-1: Example of ASSET Model Measure Identifiers Summary Table

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_40	R_Inc_40W	40 Watt - screw-in incandescent
Lights	Elec	RLGT_40	R_CFL_Under14W	Under 14 Watt - screw-in CFL

The contents of each column in these tables are explained below:

- **End Use.** This is the end use name used in the ASSET model, under which the results for this measure will appear. This identifier can be used to report aggregate competition group results. It is also typically the level at which load shapes, which are used to calculate time of use are assigned.
- **Fuel Type.** Indicates the fuel type for the measure impacts. The value is either electric (Elec), natural gas (Gas), or both fuels (Both).
- **Competition Group ID.** This is the variable name used in the ASSET model to designate a competition group. For modeling purposes, mutually exclusive efficiency options for a specific technology are grouped into competition groups. For example, if there are standard, mid-, and high-efficiency chillers available, only one of these efficiency options can be selected in a new construction or replacement decision. All of these options would be placed into a single competition group. In contrast, most add-on devices can be treated on a stand-alone basis, and would have only a single high efficiency technology in the "competition" group. For example, water heater blankets can be treated as a single (high efficiency) option. In this case, rather than modeling shares of purchases, the adoption rate gives the penetration in new construction or the acquisition rate in existing applications. As such, there is only a single technology in the competition group.
- **Efficiency Level.** Values for the technologies within a given competition group are Base, Mid Efficiency, High Efficiency, or Highest Efficiency for replace-on-burnout (ROB) measures. Measures within a competition group that do not have a Base technology are retrofit measures, which are just added to existing technologies, not replacing them.
- **TechID.** This is the variable name used in the ASSET model to designate a specific technology. The first letter of the TechID indicates the sector (R = Residential, C = Commercial, I = Industrial) and the remaining letters are used to denote the technology and efficiency level. For example, R_CAC_SEER10 is a residential (R_), central air conditioner (CAC) with a 10 SEER efficiency rating. In addition, when there are multiple TechIDs within a competition group, the lowest efficiency unit is presented first in the list, and highest efficiency unit last.
- **Measure Name.** This is a short, more descriptive label that describes key aspects of the technology (e.g., equipment type, efficiency level, configuration, LIEE, etc.).

A complete list of the ASSET model measure identifiers for each sector is also provided in section A.5. These tables include an additional field:

- **Decision Type.** The ASSET decision type options used for existing building measures are replacement-on-burnout (ROB), retrofit (RET), and conversion (CON). An ROB measure is an event driven decision, requiring the existing technology reach the end of its useful life prior to the installation of the new, high efficiency technology. Retrofits and conversions are not event driven decision, the installation of the new technology is dependent upon the payback of the measure and the assumed customer response to payback levels. The incremental cost of retrofits and conversions includes the labor cost associated with the new installation due to the consumer's choice to install the high efficiency measure. Because retrofits and conversions do not require an event, significant spikes in adoptions can occur if rebates levels are increase significantly.

A.2 Residential Measures

Residential lighting, HVAC, water heating, and miscellaneous measures such as pool pumps are included in this study. Some of these measures are exclusively multifamily measures, and are so noted in the measure descriptions. A few of the measures are also classified as "current emerging technologies" (CETs). These measures are currently available in the market, but are new to the marketplace. These technologies are associated with a higher level of uncertainty associated with their performance, costs, and the likelihood of consumer acceptance of the measures. The study did not attempt to analyze the potential associated with a broad list of emerging technologies.

For each residential measure (or measure group) in the study, a brief description of the measure and the relevant ASSET model measure identifiers is provided in this section.

Lighting Measures

The residential lighting measures examined in this study include a variety of CFL configurations, LED lamps, T12-to-T8 conversions, and lighting controls. Some of the measures are exclusively multifamily measures, and there are CETs.

Screw-in Compact Fluorescent Lamps (CFLs). Screw-in compact fluorescent lamps are modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-2. Screw-in CFLs replace standard incandescent medium-base lamps. Three CFL wattage ranges were used for the current analysis: <14W, 14 to 25W, and >25W. The assumed baseline incandescent wattage for each competition group is reflected in Table A-2. For the ASSET analysis, the impacts used were chosen to reflect 04/05 IOU assumptions for screw-in CFLs across the associated wattage ranges. The impacts were further reduced to account for the future installation of CFLs in sockets with lower run times, which will occur in modeling the replacement of all applicable and feasible incandescents with CFLs. This assumption is very important in the estimation of technical and economic potential.

Table A-2: Residential Screw-in CFL Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_40	R_Inc_40W	40 Watt - screw-in incandescent
Lights	Elec	RLGT_40	R_CFL_Under14W	Under 14 Watt - screw-in CFL
Lights	Elec	RLGT_75	R_Inc_60_to_100W	60 to 100 Watt - screw-in incandescent
Lights	Elec	RLGT_75	R_CFL_14_to_25W	14 to 25 Watt - screw-in CFL
Lights	Elec	RLGT_150	R_Inc_Over100W	Over 100 Watt - screw-in incandescent
Lights	Elec	RLGT_150	R_CFL_Over25W	Over 25 Watt - screw-in

Modular Compact Fluorescent Lamp (CFLs) Fixtures. Compact fluorescent lamp *fixtures* are modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-3. Due to the lower level of current, and likely future program activity, only a single competition group was used to model this measure. CFL fixtures can replace standard incandescent lamps or other lower-efficacy lighting fixtures. For this analysis, Itron reviewed the current IOU assumptions for CFL fixture costs and savings. The team aggregated all CFL fixtures into one measure group and chose an average cost and impact for a modular CFL fixture.

Table A-3: Residential CFL Fixture ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_FIX	R_Inc_Fixture	Incandescent Fixture
Lights	Elec	RLGT_FIX	R_CFL_Fixture	Modular CFL (Fixture)

CFL Reflectors. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-4. The two most common CFL reflector lamp options – BR30/R30 and BR40/R40 – are aggregated into one reflector measure. The R30/BR30 CFL lamps use 11-16W and R30 incandescent lamps use 65-75W, while BR40/R40 CFL lamps use 16-23W and R40 incandescent lamps use 75-120W. For this analysis, the assumed incremental cost and savings are an average of those associated with R30 and R40 bulbs. Induction lamps like the GE Genura and Sylvania Dura-One are part of this technology class, but only ballasted CFL reflectors were considered for this measure.

Table A-4: Residential CFL Reflectors ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_REFL	R_Inc_Reflector	Incandescent Reflector - R30
Lights	Elec	RLGT_REFL	R_CFL_Reflector	CFL Reflector - R30, R40

LED Reflectors, Current Emerging Technology. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-5. Some versions of R20 LED reflector lamps are currently available in the marketplace but at much higher cost relative to either the CFL or incandescent base technologies; an R20 LED lamp is modeled to cost $34 per lamp compared to $8.5 for the R30/R40 reflector. There are also a few remaining unresolved technical issues for LED reflectors, for example, the light output of LED downlights is significantly less than incandescent or CFLs, and the LEDs generate a lot of heat. For comparison, R20 CFL lamps are 9-11W, and R20 incandescent lamps are 65W.

Table A-5: LED Reflectors (CET) ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_REFL20	R_Inc_Reflector20	Incandescent Reflector - R20
Lights	Elec	RLGT_REFL20	R_LED_Reflector_CET	LED Reflector, Current Emerging Tech

CFL Torchieres. This measure is modeled as a CON decision type. ASSET model measure identifiers are presented in Table A-6. Torchieres provide high lumen lighting and have traditionally been outfitted with halogen lamps of about 300W or incandescent lamps of about 200W. For the analysis, the halogen and the incandescent torchiere were aggregated into a single measure and the assumed savings from the CFL torchiere was an average associated with replacing the aggregated measure with a two-bulb CFL fixture.

Table A-6: CFL Torchieres ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_TOR1	R_Inc_Torchiere	Non-CFL Torchiere
Lights	Elec	RLGT_TOR1	R_CFL_Torchiere	CFL Torchiere

CFL Table Lamps. This measure is modeled as a CON decision type. ASSET model measure identifiers are presented in Table A-7. This is a new measure within the IOU 04/05 programs with limited current program activity. In addition, it is difficult to determine the appropriate number of table lamps per home. To limit the perception that the data can support a high level of table lamp wattage disaggregation, table lamps were modeled as an aggregate wattage measure. For the analysis, it was assumed that on average table lamps contain relatively high wattage incandescents and CFLs, and the assumed impact reflects the range of possible values.

Table A-7: CFL Table Lamps ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_TBL	R_Inc_Table	Incandescent Table Lamp
Lights	Elec	RLGT_TBL	R_CFL_Table	CFL Table Lamp

Outdoor Lighting Photocell or Timeclock Controls. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-8. Photocells are modeled in the residential sector as controlling both outdoor lamps. When lights do not need to be on all night, a photocell provides maximum savings and eliminates the need for manual operation and seasonal time clock adjustments. It is assumed that there is one photocell or timeclock for every eight multifamily units in a complex, one for every mobile home, and 1.5 for every single family home. It is assumed that without the photocell or timeclock the controlled outdoor lights would be on 4 hours longer per night for multifamily settings and 2 additional hours in single family and the mobile home segments.

Table A-8: Outdoor Photocell or Timeclock ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_EXTC	R_ExtLite_Control	Photocell, Time Clock

LED Christmas Lights, Current Emerging Technology. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-5. LED holiday lights use just one-tenth the energy of incandescent holiday lights. They are widely available online, as well as at hardware stores, home improvement stores and major retailers, but still carry a large cost premium compared to incandescent holiday lights. For the ASSET analysis, it was assumed that homes with holiday lights, apply an average of three strings of lights per home.

Table A-9: LED Holiday Lights (CET) ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_XMAS	R_Inc_XMAS	Incandescent Christmas Lights
Lights	Elec	RLGT_XMAS	R_LEDXMAS_CET	LED Christmas Lights, Current Emerging Tech

T12-to-T8 Conversion. This measure is modeled as a CON decision type. ASSET model measure identifiers are presented in Table A-10. Linear fluorescent lamps are typically used to illuminate multifamily common areas such as laundry rooms, recreation rooms, hallways, and offices, though not limited to these applications. Linear fluorescents are also commonly used in multifamily and single family kitchens. The 04/05 IOU program accomplishments for T8s are limited to multifamily applications. The high efficiency T8s, however, were found to be more often installed in multifamily kitchens than in multifamily common areas. The installation location dramatically impacts the run time and savings assumptions used in the model. The team chooses to model the measure as the conversion of 4 foot, 2-lamp, 40W T12 linear fluorescent fixtures to 4 foot, 2 lamp, 32W T8 fixtures more commonly installed in kitchens than in multifamily common areas.

Table A-10: T12-to-T8 Retrofit ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_T12T8	R_T12_4ft	T12 Fluorescent Lighting
Lights	Elec	RLGT_T12T8	R_T8_4ft	Premium T8 El Ballast

Multifamily-Specific Lighting Measures

The measures that were applicable only to multifamily residence common areas include occupancy sensor lighting controls and LED exit signs, as noted in the measure descriptions and tables.

Ceiling or Wall-box Occupancy Sensors (Multifamily). This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-11. Occupancy sensors (infrared or ultrasonic motion detection devices) turn lights upon entry of a person into a room, and then turn the lights off from half a minute to 20 minutes after motion is no longer detected. For this retrofit analysis, it is assumed that there is one occupancy sensor for every eight multifamily units in a complex. The assumed savings are the 04/05 IOU value for common area occupancy sensors and the incremental cost is the commercial DEER 2005 value for this measure.

Table A-11: (Multifamily) Occupancy Sensor ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	ROCC	R_OCC_Sensor	Occupancy Sensor - Ceiling or Wall Box

LED Exit Signs (Multifamily). This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-12. LED exit signs offer significant savings over traditional incandescent bulb-based exit signs and even over CFL-based exit signs. The retrofit analysis assumes that an LED exit sign savings are consistent with those assumed by SDG&E and SCE for common are exit signs.

Table A-12: (Multifamily) LED Exit Signs ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Lights	Elec	RLGT_EX	R_LED_EXIT	LED Exit Sign

HVAC Measures (including Building Shell)

HVAC measures include night economizers, air conditioner upgrading, central air conditioners and heat pumps, room air conditioners, duct repairing, natural gas furnaces, AC diagnostic testing and tune-up, and whole house fans. Building shell measures are also included in this end use category due to the HVAC interactions. Building shell measures include attic/wall insulation, high performance windows, and cool roofs.

Central Air Conditioner Upgrade. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-13. Central air conditioners may be unitary (all components housed in a factory-built assembly) but are more typically split-systems (an outdoor condenser section and an indoor evaporator section).These are ducted systems and usually incorporate a heating source (either gas or electric furnace). In the beginning of the analysis period (2005) the base system is a 10 SEER unit and the higher efficiency units modeled are SEER 13 and SEER 15 units, including duct sealing as required by the 2005 Standards. In 2007, the base unit is updated to the 13 SEER and the only modeled higher efficiency unit is a 15 SEER. The assumed incremental cost for the measure was derived from the DEER (2005) database and the incremental savings used the DEER savings percentages applied to the RASS UECs by housing segment and climate zone.

Table A-13: Central Air Conditioner ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RCAC	R_CAC_SEER10	CAC 10 SEER
HVAC	Elec	RCAC	R_CAC_SEER13	CAC 13 SEER (w/Duct, 2007+)
HVAC	Elec	RCAC	R_CAC_SEER15	CAC 15 SEER (w/Duct, 2007+)

Central Heat Pump Upgrade. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-14. Central heat pumps, which are ducted systems, can also be either unitary or split-system (the most common). In the beginning of the analysis period (2005) the base system is a 10 SEER unit and the higher efficiency units modeled are SEER 13 and SEER 15 units, including duct sealing as required by the 2005 Standards. In 2007, the base unit is updated to the 13 SEER and the only modeled higher efficiency unit is a 15 SEER. The assumed incremental cost for the measure was derived from the DEER (2005) database and the incremental savings used the DEER savings percentages applied to the RASS UECs by housing segment and climate zone.

Table A-14: Central Heat Pump ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RHP	R_HP_SEER10	AC Heat Pump 10 SEER
HVAC	Elec	RHP	R_HP_SEER13	AC Heat Pump 13 SEER (w/Duct, 2007+)
HVAC	Elec	RHP	R_HP_SEER15	AC Heat Pump 15 SEER (12.70 EER)/8.8 HSPF (3.74 COP) (w/Duct, 2007+)

High Efficiency Room Air Conditioner. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-15. Room air conditioners are designed to cool individual rooms or spaces. These are non-ducted systems that can be semi-permanent through-the-wall mounted units or portable, window-mounted units. Controls can be physically mounted on the unit (typical) or remote. Minimum efficiencies (SEER) are set by Title 20/NAECA and vary by cooling capacity and whether or not the unit has louvered sides. The assumed incremental cost for the measure was derived from the DEER (2005) database and the incremental savings used the DEER savings percentages applied to the RASS UECs by housing segment and climate zone.

Table A-15: Room Air Conditioner ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RRAC	R_RAC_Base	Room A/C SEER=8.8
HVAC	Elec	RRAC	R_RAC_ES	Room A/C SEER=10.3

Whole House Fans. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-16. Whole house fans can provide an alternative to compressor-based cooling whenever the outdoor air temperature is lower than the indoor temperature (e.g., morning, late evening, and night). These fans pull cool air from the outside through a home's windows and exhaust the hot air through the attic to the outside. The incremental savings from this measure was 20% of the RASS household CAC UEC for coastal regions and 10% of the UEC for inland regions.

Table A-16: Whole-House Fan ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RFAN	R_WholeHFan	Whole House Fan

Night Economizer (Current Emerging Technology). This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-17. A night economizer system is similar to a whole house fan in that it brings outside air inside when the outside air temperatures are lower than the indoor temperature, as is often the case during mornings, late evening, and nights. The night economizer as modeled reflects the use of a smart thermostat, mechanical damper, and inlet and exhaust ducts to automatically ventilate the house with 100% outside air when outdoor temperatures are below indoor temperatures. The assumed savings for night economizer was 20% of the RASS household UEC for coastal regions and 10% of the UEC for inland regions.

Table A-17: Night Economizer (CET) ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RNECON	R_NiteEcon_CET	Night Economizer, Current Emerging Technology

Duct Repair. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-18. Leakage in unsealed ducts varies considerably with the fabricating machinery used, the methods for assembly, installation workmanship, and age of the ductwork. To seal ducts, a wide variety of sealing methods and products exist. Current duct sealing methods include use of computer-controlled aerosol and pre- and post-sealing duct pressurization testing. As shown in Table A-18, this measure was modeled for two HVAC system configurations (both with cooling); electric heating (R_DUCTR_E) and gas heating (R_DUCTR_G). The assumed savings are 8% of the RASS heating and cooling UEC.

Table A-18: Duct Repair ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RDUCTE	R_DUCTR_E	Duct Repair – Electric Space Heat, CAC
HVAC	Both	RDUCTG	R_DUCTR_G	Duct Repair – GAS Space Heat, CAC

Natural Gas Furnace. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-19. Standard efficiency natural gas furnaces have an Annual Fuel Use Efficiency (AFUEs) of 78% as regulated by Title 20/NAECA standards, although standard-practice is 80% AFUE. Efficiency is dependent on vent type, burner type, furnace type (conventional or condensing), and fan control type. The AFUE for the base unit is 81% (to reflect standard-practice) and the minimum AFUEs for the energy efficient units are 90%, 92%, and 96%, as reflected in the TechID and Measure Description fields of Table A-19. The incremental high efficiency furnace savings use the estimated RASS UEC and the DEER percentage savings.

Table A-19: Natural Gas Furnace ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	GAS	RFURN	R_Furn_AFUE81	Central Gas Furnace AFUE = 81
HVAC	GAS	RFURN	R_Furn_AFUE90	Central Gas Furnace AFUE = 90
HVAC	GAS	RFURN	R_Furn_AFUE92	Central Gas Furnace AFUE = 92
HVAC	GAS	RFURN	R_Furn_AFUE96	Central Gas Furnace AFUE = 96

HVAC Diagnostic & Tune-up. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-20. Refrigerant charge and airflow (RCA) assessment efforts are addressed by this measure. RCA involves diagnostic services for existing central air conditioners that assess and improve their operation and efficiency. For the ASSET analysis, the incremental savings are derived from combining the RASS household segment and climate zone specific central air conditioning UEC with the DEER percentage savings.

Table A-20: HVAC Diagnostic Testing ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RDIAG	R_AC_Tuneup	AC Diagnostic and Tune-up

Building Shell Measures

The building shell measures are high-performance windows, ceiling/wall insulation, and cool roofs, as described below.

High-Performance Windows (U-0.25 Window). This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-21. Windows can reduce home energy use by reducing solar heat gain in cooling predominant climates. Window thermal performance is measured in terms of thermal conductance (U-value) and solar heat gain coefficient (SHGC). A single-pane, clear-glass, aluminum-framed window might have a 1.33 U-value and a 0.79 SHGC, whereas a dual-paned, low-E glass, vinyl-framed window would have a 0.3 U-value and 0.44 SHGC. Title 24 Standards prescriptive U-factor and SHGC baseline requirements are based on climate zone and window orientation. The incremental savings are determined using the base RASS central air conditioning UEC and the assumption that the high efficiency windows will reduce air conditioning use by 25%.

Table A-21: High Performance Windows ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RWIND	R_Window_Base	Base Window
HVAC	Elec	RWIND	R_Window_U25	U-0.25 (tint) Window

Ceiling Insulation. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-22. Insulation material inhibits the transfer of heat through the roof, wall, or floor structure. The type of building construction defines the insulating possibilities. Typical insulating materials include loose-fill (blown) cellulose, loose-fill (blown) fiberglass, batts of fiberglass, and rigid polystyrene. For this analysis, the baseline ceiling insulation level is R-19, which is upgraded to R-30. As shown in Table A-22, this measure was modeled for two HVAC system configurations (both with cooling); electric heating (R_CeilIns_R19R30E) and gas heating (R_CeilIns_R19R30G). The ASSET analysis uses the DEER percent savings and the RASS heating and cooling UECs to determine incremental savings.

Table A-22: Ceiling Insulation ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RAINSLE	R_CeilIns_R19R30E	Ceiling Insulation R19 to R30 - Electric Space Heat, CAC
HVAC	Both	RAINSLG	R_CeilIns_R19R30G	Ceiling Insulation R19 to R30 - Gas Space Heat, CAC

Wall Insulation. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-23. For existing construction, this measure involves adding R-13 insulation to uninsulated walls (R-0). This is usually accomplished by drilling holes into the building's siding and blowing in insulation material. As shown in Table A-22, this measure was modeled for two HVAC system configurations (both with cooling); electric heating (R_WallIns_R0R13E) and gas heating (R_WallIns_R0R13G). The ASSET analysis uses the DEER percent savings and the RASS heating and cooling UECs to determine incremental savings.

Table A-23: Wall Insulation ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RWINSLE	R_WallIns_R0R13E	Wall Blow-In R-0 to R-13 Insulation - Electric Space Heat, CAC
HVAC	Both	RWINSLG	R_WallIns_R0R13G	Wall Blow-In R-0 to R-13 Insulation - Gas Space Heat, CAC

Cool Roof (Residential), Current Emerging Technology . This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-24. Cool roof coatings reduce the roof temperatures and thereby reduce the solar thermal loads on the building. This measure is only applicable to cooling-predominant climates and homes that use compressor-based cooling systems (i.e. not evaporative coolers). Cool roof for residences is considered a CET because applying cool roofing material to the residential sector is a new application of a technology more commonly used in the commercial sector. With the new application, the incremental costs, savings, and customer likelihood of adoption are more uncertain. For the ASSET analysis, the incremental costs of cool roofs were derived from the commercial DEER measures and the incremental savings are assumed to be 10% of the base CAC UEC from the RASS analysis.

Table A-24: Cool Roof (CET) ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
HVAC	Elec	RROOF	R_Roof	Base Roof
HVAC	Elec	RROOF	R_CoolRoof_CET	Cool Roof, Current Emerging Technology

Water Heating Measures

Water heating measures include high efficiency storage water heaters, point of use water heaters, solar water heaters, high efficiency boilers and controls, pipe insulation, water use reducing devices, high efficiency clothes washers, and ENERGY STAR dishwashers.

High Efficiency Water Heater. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-25. Water heater minimum efficiency is regulated by the January 20, 2004 Title 20/NAECA standards and the rating is an Energy Factor (EF), which accounts for recovery efficiency and standby losses. For electric water heaters, the baseline is a standard 0.88 EF 40 gallon water heater and the efficient unit has a 0.93 EF. For gas water heaters, the baseline is a standard 0.60 EF for a 40 gallon water heater and the efficient unit has a 0.63 EF. In addition, as shown in Table A-25, point-of-use (or instantaneous) water heaters are also included in the gas water heater competition group (RWH_G). Instantaneous water heaters eliminate the storage tank (and associated losses) of a standard water heater, and instead provide hot water as-needed. The incremental costs and savings for these measures are derived from the 2005 DEER.

Table A-25: High Efficiency Water Heater ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Elec	RWH	R_WHEle_EF0.88	Base Efficiency Water Heater - Electric, EF=0.88
Water Heaters	Elec	RWH	R_WHEle_EF0.93	High Efficiency Water Heater - Electric, EF=0.93
Water Heaters	Gas	RWH_G	R_WHGas_EF0.60	Base Efficiency Water Heater - Gas, EF = 0.60
Water Heaters	Gas	RWH_G	R_WHGas_EF0.63	High Efficiency Water Heater - Gas, EF = 0.63
Water Heaters	Gas	RWH_G	R_WHGAS_POU	Point of Use Water Heater - Gas

Solar (assisted) Water Heater. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-26. Solar-assisted water heaters consist of a solar collector and a back-up storage water heater. Water heated by the solar collector can be used immediately or stored for later use. There are many possible design configurations for solar water heaters, which make this a difficult measure to model. For example, hot water circulation can be either passive (no pumps) or active (pumps and controls), and there are many possible pump/control schemes. In addition, the system can be direct (potable water circulated directly through the collector) or indirect (fluid in the collector is antifreeze and a heat exchanger is used to transfer heat to the water). As shown in Table A-26, this measure was modeled for both electric (R_WHEle_Solar_CET) and gas

(R_WHGAS_Solar_CET) back-up water heaters. For the ASSET analysis, the model was assumed to have an incremental savings equal to 1.5 times the savings associated with a point of use water heater. This savings assumption was approximately equal to the savings found in the RASS analysis.

Table A-26: Solar Water Heater ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Elec	RSOLWH	R_WHEle_Solar_CET	Solar Water Heater - Retrofit
Water Heaters	Gas	RSOLWH_G	R_WHGAS_Solar_CET	Solar Water Heater - Retrofit

High-Efficiency Gas Boiler (Multifamily). This is a multifamily measure and it is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-27. The efficiency of a hot water boiler is specified as the annual fuel utilization efficiency (AFUE), and minimum efficiencies are regulated by Title 20/NAECA standards. The baseline unit has a 78% AFUE and the high-efficiency unit has an 82% AFUE.

Table A-27: (Multifamily) Efficient Boiler ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Gas	RBOILER_G	R_BoilerMF_Base	Standard Efficiency Small Boiler
Water Heaters	Gas	RBOILER_G	R_BoilerMF	High Efficiency Small Multifamily Boiler – AFUE 82%

Circulation Pump Time Clock/Boiler Controller (Multifamily). This measure is a multifamily measure and is modeled as a RET decision. The baseline assumes a circulation pump continuously circulates hot water though the hot water distribution system. The measure adds a time clock control to turn off the pump during low demand hours. The savings assumed for the ASSET analysis were set to 20% of the utility claimed savings. The reduction is savings applies evaluation results from the 04/05 multifamily program.

Table A-28: (Multifamily) Efficient Boiler ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Gas	RWHBC_G	R_Bcontroler_MF	Circulation Pump Time Clock, Multifamily Boiler Controller

Low Flow Showerhead. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-29. Current Title 20/NAECA federal standards mandate that low flow showerheads have a maximum flow rate of 2.5 gallons per minute (gpm) at 80 psi. Low flow showerheads can reduce the flow rate to as little as 0.25 gpm. The reduction in shower water use can substantially lower water heating energy use since showering accounts for about one-fourth of total domestic hot water energy use. As shown in Table A-29, this measure was modeled for both electric (R_WH_Shw) and gas (R_WH_Shw_G) water heating scenarios. For the ASSET analysis, the 2004-05 DEER Update Study was the source of the impacts for this measure.

Table A-29: Low-Flow Showerhead ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Elec	RSHW	R_WH_Shw	Low Flow Showerhead, Elec Water Heat
Water Heaters	Gas	RSHW_G	R_WH_Shw_G	Low Flow Showerhead, Gas Water Heat

Faucet Aerators. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-30. Water faucet aerators are threaded screens that attach to existing faucets. They reduce the volume of water coming out of faucets while introducing air into the water stream. Current Title 20/NAECA federal standards mandate that lavatory and kitchen faucets have a maximum flow rate of 2.2 gallons per minute (gpm) at 60 psi. A water-saving aerator can reduce the flow to as little as 0.5 gpm. As shown in Table A-30, this measure was modeled for both electric (R_WH_FA) and gas (R_WH_FA_G) water heating scenarios. For the ASSET analysis, the 2004-05 DEER Update Study was the source of the impacts for this measure

Table A-30: Faucet Aerator ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Elec	RFA	R_WH_FA	Faucet Aerators, Elec Water Heat
Water Heaters	Gas	RFA_G	R_WH_FA_G	Faucet Aerator, Gas Water Heat

Pipe Wrap. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-31. The measure is application of pipe insulation to a hot water distribution line. Pipe insulation conserves energy by reducing heat loss from the hot water pipe. In residential new construction applications, the first five feet of the hot water distribution pipe (closest to the water heater) is required by Title 24 to be insulated with a minimum of R4 insulation. As shown in Table A-31, this measure was modeled for both electric (R_WH_PW) and gas (R_WH_PW_G) water heating scenarios. For the ASSET analysis, the 2004-05 DEER Update Study was the source of the impacts for this measure.

Table A-31: Pipe Wrap ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Elec	RPW	R_WH_PW	Pipe Wrap, Elec Water Heat
Water Heaters	Gas	RPW_G	R_WH_PW_G	Pipe Wrap, Gas Water Heat

High Efficiency Clothes Washers. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-32. A standard clothes washer has multiple temperature, water level, and cycle duration settings that are adjusted based on the clothing type and size of the laundry load. A vertical axis machine generally fills the tub until all of the clothes are immersed in water. A horizontal axis clothes washer utilizes a cylinder that rotates horizontally to wash, rinse, and spin the clothes. The horizontal axis machine only requires about one third of the tub to be full, since the rotation of the drum around its axis forces the clothes into the water and thus can drastically reduce the total energy use for washing. These machines are also easier on clothes and use less detergent.

The efficiency basis for clothes washers is the Modified Energy Factor (MEF) as regulated by Title 20/NAECA Standards. A 1.04 MEF was the minimum established January 1, 2004. A 1.26 MEF was the minimum efficiency level established January 1, 2007. The ASSET analysis uses a base measure with a 1.04 MEF for 2005 and 2006, updating the base to 1.26 in 2007.

Both single-family and multifamily units were accounted for in this measure; a 3.5 cubic foot capacity washer was assumed for single family homes and a 2.65 cubic foot capacity washer was assumed for multi family housing. The analysis only models multifamily clothes washers in the resident's home, it does not model common area clothes washers. As shown in Table A-32, this measure was modeled for both electric (RCW) and gas (RCW_G) water heating scenarios for a wide range of MEF values. The incremental savings for clothes washers was determined using the RASS average housing segment wash cycles and the DOE energy star calculator.

Table A-32: High Efficiency Clothes Washer ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Elec	RCW	R_CW_MEF1.04	Clothes Washer - Elec Water Heat MEF=1.04, 2.65 Capacity
Water Heaters	Elec	RCW	R_CW_MEF1.26	Clothes Washer - Elec Water Heat MEF=1.26, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Elec	RCW	R_CW_MEF1.60	Clothes Washer - Elec Water Heat MEF=1.60, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Elec	RCW	R_CW_MEF1.80	Clothes Washer - Elec Water Heat MEF=1.80, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Elec	RCW	R_CW_MEF2.0	Clothes Washer - Elec Water Heat MEF=2.0, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Elec	RCW	R_CW_MEF2.2	Clothes Washer - Elec Water Heat MEF=2.2, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Gas	RCW_G	R_CW_MEF1.04_G	Clothes Washer - Gas Water Heat & Dry, 2.65 Capacity MEF=1.04
Water Heaters	Gas	RCW_G	R_CW_MEF1.26_G	Clothes Washer - Gas Water Heater & Dry, MEF=1.26, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Gas	RCW_G	R_CW_MEF1.60_G	Clothes Washer - Gas Water Heater & Dry, MEF=1.60, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Gas	RCW_G	R_CW_MEF1.80_G	Clothes Washer - Gas Water Heater & Dry, MEF=1.80, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Gas	RCW_G	R_CW_MEF2.0_G	Clothes Washer - Gas Water Heater & Dry, MEF=2.0, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily
Water Heaters	Gas	RCW_G	R_CW_MEF2.2_G	Clothes Washer - Gas Water Heater & Dry, MEF=2.2, 3.5 Capacity for Single family and 2.65 Capacity for Multifamily

High Efficiency Dishwashers. This measure is modeled as a ROB decision. ASSET model measure identifiers are presented in Table A-33. ENERGY STAR-labeled dishwashers save energy via improved technology for the primary wash cycle, and by using less hot water. They include more effective washing action, energy efficient motors, and other advanced technology such as sensors that determine the length of the wash cycle and the temperature of the water necessary to clean the dishes. The baseline Energy Factor (EF) consistent with Title 20/NAECA is 0.46 EF for standard size dishwashers. High efficiency dishwashers range from 0.58 to 0.68 EF. As shown in Table A-33, this measure was modeled for both electric (RDW) and gas (RDW_G) water heating scenarios for a wide range of EF values. For the ASSET analysis, the incremental savings were determined using the RASS average cycles per housing segment and the DOE energy star calculator. The approach customizes the energy star savings to California usage patterns.

Table A-33: High Efficiency Dishwashers ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Water Heaters	Elec	RDW	R_DW_EF0.46	Dishwasher - Elec Water Heat, EF=0.46
Water Heaters	Elec	RDW	R_DW_EF0.58	Dishwasher - Elec Water Heat, EF=0.58
Water Heaters	Elec	RDW	R_DW_EF0.62	Dishwasher - Elec Water Heat, EF=0.62
Water Heaters	Elec	RDW	R_DW_EF0.68	Dishwasher - Elec Water Heat, EF=0.68
Water Heaters	Both	RDW_G	R_DW_EF0.46_G	Dishwasher - Gas Water Heat, EF=0.46
Water Heaters	Both	RDW_G	R_DW_EF0.58_G	Dishwasher - Gas Water Heater, EF=0.58
Water Heaters	Both	RDW_G	R_DW_EF0.62_G	Dishwasher - Gas Water Heater, EF=0.62
Water Heaters	Both	RDW_G	R_DW_EF0.68_G	Dishwasher - Gas Water Heater, EF=0.68

Miscellaneous Equipment Measures

Residential miscellaneous equipment measures are refrigerators, refrigerator recycling, and pool pumps.

ENERGY STAR Refrigerators. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-34. ENERGY STAR refrigerators must exceed the July 1, 2001 Title 20/NAECA minimum standards for refrigerator energy consumption by at least 15%. Refrigerator/freezer efficiency is improved through component improvements such as increased cabinet insulation, compressor efficiency, evaporator fan efficiency, defrost controls, oversized condenser coils, and improved door seals. The incremental savings used in the ASSET analysis are the DEER values associated with a side-by-side refrigerator without ice in the door.

Table A-34: ENERGY STAR Refrigerators ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Misc.	Elec	RREF	R_REF_Base	Refrigerator – Base
Misc.	Elec	RREF	R_REF_ES	Refrigerator – ENERGY STAR

Refrigerator and Freezer Recycling. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-35. For this analysis, all refrigerators and freezers are eligible for recycling. The assumed savings from a recycled refrigerator begins at 1,776 kWh and declines yearly by 4%. The assumed savings from a recycled freezer begins at 1,406 kWh and declines yearly by 4%. The starting savings assumptions are derived from an ongoing analysis of the 04/05 recycling program. The yearly reductions are consistent with the reduction in savings from the previous analysis when compared to those from the 04/05 analysis. The reduction in yearly savings is consistent with improvements in refrigerators.

Table A-35: Refrigerator\Freezer Recycling ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Misc.	Elec	RRRCY	R_REF_Recyl	Refrigerator Recycling
Misc.	Elec	RFRCY	R_FRZ_Recyl	Freezer Recycling

Pool Pump and Motor. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-36. This measure involves the replacement of a standard efficiency single speed pool pump and motor with either a new premium efficiency motor single or two speed pump[1]. New efficient pumps and motors have high efficiency capacitor start, capacitor run motors, high efficiency permanent split capacitor motors, and newer closed face impeller pumps. For the ASSET analysis, the recent code changes change the base pool pump from a one speed pump to a two speed pump in 2008.

Table A-36: Pool Pumps and Motors ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description
Misc.	Elec	R_POOL	R_1SpeedPP_Base	Pool Pump
Misc.	Elec	R_POOL	R_1SpeedPP	Efficient Single-Speed Pool Pump, 1 hp
Misc.	Elec	R_POOL	R_2SpeedPP	Efficient Two-Speed Pool Pump

1 As of January 1, 2008 Title 20/NAECA standards in require pool pumps with a capacity of 1 hp or more to have the capability of operating at two or more speeds.

A.3 Commercial Measures

Commercial lighting, HVAC, water heating, food service, refrigeration, and miscellaneous measures such as pool heaters are included in this study. A few of the measures are also classified as "current emerging technologies" (CETs). These measures are currently available in the market, but are new to the marketplace. These technologies are associated with a higher level of uncertainty associated with their performance, costs, and the likelihood of consumer acceptance of the measures. The study did not attempt to analyze the potential associated with a broad list of emerging technologies.

For each commercial measure (or measure group) in the study, a brief description of the measure and the relevant ASSET model measure identifiers is provided in this section. A complete list of all the commercial measures is provided in section A.5.

Lighting Measures

The commercial lighting measures examined in this study include a variety of CFL configurations, T8/T5 linear fluorescent, HIDs, lighting controls, and LED lighting. Lighting impacts were usually determined using a delta watts calculation with CEUS runtimes by building type.

Compact Fluorescent Measures

Screw-In Compact Fluorescent Lamps (CFLs). This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-37. Screw-in CFLs replace standard incandescent medium-base lamps. Three CFL wattage ranges were used for the current analysis: <16W, 16 to 24W, and >24W. The assumed baseline incandescent wattage for each competition group is reflected in Table A-37. For the ASSET analysis, the impacts used were chosen to reflect delta wattage calculations with run time assumptions derived from the CEUS operating hours by business type.

Table A-37: Screw-In CFL ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	Inc1	C_INC_Under61W	Incandescent Bulb less than 61 watts
Lights	Elec	Inc1	C_CFL_Under15W	Screw-in CFL less than 16 watts
Lights	Elec	Inc2	C_INC_61_to_99W	Incandescent Bulb 60-99 watts
Lights	Elec	Inc2	C_CFL_16_24W	Screw-in CFL 16-24 watts
Lights	Elec	Inc3	C_INC_100_to_150W	Incandescent Bulb 100-150 watts
Lights	Elec	Inc3	C_CFL_Over24W	Screw-in CFL greater than 24 watts

Hard-wired CFL Fixtures. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-38. CFL fixtures can replace standard incandescent lamp or other lower-efficacy lighting fixtures. Three CFL wattage ranges were used for the current analysis: <16W, 16 to 24W, and >24W. The assumed baseline incandescent wattage for each competition group is reflected in Table A-38. For the ASSET analysis, the impacts used were chosen to reflect delta wattage calculations with run time assumptions derived from the CEUS operating hours by business type.

Table A-38: Hard-wired CFL Fixture ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	IncFix1	C_INC_Fixture_Under61W	Fixture, Incandescent Bulb less than 61 watts
Lights	Elec	IncFix1	C_CFL_Fixture_Under15W	Fixture, Pin based CFL less than 16 watts
Lights	Elec	IncFix2	C_INC_Fixture_61_to_99W	Fixture, Incandescent Bulb 60-99 watts
Lights	Elec	IncFix2	C_CFL_Fixture_16_24W	Fixture, Pin based CFL 16-24 watts
Lights	Elec	IncFix3	C_INC_Fixture_100_to_150W	Fixture, Incandescent Bulb 100-150 watts
Lights	Elec	IncFix3	C_CFL_Fixture_Over24W	Fixture, Pin based CFL greater than 24 watts

CFL Reflectors. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-39. The most common commercial CFL reflector lamp is a BR30/R30. The R30/BR30 CFL lamps use 11-16W and R30 incandescent lamps use 65-75W. For the analysis, the incremental costs were derived from the market share tracking study and the incremental savings were determined using delta watts and CEUS building type specific run times.

Table A-39: CFL Reflector ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	IncRefl	C_Reflector_INC	Incandescent reflector
Lights	Elec	IncRefl	C_Reflector_CFL	CFL reflector

T8/T5 Linear Fluorescent Measures

4ft and 8 ft T12 to T8 Lamps. This measure is modeled as a CON decision type with automatic replacement. Automatic replacement assumes that, at the end of the measure's useful life, T8s are replace automatically with T8s and that the replacement bulbs are not eligible for a utility rebate. ASSET model measure identifiers are presented in Table A-40.

This measure is one-for-one lamp conversion of T12 fixtures to T8 fixtures. Two efficiency levels are modeled for both lamp lengths; standard T8s and reduced watt T8s. The 4ft lamp measure is modeled with a baseline 2-lamp 40W, magnetic ballast, T12 fixture and the high-efficiency options are electronic ballast 32W or 28W (reduced watt) T8s. The 8ft lamp measure is modeled with a baseline 1-lamp 60W, magnetic ballast, T12 fixture and the high-efficiency options are electronic ballast 59W or 55W (reduced watt) T8s. The incremental savings are calculated using a delta watt approach with run time assumptions derived from CEUS.

Table A-40: T12-to-T8 Conversion ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	T12T8_4Ft	C_T12_Fixture_4Ft	T12 fixture, 4 ft, 2 lamp
Lights	Elec	T12T8_4Ft	C_T8_Fixture_4Ft	T8 Fixture, 4 ft 2 lamp
Lights	Elec	T12T8_4Ft	C_T8_2G_4Ft	Second generation T8, 4ft, 2 lamp
Lights	Elec	T12T8_8Ft	C_T12_Fixture_8Ft	T12 fixture, 8 ft, 1 lamp
Lights	Elec	T12T8_8Ft	C_T8_Fixture_8Ft	T8 Fixture, 8 ft 1 lamp
Lights	Elec	T12T8_8Ft	C_T8_2G_8Ft	Second generation T8, 8 ft, 1 lamp

T12-toT8 Conversion plus De-Lamping. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-41. Due to the higher lumen output of T8s versus T12s, an approximately equivalent lumen level can be achieved with fewer T8 lamps, although a slight lumen reduction may result. For the 4ft delamping measure, a 4-lamp 40W T12 fixture was converted to a 2-lamp 32W T8 fixture. For the 8ft delamping measure, a 2-lamp 60W T12 fixture was converted to a 1-lamp 86W T8HO fixture.

Table A-41: T12-to-T8 w/Delamping ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	T12Delamp4FT	C_T12_Delamping_4Ft	Delamping 4 Ft T12 to T8
Lights	Elec	T12Delamp8FT	C_T12_Delamping_8Ft	Delamping 8 Ft T12 to T8

Interior High Bay T8/T5HO Fluorescent Fixture. This measure is modeled as a CON decision type. ASSET model measure identifiers are presented in Table A-42. Traditional interior high bay lighting systems use high wattage incandescent or high intensity discharge (HID) lamps such as mercury vapor or metal halide. This measure replaces the traditional high wattage fixtures with new four- lamp 4ft T5HO fixtures.

Table A-42: High Bay T8/T5HO ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	HighBayT8	C_MV_HighBay	High Bay Mercury Vapor (Over 14 ft)
Lights	Elec	HighBayT8	C_T8_HighBay	High Bay T8 or T5 (Over 14 ft)

Lighting Control Measures

Plug Load Occupancy Sensors. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-43. This device saves energy by turning off desktop equipment when a space is unoccupied. The measure is essentially a power strip linked to a remote occupancy sensor which controls a majority of the outlets (some outlets are uncontrolled for devices that must always have power).

Table A-43: Plug Load Occupancy Sensor ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	OCCPL	C_OCCSensor_Plugload	Plug load motion sensor

Area Lighting Occupancy Sensors (Motion Sensor). This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-44. Occupancy sensors sense the presence of a person in a space and are used to control the area lighting in the space. Configurations include wall-box, wall-or-ceiling mounted, or (fixture/ballast) integrated sensors. Only passive-infrared or ultrasonic motion detection devices are accepted by IOU rebate programs.

Table A-44: Area Lighting Occupancy Sensor ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	OCC1	C_OCCSensor_Motion	Motion sensor

Daylighting with Dimmable Ballast. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-45. Dimmable electronic ballasts are incorporated into a daylighting strategy around the perimeter of office buildings or in areas under skylights. These systems use photocells to reduce power consumption and light output when daylight is available. Dimming electronic ballasts were assumed to be applicable to areas under skylights and to the perimeter of buildings with more than 20% glass wall area.

Table A-45: Daylighting w/Dimmable Ballast ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	DL1	C_Lt_DLInst	Daylighting with dimmable ballast

Outdoor Lighting Controls (Photocells and Time Clocks). This measure is modeled as a CON decision type. ASSET model measure identifiers are presented in Table A-46. Photocells can be used to ensure that outdoor lamps turn on only when they are needed. Photocell control can save energy in situations where outside lighting is left on more hours than dawn-to-dusk. When outdoor lights do not need to be on all night, outdoor lighting operation can be further reduced by using a photocell in series with a time clock (photocell/timeclock). This configuration provides maximum savings and eliminates the need for manual operation and seasonal time clock adjustments. The three possible control configurations are represented in Table A-46: photocell control, timeclock control, and photocell/timeclock control.

Table A-46: Outdoor Lighting Control ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	ExtLTCtrl	C_LT_PCNoCtrl	No exterior lighting control
Lights	Elec	ExtLTCtrl	C_LT_PCPC	Photo cell exterior lighting control
Lights	Elec	ExtLTCtrl	C_LT_PCTC	Time clock exterior lighting control
Lights	Elec	ExtLTCtrl	C_LT_PCPT	Photo cell and time clock exterior lighting control

HID Lighting Measures

Pulse Start High Intensity Discharge (HID) Fixtures**.** This measure is modeled as a CON decision type. ASSET model measure identifiers for interior fixtures are presented in Table A-47 and for exterior fixtures in Table A-48. This measure is replacement of either incandescent lamps or mercury vapor lamps with pulse start HIDs. Pulse start HIDs include pulse start metal halide (PSMH) and high pressure sodium lamps. Both indoor and outdoor applications were considered, although high pressure sodium lamps are primarily found outdoors. For the ASSET analysis, this measure was modeled as three competition groups, one with incandescent lamps as the base (identifiers end with “i”) and the other two with mercury vapor lamps as the base (identifiers end with “mv”). The incremental savings were derived using a delta watt and run time approach by building type.

Table A-47: Interior Pulse-Start HID Fixture ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	INTHID1i	C_INC_150_to_500W_Int	Interior Incandescent 150-500 watts
Lights	Elec	INTHID1i	C_PSMH_Under151W_Int_INC	Interior Pulse Start Metal Halide under 151 watts
Lights	Elec	INTHID1mv	C_MV_Under301W_Int	Interior Mercury Vapor under 301 watts
Lights	Elec	INTHID1mv	C_PSMH_Under151W_Int_MV	Interior Pulse Start Metal Halide under 151 watts
Lights	Elec	INTHID2mv	C_MV_Over300W_Int	Interior Mercury Vapor over 300 watts
Lights	Elec	INTHID2mv	C_PSMH_Over150W_Int	Interior Pulse Start Metal Halide over 150 watts

Table A-48: Exterior Pulse-Start HID Fixture ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	EXTHID1i	C_INC_150_to_500W_Ext	Exterior Incandescent 150-500 watts
Lights	Elec	EXTHID1i	C_PSMH_Under151W_Ext_INC	Exterior Pulse Start Metal Halide under 151 watts
Lights	Elec	EXTHID1mv	C_MV_Under301W_Ext	Exterior Mercury Vapor under 301 watts
Lights	Elec	EXTHID1mv	C_PSMH_Under151W_Ext_MV	Exterior Pulse Start Metal Halide under 151 watts
Lights	Elec	EXTHID2mv	C_MV_Over300W_Ext	Exterior Mercury Vapor over 300 watts
Lights	Elec	EXTHID2mv	C_PSMH_Over150W_Ext	Exterior Pulse Start Metal Halide over 150 watts

LED Lighting Measures

LED Exit Signs. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-49. Light Emitting Diode (LED) exit signs offer significant savings over traditional incandescent bulb-based exit signs and even over CFL-based exit signs. The baseline exit sign uses 2-20W incandescent bulbs. LED exit signs were assumed to be 5W.

Table A-49: LED Exit Sign ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	Exit1	C_LT_EXLED	LED Exit Sign

LED Channel Signs. This measure is modeled as a CON decision type. ASSET model measure identifiers are presented in Table A-50. LED channel signs can replace conventional neon or incandescent channel letter signs. The signs can be used outdoor or indoors. IOU programs specify that the replacement sign can not use more than 20% of the baseline lamp watts.

Table A-50: LED Channel Sign ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Lights	Elec	Signs	C_NeonSignage	Neon Signs
Lights	Elec	Signs	C_LEDSignage	LED Signs

HVAC Measures (including Building Shell)

HVAC measures include space cooling, space heating, and HVAC motor measures. Building shell measures are also included in this end use category due to the HVAC interactions. Impacts used for the ASSET analysis were obtained from a variety of sources including DEER, utility workpapers, EM&V reports, and previous energy efficiency potential studies.

Space Cooling Measures

High-Efficiency Packaged Air Conditioning System. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-51. Commercial central air conditioners are typically unitary (all components housed in a factory-built assembly) rooftop units, but can also be split-systems (an outdoor condenser section and an indoor evaporator section). These are ducted systems and usually incorporate a heating source (typically gas or heat pump but can be electric furnace).

As shown in Table A-51, two cooling size categories were modeled; less than 65 kBtuh (C_HV_Paclt65) which is SEER-rated equipment and >= 65 kBtuh (C_HV_Pacgt65) which is EER-rated equipment. For the SEER-rated equipment, in the beginning of the analysis period (2005) the base system is a 10 SEER unit and the higher efficiency units modeled are SEER 13 and SEER 15 units, including duct sealing as required by the 2005 Standards. In 2007, the base unit is updated to the 13 SEER and the only modeled higher efficiency unit is a 15 SEER. Incremental costs and savings were derived from building type and climate zone specific DEER values.

Table A-51: High-Efficiency Package A/C ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_Paclt65	C_HV_PAClt65_10	Packaged A/C (<65k 10 SEER)
HVAC	Elec	C_HV_Paclt65	C_HV_PAClt65_13	Packaged A/C (<65k 13 SEER)
HVAC	Elec	C_HV_Paclt65	C_HV_PAClt65_15	Packaged A/C (<65k 15 SEER)
HVAC	Elec	C_HV_Pacgt65	C_HV_PACgt65_10	Packaged A/C (>=65k 10 EER)
HVAC	Elec	C_HV_Pacgt65	C_HV_PACgt65_11	Packaged A/C (>=65k 11 EER)
HVAC	Elec	C_HV_Pacgt65	C_HV_PACgt65_12	Packaged A/C (>=65k 12 EER)

Package A/C Tune-Up. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-52. This measure is used to model refrigerant charge and air flow (RCA) and other "tune-up" measures for commercial package units. There is considerable uncertainty concerning the average level of savings achieved from RCA. In addition, commercial RCA is not currently included in the 2005 DEER. To determine costs and savings, Itron examined assumptions in the utility working papers. This analysis led the group to apply a systematic reduction to the utility climate zone specific RAC values.

Table A-52: Package A/C Tune-Up ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_PkgAC_Tuneup	C_HV_PkgAC_Tuneup	Package AC/DX Tune Up

High-Efficiency Packaged Terminal Heat Pump or Air Conditioning Units. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-53. Packaged terminal heat pump or air conditioning units are typically through-the-wall, self-contained units that are two tons or less in size. Heat pump units are more common, especially for lodging applications. This measure involves installation of a high efficiency unit that has an EER about 20% higher. The A/C-only and HP units are modeled as separate competition groups. For the ASSET analysis, the incremental costs and savings were derived from a combination of the DEER database and utility working papers.

Table A-53: High-Efficiency PTAC/PTHP ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_PTAC	C_HV_PTAC_Base	PTAC (< 9 EER)
HVAC	Elec	C_HV_PTAC	C_HV_PTAC_HE	PTAC (> 9 EER)
HVAC	Elec	C_HV_PTHP	C_HV_PTHP_Base	PTHP (9 EER)
HVAC	Elec	C_HV_PTHP	C_HV_PTHP_HE	PTHP 10 EER & 3 COP

Efficient Centrifugal Chiller. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-54. Centrifugal chillers are typically greater than 200 tons and are water-cooled (i.e. reject heat through a cooling tower). In general, efficiency levels for centrifugal chillers start at 0.80 kW/ton (for older units) and may go as high as 0.4 kW/ton. This measure involves installation of a high efficiency chiller (0.51 kW per ton) versus a standard unit (0.75 kW per ton).For the ASSET analysis, the incremental costs and savings were derived from the DEER database.

Table A-54: Efficient Centrifugal Chiller ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_ChillerCent	C_HV_ChCent_Base	Base Centrifugal Chiller
HVAC	Elec	C_HV_ChillerCent	C_HV_ChCent_HE	High-Efficiency Centrifugal Chiller

Efficient Reciprocating Chiller. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-55. Reciprocating chillers are typically less than 200 tons and are air-cooled (i.e. reject heat through an air-cooled condenser). This measure involves installation of a high efficiency chiller (1.008 kW per ton) versus a standard unit (1.3 kW per ton. The incremental savings and costs were derived from the DEER database.

Table A-55: Efficient Reciprocating Chiller ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_ChillerRecip	C_HV_ChRec_Base	Reciprocating Chillers Base
HVAC	Elec	C_HV_ChillerRecip	C_HV_ChRec_HE	Reciprocating Chillers

Chiller and Ventilation System Retro-Commissioning (RCx). These measures are modeled as RET decision types. ASSET model measure identifiers are presented in Table A-56. Retro-commissioning (RCx) is the act of optimizing the operation of an existing building's

HVAC, lighting, and related control systems. The per-unit costs and savings for this measure are highly variable in actual implementations. In addition, some of the measures encompassed by RCx are already discretely modeled. For example, only chiller and ventilation RCx was modeled under this measure, since lighting RCx would overlap with the other lighting control measures. As such, this study attempted to provide an aggregate, average estimate of the savings and costs for this measure that is incremental to measures already analyzed separately within the study. The claimed savings for this measure from various utility programs were examined, and the representative per unit savings decreased to eliminate the double counting of potential.

Table A-56: Retro-Commissioning ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_Retro_Vent	C_HV_Retro_Vent	Retro-commissioning
HVAC	Elec	C_HV_Retro_Chiller	C_HV_Retro_Chiller	Electric Chiller Retro-commissioning

Space Heating Measures

High-Efficiency Space Heating Gas Boiler. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-57. High efficiency, non-condensing, space heating boilers have AFUEs of 85% compared to a base efficiency of 80%. New high efficiency condensing boilers incorporate such features as power burners, electronic spark ignition, or vent dampers to increase their AFUE. A 95% AFUE unit was modeled as the highest efficiency, current emerging technology unit. For the analysis, the incremental measure costs and savings for the AFUE 85% boiler were derived from the DEER database.

Table A-57: HE Space Heating Boiler ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Gas	C_HV_Boiler	C_HV_Boiler_80	Gas Space Heating Boilers 80%
HVAC	Gas	C_HV_Boiler	C_HV_Boiler_85	Gas Space Heating Boilers 85%
HVAC	Gas	C_HV_Boiler	C_HV_Boiler_95_CET	Gas Space Heating Boilers 95% - current emerging tech

High-Efficiency Gas Furnace. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-58. Standard efficiency natural gas furnaces have an Annual Fuel Use Efficiency (AFUEs) of 78% as regulated by Title 20/NAECA standards, although standard-practice is 80% AFUE. Efficiency is dependent on vent type, burner type, furnace type (conventional or condensing), and fan control type. The AFUE for the base unit is 80% (to reflect standard-practice) and the minimum AFUEs for the energy efficient units are 92%, 94% as reflected in the TechID and Measure Description fields of Table A-58. For the ASSET analysis, the incremental costs and savings were derived from DEER.

Table A-58: HE Gas Furnace ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Gas	C_HV_Furnace	C_HV_Furn_AFUE80	Gas Furnace Base - AFUE 80
HVAC	Gas	C_HV_Furnace	C_HV_Furn_AFUE92	HE Gas Furnace - AFUE 92
HVAC	Gas	C_HV_Furnace	C_HV_Furn_AFUE94	Condensing Gas Furnace - AFUE 94

HVAC Motor Measures

Premium-Efficiency HVAC Fan Motors. This measure is modeled as an ROB decision type. ASSET model measure identifiers for the four motor size ranges that were modeled are presented in Table A-59. The measure is replacement of a standard-efficiency HVAC ventilation fan motor with a NEMA premium-efficiency motor. The motor savings used in the ASSET analysis are derived from utility workpapers.

Table A-59: Premium-Efficiency HVAC Fan Motor ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_Motor_0-10	C_HV_Motor_0-10_Base	0-10 hp Vent Motor BaseEff
HVAC	Elec	C_HV_Motor_0-10	C_HV_Motor_0-10	0-10 hp Vent Motor PremEff
HVAC	Elec	C_HV_Motor_11-25	C_HV_Motor_11-25_Base	11-25 hp Vent Motor BaseEff
HVAC	Elec	C_HV_Motor_11-25	C_HV_Motor_11-25	11-25 hp Vent Motor PremEff
HVAC	Elec	C_HV_Motor_26-49	C_HV_Motor_26-49_Base	26-49 hp Vent Motor BaseEff
HVAC	Elec	C_HV_Motor_26-49	C_HV_Motor_26-49	26-49 hp Vent Motor PremEff
HVAC	Elec	C_HV_Motor_50+	C_HV_Motor_50+_Base	50+ hp Vent Motor BaseEff
HVAC	Elec	C_HV_Motor_50+	C_HV_Motor_50+	50+ hp Vent Motor PremEff

VSD for VAV Systems. This measure is modeled as a RET decision type. ASSET model measure identifiers for the three motor size ranges that were modeled are presented in Table A-60. Energy usage in HVAC VAV systems can be reduced by installing electronic variable frequency drives (VFDs) on ventilation fans controlled by less efficient means such as throttling valves, inlet vanes, or bypass dampers. The energy required to operate a fan motor can be reduced as much as 85% during reduced load conditions by installing a VFD. Utility rebates cover fan motors up to 100 hp. For the ASSET analysis, the incremental costs and savings are derived from DEER.

Table A-60: VSD for VAV Systems ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_VSD_Motor_10-25	C_HV_VSD_Motor_10-25	10-25 hp VSD for VAV System
HVAC	Elec	C_HV_VSD_Motor_26-49	C_HV_VSD_Motor_26-49	26-49 hp VSD for VAV System
HVAC	Elec	C_HV_VSD_Motor_50-100	C_HV_VSD_Motor_50-100	50-100 hp VSD for VAV System

VSD Chilled Water Circulation Pumps. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented Table A-61. Variable speed drives installed on chilled water pumps can reduce energy use by varying the pump speed according to the building's demand for cooling. There is also a reduction in piping losses associated with this measure, which can have a major impact on the heating loads and energy use for a building. Pump speeds, however, can generally only be reduced to a minimum specified rate, because chillers and the control valves may require a minimum flow rate to operate. For the ASSET analysis, the incremental costs and savings were derived DEER.

Table A-61: VSD Chiller Water Pumps ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_ChillerAux	C_HV_ChillerAux	VSD Chilled Water Loop Pumps

<u>Building Shell Measures</u>

Reflective Window Film. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-62. Reflective window film is an effective way to reduce solar energy gains into a conditioned space, thus reducing mechanical cooling energy consumption. For the ASSET analysis, the incremental costs and savings were derived from DEER.

Table A-62: Reflective Window Film ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_Shell_WindFilm	C_HV_WindowFilm	Window Film

Cool Roof. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-63. A cool roof reflects a larger portion of the solar radiation than the typical darker-colored roof, which will lower the plenum/attic temperature (where the ducts can typically be located) and reduce the space cooling load. For the ASSET analysis, the incremental costs and savings were derived from DEER.

Table A-63: Cool Roof ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
HVAC	Elec	C_HV_Shell_CoolRoof	C_HV_CoolRoof	Cool Roofs

Water Heating Measures

Water heating measures include high efficiency storage water heaters, point of use water heaters, solar water heaters, and commercial high efficiency clothes washers.

High-Efficiency Gas Water Heater. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-64. Efficient gas water heaters consist of a high efficiency natural gas storage-type hot water heater and tank. Many small commercial buildings and even some large commercial buildings use residential-sized water heaters to meet their needs for hand washing in restrooms or janitorial purposes (i.e., small office, small retail, supermarket, warehouse). Instantaneous water heaters are also available. Unlike storage water heaters, tankless or instantaneous water heaters heat water only as it is used, or on demand. A tankless unit has a heating device that is activated by the flow of water when a hot water valve is opened. Once activated, the heater delivers a constant supply of hot water. The output of the heater, however, limits the rate of the heated water flow. For ASSET, the incremental costs and energy savings are derived from DEER.

Table A-64: HE Gas Water Heater ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
WH	Gas	C_WH_WaterHeater	C_WH_Storage_Base	Gas Storage Water Heater – Base
WH	Gas	C_WH_WaterHeater	C_WH_Storage_HE	Gas Storage Water Heater - HE (EF>=0.86)
WH	Gas	C_WH_WaterHeater	C_WH_Instant	Instantaneous Water Heater – Gas

Solar (assisted) Water Heater. This measure is modeled as an RET decision type. ASSET model measure identifiers are presented in Table A-65. Solar-assisted water heaters consist of a solar collector and a back-up storage water heater. Water heated by the solar collector can be used immediately or stored for later use. There are many possible design configurations for solar water heaters, which make this a difficult measure to model. For example, hot water circulation can be either passive (no pumps) or active (pumps and controls), and there are many possible pump/control schemes. In addition, the system can be direct (potable water circulated directly through the collector) or indirect (fluid in the collector is antifreeze and a heat exchanger is used to transfer heat to the water). As shown in Table A-65, this measure was modeled only for gas-fired back-up water heaters.

Table A-65: Solar Water Heater ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
WH	Gas	C_WH_SolarWH	C_WH_Storage_Solar	Solar Water Heating back-up for Gas Storage Water Heater

Service Hot Water (SHW) Gas Boiler. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-66. The efficiency of a service hot water (SHW) boiler is specified as the annual fuel utilization efficiency (AFUE), and minimum efficiencies are regulated by Title 20/NAECA standards. The high efficiency, non-condensing, service hot water (SHW) boilers have AFUEs of 85% compared to a base efficiency of 80%. New high efficiency condensing boilers incorporate such features as power burners, electronic spark ignition, or vent dampers to increase their AFUE. A 95% AFUE unit was modeled as the highest efficiency, current emerging technology unit. For the ASSET analysis, the incremental savings are derived from the claimed utility savings.

Table A-66: SHW Gas Boiler ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
WH	Gas	C_WH_Boiler	C_WH_Boiler_80	Gas Water Heating Boiler - Base 80
WH	Gas	C_WH_Boiler	C_WH_Boiler_85	Gas Water Heating Boiler - HE 85
WH	Gas	C_WH_Boiler	C_WH_Boiler_95_CET	Gas Water Heating Boiler - HE 95 – CET

***SHW Circulation Pump Time Clock Retrofit*.** This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-67. Installing a time clock on the circulation pump for the service hot water system can reduce demand during periods when the building is unoccupied. For the ASSET analysis, the incremental costs and savings were derived from DEER.

Table A-67: SHW Circulation Pump Control ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
WH	Gas	C_WH_CircCtrl	C_WH_CircTimer	Water Heater Setback Gas

Commercial Horizontal Axis Clothes Washer. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-68. A horizontal axis clothes washer uses a drum that rotates horizontally to wash, rinse, and spin the clothes. These types of washing machines are typically front-loading but can also be top loading, and uses significantly less water (hot and cold) than the standard vertical axis machines. A vertical axis machine generally fills the tub until all of the clothes are immersed in water. In contrast, the horizontal axis machine only requires about one-third of the tub to be full, since the rotation of the drum around its axis forces the clothes into the water. These machines are also easier on clothes and use less detergent.

Table A-68: Commercial Clothes Washer ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
WH	Gas	C_WH_Washer	C_ClothesWasher_Base	Commercial Clothes Washer - Base (Gas)
WH	Gas	C_WH_Washer	C_ClothesWasher_HE	Commercial Clothes Washer - HE (Gas)

Food Service Equipment Measures

The measures included in this end use group are those measures typically offered by the IOUs as commercial/institutional food service programs. An extensive list of food service equipment is covered including convection ovens, combination ovens, fryers, griddles, holding cabinets, pressureless steamers, ice makers, and self-contained solid-door or glass-door refrigerator/freezers. Technical specifications, rebate forms, test results, and lists of certified equipment that meet the measure performance criteria are maintained on www.fishnick.com and also by ENERGY STAR for applicable measures. Impacts and costs used for the ASSET analysis were primarily derived from the food service workpapers developed by Fisher-Nickel.

A complete list of the food service measures is available in section A.5. Brief measure descriptions and ASSET model measure identifiers for individual measures are presented below.

ENERGY STAR Fryers. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-69. This is an ENERGY STAR measure for both electric and gas fryers. The ENERGY STAR rating is applicable to regular open deep fat fryers, which typically have a 15-inch wide or narrower fry vat and a shortening capacity of less than 60 pounds. Energy efficiency is achieved primarily via additional insulation of the vat and advanced burner and heat exchanger design. For *electric fryers*, the cooking efficiency for the base unit is 75% and an ENERGY STAR unit is 80%. For *gas fryers*, the cooking efficiency for the base unit is 35% and an ENERGY STAR unit is 50%. An additional ENERGY STAR criteria is that the units must have minimum idle energy rates of 9 kBtuh for gas and 1000 watts for electric.

Large vat fryers, which are not covered by ENERGY STAR, are also included in the IOU programs. These fryers are rectangular vat, deep fat fryers with a vat width greater than 18-inches and a shortening capacity greater than 60 pounds. Typical large vat fryers come in 18, 20, 24, and 34-inch widths (18-inches is the most common width). As the cooking efficiency requirements are the same for both types of fryers, and it was not possible to distinguish between the two fryer types from the CEUS data, they were modeled as a single measure in the ASSET model.

Table A-69: ENERGY STAR Fryer ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_Fryer_Elec	C_Fryer_Elec_Base	Fryer (Electric) Base
Food	Elec	C_FD_Fryer_Elec	C_Fryer_Elec_ES	Fryer (Electric) EStar ≥80%
Food	Gas	C_FD_Fryer_Gas	C_Fryer_Gas_Base	Fryer (Gas) Base
Food	Gas	C_FD_Fryer_Gas	C_Fryer_Gas_ES	Fryer (Gas) EStar ≥50%

Griddles. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-70. Both electric and gas griddles are available, but gas griddles are the predominant technology (about 75%). Energy efficiency is achieved primarily via features such as advanced burner or heating element design, cooking surface treatment (chrome cooking surface), and increased insulation. For *electric griddles*, the cooking efficiency for the base unit is 65% and the energy efficient unit is 70%. For *gas griddles*, the cooking efficiency for the base unit is 32% and the energy efficient unit is 38%.

Table A-70: Griddle ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_Griddle_Elec	C_Griddle_Elec_Base	Griddle (Electric) Base
Food	Elec	C_FD_Griddle_Elec	C_Griddle_Elec_HE	Griddle (Electric) HE ≥70%
Food	Gas	C_FD_Griddle_Gas	C_Griddle_Gas_Base	Griddle (Gas) Base
Food	Gas	C_FD_Griddle_Gas	C_Griddle_Gas_HE	Griddle (Gas) HE ≥38%

Convection Oven. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-71. Convection ovens use a small fan to circulate hot air within the oven cavity, which heats food more effectively than a conventional oven. There are a vast number of variations of convection ovens in terms of size, technology, capacity, and type, which lends a high level of uncertainty to the energy and demand impacts for this measure. For *electric convection ovens*, the cooking efficiency for the base unit is 65% and the energy efficient unit is 70%. For *gas convection ovens*, the cooking efficiency for the base unit is 30% and the energy efficient unit is 40%.

Table A-71: Convection Oven ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_ConvecOven_Elec	C_Oven_Convec_Elec_Base	Convection Oven (Electric) Base
Food	Elec	C_FD_ConvecOven_Elec	C_Oven_Convec_Elec_HE	Convection Oven (Electric) HE ≥70%
Food	Gas	C_FD_ConvecOven_Gas	C_Oven_Convec_Gas_Base	Convection Oven (Gas) Base
Food	Gas	C_FD_ConvecOven_Gas	C_Oven_Convec_Gas_HE	Convection Oven (Gas) HE ≥40%

Combination Oven. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-72. A combination oven is a convection oven with the added capability of steam injection. The configuration variations are even more numerable than convection ovens due to different methods for producing steam, multiple operation modes (convection-only, steam-only, convection plus steam), multitude cavity sizes, shelf layouts, and control options. For *electric combination ovens*, the cooking efficiency for the base unit is 44% and the energy efficient unit is 60%. For *gas combination ovens*, the cooking efficiency for the base unit is 35% and the energy efficient unit is 40%.

Rack ovens, which are also included in the IOU programs, were also indirectly accounted for under this measure. The CEUS data did not distinguish between rack and combination ovens. Instead, these oven types would have been captured under the generic "Oven (in Range or standalone)" CEUS equipment category. As such, the potential for both of these measures was modeled by assuming that 10% of the oven population in this CEUS category were eligible for this measure, and the savings and costs for combination ovens were applied.

Table A-72: Combination Oven ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_Oven_Elec	C_Oven_Elec_Base	Combination Oven (Electric) Base
Food	Elec	C_FD_Oven_Elec	C_Oven_Elec_HE	Combination Oven (Electric) HE ≥60%
Food	Gas	C_FD_Oven_Gas	C_Oven_Gas_Base	Combination Oven (Gas) Base
Food	Gas	C_FD_Oven_Gas	C_Oven_Gas_HE	Combination Oven (Gas) HE ≥40%

Electric Holding Cabinets. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-73. Food holding cabinets are used to transport and/or temporarily store hot food. In addition to the energy savings, insulated cabinets radiate less heat into the kitchen, thus helping to keep the work environment more comfortable. Full-size, ¾ size, and ½ size solid-door, hot food units are rebated through the IOU programs. The efficiency basis for this equipment is the "maximum idle energy rate" or MIER. The base unit is an ENERGY STAR compliant unit with a MIER of 40 W per ft^3 (as specified by Title 20 effective January 1, 2006). The energy efficient unit MIER is 20 W per ft^3.

Table A-73: Holding Cabinet ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_HoldingCB_Elec	C_HoldCabinet_Elec_Base	Holding Cabinet (Electric) Base
Food	Elec	C_FD_HoldingCB_Elec	C_HoldCabinet_Elec_HE	Holding Cabinet (Electric) HE (<=20W/ft3)

ENERGY STAR Steam Cookers (Pressureless Steamers). This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-74. This is an ENERGY STAR measure for both electric and gas fuel types. Steam cookers are cabinets that have multiple drawers or "pans" in which steam is used as a fast-cooking option. Two-pan units are the most prevalent in the industry, but 3-, 4-, 5-, and 6-pan configurations are also used. The steam can be generated in two ways: from an external source in which case is it continually pushed through the cavity and drained away, or self-generated by a coil or burner within the cabinet, as with connectionless steamers which do not have drains. For *electric steam cookers*, the cooking efficiency for the base unit is 75% and an ENERGY STAR unit is 80%. For *gas steam cookers*, the cooking efficiency for the base unit is 15% and an ENERGY STAR unit is 38%. ENERGY STAR criteria also includes maximum idle energy rates for 3 to 6 pan configurations. The electric cooker energy/demand impacts are based on a 3-pan configuration and the gas cooker impacts are based on a 6-pan configuration.

Table A-74: ENERGY STAR Steam Cooker ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_Steamer_Elec	C_Steamer_Elec_Base	Pressureless Steamer (Electric) Base
Food	Elec	C_FD_Steamer_Elec	C_Steamer_Elec_ES	Pressureless Steamer (Electric) EStar ≥50%
Food	Gas	C_FD_Steamer_Gas	C_Steamer_Gas_Base	Pressureless Steamer (Gas) Base
Food	Gas	C_FD_Steamer_Gas	C_Steamer_Gas_ES	Pressureless Steamer (Gas) EStar ≥38%

Commercial Ice Machine. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-75. These are self-contained/packaged air-cooled units that produce the ice and maintain it in a storage bin. Energy efficiency is achieved by using thicker insulation and premium-efficiency condenser fan motors, as well as by reducing evaporator thermal cycling time. The ice production metric for ice machines is the "ice harvest rate" (IHR) and is expressed as lbs of ice produced per day (lbs/day). IOU rebate programs use seven IHR size ranges (101-200 lbs/day to >1500 lbs/day). The energy efficiency basis for ice machines is kWh per 100 lbs of ice (kWh/100 lbs). The impacts and savings for the 201-300 lbs/day IHR CEE Tier 2 unit was used for the ASSET analysis, as this appeared to be the most predominant type in the IOU quarterly reports. For this size ice maker, the base efficiency is 11 kWh/100 lbs and the energy efficient unit is 8.5 kWh/100 lbs. As of January 2008, the IOUs are now offering an additional category for this measure: Super Efficient CEE Tier 3.

Table A-75: Ice Machine ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_IceMaker	C_Ref_IceMaker_Base	Commercial Ice Machine Base
Food	Elec	C_FD_IceMaker	C_Ref_IceMaker_T2	Commercial Ice Machine Tier 2

Solid-Door Refrigerator/Freezer. This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-76. These are upright, self-contained, packaged cases that have solid-doors and can be either refrigerator or freezer units. Energy efficiency is achieved by employing energy-efficient motors for the compressors and fans, efficient lighting, and controls or technologies to reduce anti-sweat and defrost demands. The IOU programs rebate four configurations based on the number of sections and cavity size in ft^3. The energy efficiency basis for solid-door refrigerator/freezers is maximum daily energy use (kWh/day). The baseline system efficiency, governed by California Title 20, is an ENERGY STAR/CEE Tier 1 efficiency unit.

The impacts and savings for the "1-section: 19-30 ft^3" configuration were used for the ASSET analysis, as this was the most predominant type in the IOU 0405 filings. The IOU workpapers use a 24-ft^3 unit to represent this configuration. For a solid-door *refrigerator* in this size category, the IOU workpapers assume the base unit efficiency is 4.44 kWh/day and the energy efficient unit is 2.66 kWh/day (40% reduction). For a solid-door *freezer* in this size category, the IOU workpapers assume the base unit efficiency is 10.98 kWh/day and the energy efficient unit is 7.69 kWh/day (30% reduction).

Table A-76: Solid-Door Refrigerator/Freezer ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_SD_Refrig	C_Ref_SD_Refrig_Base	Solid-Door Reach-In Refrigerator Base
Food	Elec	C_FD_SD_Refrig	C_Ref_SD_Refrig_T2	Solid-Door Reach-In Refrigerator Tier 2
Food	Elec	C_FD_SD_Freezer	C_Ref_SD_Freezer_Base	Solid-Door Reach-In Freezer Base
Food	Elec	C_FD_SD_Freezer	C_Ref_SD_Freezer_T2	Solid-Door Reach-In Freezer Tier 2

Glass-Door Refrigerators (Merchandisers). This measure is modeled as an ROB decision. ASSET model measure identifiers are presented in Table A-77. These are upright, self-contained/packaged refrigerated cases that have glass-doors. The most typical configuration is a glass-door merchandiser that is stocked with beverages. Energy efficiency can be achieved by employing energy-efficient motors for the compressors and fans, efficient lighting, and controls or technologies to reduce anti-sweat and defrost demands. The IOU programs rebate four configurations based on the number of sections and cavity size in ft^3. The energy efficiency basis for glass-door refrigerators is maximum daily energy use (kWh/day). The baseline system efficiency, governed by California Title 20, is an ENERGY STAR/CEE Tier 1 efficiency unit.

The impacts and savings for the "1-section: 19-30 ft^3" configuration were used for the ASSET analysis, as this was the most predominant type in the IOU 0405 filings. The IOU workpapers use a 24 ft^3 unit to represent this configuration. For a glass-door *refrigerator* in this size category, the IOU workpapers assume the base unit efficiency is 8.90 kWh/day and the energy efficient unit is 4.45 kWh/day (50% reduction).

Table A-77: Glass-Door Refrigerator ASSET Model Measure Identifiers

End Use	Fuel	Competition Group ID	Tech ID	Measure Description
Food	Elec	C_FD_GD_Refrig	C_Ref_GD_Refrig_Base	Glass-Door Reach-In Refrigerator Base
Food	Elec	C_FD_GD_Refrig	C_Ref_GD_Refrig_T2	Glass-Door Reach-In Refrigerator Tier 2

Refrigeration Measures

Refrigeration measures include infiltration reduction, display case and walk-in component, and compressor/condenser system measures. Impacts used for the ASSET analysis were obtained from a variety of sources including DEER, utility workpapers, EM&V reports, and previous energy efficiency potential studies.

Infiltration Reduction Measures

Strip Curtains for Walk-Ins. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-78. Installing strip curtains in the doorways of walk-in boxes and refrigerated warehouses can produce energy savings by decreasing the infiltration of outside air into the refrigerated space. Although refrigerated spaces have doors, these doors are often left open, for example during product delivery and store stocking activities. For the ASSET analysis, the incremental costs and savings were derived from utility workpapers.

Table A-78: Strip Curtain ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_StripCurt	C_Ref_StripCurt	Strip Curtains for Walk-ins

Display Case and Walk-In Door Gaskets. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-79. Replacing old, damaged, or deteriorated door gaskets with new ones on display case and walk-in doors can produce energy savings by decreasing the infiltration of outside air into the refrigerated space. For the ASSET analysis, the incremental costs and savings were derived from utility work papers.

Table A-79: Door Gasket ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_Gaskets	C_Ref_Gaskets	Walk-In Cooler/Freezer Door Gaskets

Auto-Closer for Walk-In Doors. This measure is modeled as a RET decision type. ASSET model measure identifiers for the two door types that were modeled are presented in Table A-80. Installing an auto-closer on the solid or glass doors of walk-in boxes can produce energy savings by decreasing the infiltration of outside air into the refrigerated space. The auto-closer ensures that the door is quickly and firmly closed after being opened. For the ASSET analysis, the incremental costs and savings were derived from DEER.

Table A-80: Auto-Closer for Walk-In Doors ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_SDAutoClose	C_Ref_SDAutoClose	Auto Closer for Walk-in Solid-Door
Refrig	Elec	C_Ref_GDAutoClose	C_Ref_GDAutoClose	Auto Closer for Walk-In Glass-Doors

Night Covers for Display Cases. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-81. Night covers are film- or blanket-type sheets that are manually used to cover open display cases when the business is closed. Night covers reduce the infiltration of warm ambient air into the case, which in turn reduces the load on the refrigeration system. The target market for this measure is small, independently owned grocery stores and other stores that are typically closed at night and restock their shelves during the day, since the night covers prevent access to the product in the case. The target cases are open vertical medium-temperature display cases with a single- or double-air curtain, and low-temperature tub (coffin) type cases, as represented in Table A-81. For the ASSET analysis, the incremental costs and savings were derived utility work papers.

Table A-81: Night Covers for Display Cases ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_NCover_Frz	C_Ref_NCover_Frz	Night Covers - LowTemp Coffin Cases
Refrig	Elec	C_Ref_NCover_Ref	C_Ref_NCover_Ref	Night Covers - MedTemp Vertical Cases

<u>Display Case and Walk-In Component Measures</u>

ECM/PSC Evaporator Fan Motor. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-82. Shaded pole motors can be replaced by either electronically commutated (ECM) motors or permanent-split-capacitor (PSC) motors. In addition to saving energy, ECM and PSC motors can be more reliable, resulting in reduced downtime and replacement costs. For the ASSET analysis, the incremental costs and savings were derived from the utility work papers.

Table A-82: ECM/PSC Evaporator Fan Motor ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_EvapFanMT	C_Ref_EvapFan_Base	Evaporator Fan Motors - Shaded Pole
Refrig	Elec	C_Ref_EvapFanMT	C_Ref_EvapFan_PSC	Evaporator Fan Motors – PSC
Refrig	Elec	C_Ref_EvapFanMT	C_Ref_EvapFan_ECM	Evaporator Fan Motors – ECM

Evaporator Fan Controller for Medium Temperature Walk-Ins. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-83. In conventional walk-in evaporator systems, the fans can run constantly whether the temperature setpoint is satisfied or not. This measure works by cycling the evaporator fans when the compressor is cycled off and there is no refrigerant flow through the evaporator. This measure is only applicable when the fans run continuously at full speed. For the ASSET analysis, the incremental costs and savings were derived from DEER.

Table A-83: Evaporator Fan Controller ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_EvapFan_Ctrl	C_Ref_EvapFan_Ctrl	Evaporator Fan Controller for Walk-Ins

Anti-Sweat Heater (ASH) Controls. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-84. Anti-sweat heaters (ASH) prevent condensation on glass doors and their metal frames by heating them. Uncontrolled ASHs are continuously on. However, a humidistat-based controller can be used to turn off ASHs when the ambient relative humidity is low enough that condensation will not occur. Savings result from reducing the operating hours of the ASHs from always on to only when needed as determined by the ambient conditions. For the ASSET analysis, the incremental costs and savings were derived utility work papers.

Table A-84: Anti-Sweat Heater Controls ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_ASHCtrl	C_Ref_ASHCtrl	Anti-Sweat Heater Controls

Replace Open Multi-Deck Reach-in with New NoASH Glass Door Display Case. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-85. This measure is replacement of an open, vertical, low-temperature or medium-temperature, multi-deck display case with a new premium-efficiency display case that incorporates T8 lighting, ECM evaporator fan motors, and low/no anti-sweat heating glass doors. For the ASSET analysis, the incremental costs and savings were derived DEER.

Table A-85: Open-to-HE Glass Door Display Case ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_OpenMDToGD	C_Ref_OpenMDToGD_Base	Open Multi-Deck to New HiEff Glass Door Reach-in (Base)
Refrig	Elec	C_Ref_OpenMDToGD	C_Ref_OpenMDToGD_HE	Open Multi-Deck to New HiEff Glass Door Reach-in (HiEff)

Replace Standard Glass Door Case with NoASH Glass Door Display Case. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-86. This measure is replacement of a low-temperature standard glass door display case that utilizes T12/magnetic ballast lighting, standard shaded-pole motors, and glass doors that use ASHs with a new premium-efficiency display case that incorporates T8 lighting, ECM evaporator fan motors, and low/no anti-sweat heating glass doors.

Table A-86: Std-to-HE Glass Door Display Case ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_NoASHGD	C_Ref_NoASHGD_Base	New HiEff LowTemp NoASH Glass Door Case (Base)
Refrig	Elec	C_Ref_NoASHGD	C_Ref_NoASHGD_HE	New HiEff LowTemp NoASH Glass Door Case (Base)

Compressor/Condenser System Measures

Floating Head Pressure (FHP) Control. This measure is modeled as a CON decision type. ASSET model measure identifiers for both air-cooled and evaporative-cooled multiplex systems are presented in Table A-87. Floating head pressure controls allow a refrigeration system to operate under lower condensing temperature and pressure settings, where compressor operation is most efficient, working against a relatively low head pressure. The condensing temperature is allowed to float below the design setpoint (typically about 95°F) under lower outdoor temperatures, which in-turn lowers the condensate pressure. In a conventional system a higher fixed condensing temperature set point is used which results in a lowered capacity for the system, requires extra power, and may overload the compressor motor. Energy savings can be realized if the refrigeration system head pressure is allowed to float during periods of low ambient temperature, when the condensing temperature can be dramatically reduced. The incremental costs and savings were derived from DEER.

Table A-87: Floating Head Pressure Control ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_MplxBaseToFHP_AirCond	C_Ref_MplxBase_AirCond	Base Multiplex Air-Cooled Condenser System (noFHP or HE Cond)
Refrig	Elec	C_Ref_MplxBaseToFHP_AirCond	C_Ref_MplxFHP_AirCond	Multiplex Air-Cooled System with FHP (Fixed setpoint)
Refrig	Elec	C_Ref_MplxBaseToFHP_EvapCond	C_Ref_MplxBase_EvapCond	Base Multiplex Evap-Cooled Condenser System (noFHP or HE Cond)
Refrig	Elec	C_Ref_MplxBaseToFHP_EvapCond	C_Ref_MplxFHP_EvapCond	Multiplex Evap-Cooled System with FHP (Fixed setpoint)

Single Compressor to Multiplex Compressor System. This measure is modeled as a CON decision type. ASSET model measure identifiers for both air-cooled and evaporative-cooled systems are presented in Table A-88. This measure is conversion of multiple single-line (stand-alone or conventional) compressors to a multiplex system. In a multiplex system, multiple compressors are piped to common suction and discharge manifolds that serve multiple lines of the same temperature. During periods when the refrigeration load is less than the design value, the multiplexed compressors can cycle to more closely match the refrigeration load than the single stand-alone compressor could. For the ASSET analysis, the incremental costs and savings were derived from DEER.

Table A-88: Single-to-Multiplex System ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_Sngl2Mplx_AirC	C_Ref_Sngl2Mplx_AirC_Base	Single Compressor to Multiplex AirCooled System – Base
Refrig	Elec	C_Ref_Sngl2Mplx_AirC	C_Ref_Sngl2Mplx_AirC_HE	Single Compressor to Multiplex AirCooled System
Refrig	Elec	C_Ref_Sngl2Mplx_EvapC	C_Ref_Sngl2Mplx_EvapC_Base	Single Compressor to Multiplex EvapCooled System – Base
Refrig	Elec	C_Ref_Sngl2Mplx_EvapC	C_Ref_Sngl2Mplx_EvapC_HE	Single Compressor to Multiplex EvapCooled System

Multiplex System with Efficient (Oversized) Condenser. This measure is modeled as an ROB decision type. ASSET model measure identifiers for both air-cooled and evaporative-cooled systems are presented in Table A-89. Condensers can be oversized in order to take maximum advantage of low ambient dry-bulb (for air-cooled) or wet-bulb (for evaporative-cooled) temperatures. A standard evaporative-cooled condenser design uses a 20^{o}F to 25^{o}F temperature difference (TD), that is, the difference between the condensing temperature and ambient wet-bulb temperature. An oversized evaporative-cooled unit would be designed with a TD of 20°F or less, and an air-cooled unit with a TD of 15°F or less. Consequently, an oversized condenser is able to reject heat at a lower condensing temperature than a typical evaporative or air-cooled condenser.

Table A-89: Energy Efficient Condenser ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_MplxFHPToEE_ AirCond	C_Ref_MplxEE_ AirCond	Energy Efficient Air-Cooled Condenser
Refrig	Elec	C_Ref_MplxFHPToEE_ EvapCond	C_Ref_MplxEE_ EvapCond	Energy Efficient Evap-Cooled Condenser

Suction Line Insulation. This measure is modeled as a RET decision type. ASSET model measure identifiers are presented in Table A-90. This measure is applying closed-cell nitrite rubber or equivalent insulation to the suction lines of a remote refrigeration system. Suction line insulation reduces the additional ambient heat load that is absorbed by the refrigerant between exiting the evaporator and entering the compressor. For the ASSET analysis, the incremental costs and savings were derived from utility papers.

Table A-90: Suction Line Insulation ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Refrig	Elec	C_Ref_SucLnIns	C_Ref_SucLnIns	Suction Line Insulation

Miscellaneous Equipment Measures

Miscellaneous equipment measures are office equipment measures, vending machine controllers, and pool heaters. The impacts used for the ASSET analysis were obtained from a variety of sources including DEER, utility workpapers, EM&V reports, and previous energy efficiency potential studies.

ENERGY STAR Copier. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-91. Copiers are the most energy-intensive type of office equipment. Standard office copiers need to be ready on demand in the office environment, but generally require a warm-up period after they are turned on. For this reason, copiers are left on all day regardless of use or need. The most common energy saving technique is to have an idle-off control that shuts the copier down in stages depending on the length of time the copier has been out of use. This feature is included in ENERGY STAR copiers. For the ASSET analysis, the incremental savings were derived from DEER.

Table A-91: ENERGY STAR Copier ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Other	Elec	C_MS_Copier	C_Copier_Base	Small Copier Base
Other	Elec	C_MS_Copier	C_Copier_ES	Small Copier ENERGY STAR

80 PLUS Power Supply. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-92. This measure is a high-efficiency power supply for computer and servers. The 80 PLUS power supply program is primarily for manufacturers of new computers. 80 PLUS power supplies operate at an efficiency of 80% or greater at 20%, 50%, and 100% of rated load. Savings for a desktop PC are estimated at 85 kWh per year and for a server are 301 kWh per year. For the ASSET analysis, the incremental costs were derived from utility work papers and plans.

Table A-92: 80-Plus Power Supply ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Other	Elec	C_MS_80Plus	C_Computer_Base	Computer with std power supply
Other	Elec	C_MS_80Plus	C_Computer_80Plus	Computer with 80+ power supply

Vending Machine Controller. These measures are modeled as an RET decision type. ASSET model measure identifiers for both refrigerated and unrefrigerated vending machines are presented in Table A-93. Using a custom passive infrared sensor, the vending machine controller completely powers down a vending machine when the area surrounding it is unoccupied for 15 minutes. For refrigerated vending machines, regardless of occupancy, the controller will automatically power up the vending machine at one- to three-hour intervals to ensure that the vended products stay cold. The vending machine controller is a simple plug-and-play product, typically requiring 15 minutes or less for installation. For the ASSET analysis, the incremental costs and savings were derived DEER.

Table A-93: Vending Machine Controller ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Other	Elec	C_MS_RefVendCtrl	C_RefVendCtrl	Refrigerated Vending Machine Controller
Other	Elec	C_MS_NRefVendCtrl	C_NRefVendCtrl	Vending Machine (NonRefrigerated) Controller

High-Efficiency Commercial Pool Heaters. This measure is modeled as an ROB decision type. ASSET model measure identifiers are presented in Table A-94. Commercial pool and spa heaters covered by this measure range in size from 500 kBtuh to 2,000 kBtuh. The thermal efficiency of the base heater is 78% (the Title 20 minimum), and the high-efficiency unit is at least 84%. For the ASSET analysis, the incremental costs and savings were derived utility work papers.

Table A-94: Commercial Pool Heater ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description
Other	Gas	C_WH_PoolHeater	C_PoolHeater_Base	Commercial Gas Pool Heater - Base
Other	Gas	C_WH_PoolHeater	C_PoolHeater_HE	Commercial Gas Pool Heater - HE

A.4 Industrial Measures

Industrial measures included in this study are listed in Table A-95 and Table A-96. The industrial measures analyzed in this study replicate the measures analyzed in the 2006 California Energy Efficiency Study. The majority of industrial measures were analyzed at retrofit measures. A very limit number of replace-on-burnout measures were also analyzed. All measures analyzed within the industrial sector used the ASSET automatic replacement feature. When high efficiency measures reach the end of their expected useful life, automatic replacement assumes that customers replace the technology with the same high efficiency technology and that the replacement occurs without a utility rebate. This assumption maintains the gross market potential in the extended years of the forecast period, but limits the first year program potential in years 2016-2026.

Table A-95: Industrial Electric Measures

Use	Fuel Type	Tech Id	Measure Description	Efficiency Level
Compressed Air	Electric	Compressed_Air-OM	Compressed Air – Operations and Maintenance	High Efficiency
Compressed Air	Electric	Compressed_Air_Controls	Compressed Air - Controls	High Efficiency
Compressed Air	Electric	Compressed_Air_System_Optimization	Compressed Air - System Optimization	High Efficiency
Compressed Air	Electric	Compressed_Air_Sizing	Compressed Air - Sizing	High Efficiency
Compressed Air	Electric	Comp_Air_Base_1-5_HPMotor	Compressed Air base 1 to 5 HP motor	Base
Compressed Air	Electric	Comp_Air_Replace_1-5_HPMotor	Compressed Air high Efficiency 1 to 5 HP motor	High Efficiency
Compressed Air	Electric	Comp_Air_ASD_(1-5_HP)	Compressed Air ASD (1-5 hp)	High Efficiency
Compressed Air	Electric	Comp_Air_Motor_Practices-1_(1-5_HP)	Compressed Air Motor Practices-1 (1-5 HP)	High Efficiency
Compressed Air	Electric	Comp_Air_Base_6-100_HPMotor	Compressed Air base 6 to 100 HP motor	Base
Compressed Air	Electric	Comp_Air_Replace_6-100_HPMotor	Compressed Air high Efficiency 6 to 100 HP motor	High Efficiency
Compressed Air	Electric	Comp_Air_ASD_(6-100_HP)	Compressed Air ASD (6-100 hp)	High Efficiency
Compressed Air	Electric	Comp_Air_Motor_Practices-1_(6-100_HP)	Compressed Air Motor Practices-1 (6-100 HP)	High Efficiency
Compressed Air	Electric	Comp_Air_Base_100+_HPMotor	Compressed Air base 6 to 100 HP motor	Base
Compressed Air	Electric	Comp_Air_Replace_100+_HPMotor	Compressed Air - Replace 100+ HP Motor	High Efficiency
Compressed Air	Electric	Comp_Air_ASD_(100+_HP)	Compressed Air - ASD (100+ hp)	High Efficiency
Compressed Air	Electric	Comp_Air_Motor_Practices-1_(100+_HP)	Compressed Air - Motor Practices-1 (100+ HP)	High Efficiency
Compressed Air	Electric	Power_Recovery_Comp_Air	Compressed Air Power recovery	High Efficiency
Compressed Air	Electric	Refinery_Controls_Comp_Air	Compressed Air Refinery Controls	High Efficiency
Compressed Air	Electric	Energy_Star_Transformers_Comp_Air	Compressed Air ENERGY STAR Transformers	High Efficiency
Fans	Electric	Fans_O&M	Fan operations and maintenance	High Efficiency
Fans	Electric	Fans_Controls	Fan controls	High Efficiency
Fans	Electric	Fans_System_Optimization	Fan system optimization	High Efficiency
Fans	Electric	FansImprove_components	Fan improve components	High Efficiency
Fans	Electric	Fan_Base_1-5_HPMotor	Fan base efficiency 1-5 HP motor	Base
Fans	Electric	Fan_Replace_1-5_HP_Motor	Fan high efficiency 1-5 HP motor	High Efficiency
Fans	Electric	Fan_ASD_(1-5_hp)	Fan ASD (1-5 hp)	High Efficiency

Table A-95 (cont'd.): Industrial Electric Measures

Use	Fuel Type	Tech Id	Measure Description	Efficiency Level
Fans	Electric	Fan_Motor_practices-1_(1-5_HP)	Fan efficient motor practices (1-5 HP)	High Efficiency
Fans	Electric	Fan_Base_6-100_HPmotor	Fan base efficiency 6-100 HP motor	Base
Fans	Electric	Fan_Replace_6-100_HP_motor	Fan high efficiency 6-100 HP motor	High Efficiency
Fans	Electric	Fan_ASD_(6-100_hp)	Fans - ASD (6-100 hp)	High Efficiency
Fans	Electric	Fan_Motor_practices-1_(6-100_HP)	Fans efficient motor practices (6-100 HP)	High Efficiency
Fans	Electric	Fan_Base_100+_HPmotor	Fan base efficiency 100+ HP motor	Base
Fans	Electric	Fan_Replace_100+_HP_Motor	Fan high efficiency 100+ HP motor	High Efficiency
Fans	Electric	Fan_ASD_(100+_hp)	Fan ASD (100+ hp)	High Efficiency
Fans	Electric	Fan_Motor_practices-1_(100_HP)	Fans motor practices (100+ HP)	High Efficiency
Fans	Electric	Optimize_drying_process	Fans optimize drying process	High Efficiency
Fans	Electric	Power_recovery_Fans	Fan power recovery	High Efficiency
Fans	Electric	Refinery_Controls_Fans	Fan refinery controls	High Efficiency
Fans	Electric	Energy_Star_Transforms_Fan	Fan energy star transformers	Base
Pump	Electric	Pumps_OM	Pumps operation and maintenance	High Efficiency
Pump	Electric	Pump_Controls	Pump efficient controls	High Efficiency
Pump	Electric	Pump_System_Optimization	Pump system optimization	High Efficiency
Pump	Electric	Pump_Sizing	Pump optimal sizing	High Efficiency
Pump	Electric	Pump_Base_1-5_HPMotor	Pump base 1-5 HP motor	Base
Pump	Electric	Pump_Replace_1-5_HP_Motor	Pump high efficiency 1-5 HP Motor	High Efficiency
Pump	Electric	Pump_ASD_(1-5_hp)	Pump ASD (1-5 HP)	High Efficiency
Pump	Electric	Pump_Motor_practices-1_(1-5_HP)	Pump motor practices (1-5 HP)	High Efficiency
Pump	Electric	Pump_Base_6-100_HPMotor	Pump base 6-100 HP motor	Base
Pump	Electric	Pump_Replace_6-100_HP_Motor	Pump high efficiency 6-100 HP motor	High Efficiency
Pump	Electric	Pump_ASD_(6-100_hp)	Pump ASD (6-100 hp)	High Efficiency
Pump	Electric	Pump_Motor_practices-1_(6-100_HP)	Pump motor practices (6-100 HP)	High Efficiency
Pump	Electric	Pump_Base_100+HPMotor	Pump base 100+ HP motor	Base
Pump	Electric	Pump_Replace_100+_HP_Motor	Pump high efficiency 100+ HP motor	High Efficiency
Pump	Electric	Pump_ASD_(100+_hp)	Pump ASD (100+ hp)	High Efficiency

Table A-95 (cont'd.): Industrial Electric Measures

Use	Fuel Type	Tech Id	Measure Description	Efficiency Level
Pump	Electric	Pump_Motor_practices-1_(100+_HP)	Pump motor practices-1 (100+ HP)	High Efficiency
Pump	Electric	Power_recovery_Pumps	Pump Power Recovery	High Efficiency
Pump	Electric	Refinery_Controls_Pumps	Pump Refinery Controls	High Efficiency
Pump	Electric	Energy_Star_Transformers_Pump	Pump ENERGY STAR Transformers	High Efficiency
Pump	Electric	Bakery_Process_(Mixing)_O&M	Bakery process mixing – Operations and maintenance	High Efficiency
Pump	Electric	OM_drives_spinning_machines	Operations and maintenance/drives spinning machines	High Efficiency
Pump	Electric	Air_conveying_systems	Air Conveying Systems	High Efficiency
Pump	Electric	Replace_V-Belts_drives	Replace V-Belts	High Efficiency
Drive	Electric	Drives_EE_Motor	Drives energy efficiency motor	High Efficiency
Drive	Electric	Gap_Forming_papermachine	Gap forming paper machine	High Efficiency
Drive	Electric	High_Consistency_forming	High consistency forming	High Efficiency
Drive	Electric	Optimization_control_PM	Optimization control PM	High Efficiency
Drive	Electric	Efficient_Practices_Printing_Press	Efficient Practices Printing Press	High Efficiency
Drive	Electric	Efficient_Printing_press_(fewer_cylinders)	Efficient printing press with fewer cylinders	High Efficiency
Drive	Electric	Light_cylinderes	Light Cylinders	High Efficiency
Drive	Electric	Efficient_drives	Efficient Drives	High Efficiency
Drive	Electric	Clean_Room_Controls	Clean Room - Controls	High Efficiency
Drive	Electric	Clean_Room_New_Designs	New, high efficiency clean room designs	High Efficiency
Drive	Electric	Drives_Process_Controls_(batch_+_site)	Drives - process controls (batch + site)	High Efficiency
Drive	Electric	Process_Drives_ASD	Process Drives - ASD	High Efficiency
Drive	Electric	OM_Extruders_Injection_Molding	Operations and maintenance for Extruders/Injection Molding	High Efficiency
Drive	Electric	Extruders_injection_Molding_Multipump	Extruders/Injection Molding – Multi-Pump	High Efficiency
Drive	Electric	Direct_Drive_Extruders	Direct Drive Extruders	High Efficiency
Drive	Electric	Injection_Molding_Impulse_Cooling	Injection Molding - Impulse Cooling	High Efficiency
Drive	Electric	Injection_Molding_Direct_Drive	Injection Molding - Direct Drive	High Efficiency

Table A-95 (cont'd.): Industrial Electric Measures

Use	Fuel Type	Tech Id	Measure Description	Efficiency Level
Drive	Electric	Efficient_Grinding	Efficient Grinding	High Efficiency
Drive	Electric	Process_Control_Drives	Process Control	High Efficiency
Drive	Electric	Process_Optimization	Process Optimization	High Efficiency
Drive	Electric	Drives_Process_Control	Drives - Process Control	High Efficiency
Drive	Electric	Efficient_Drives_Rolling	Efficient Drives - Rolling	High Efficiency
Drive	Electric	Drives_Optimization_process_(MT)	Drives - Optimization process (M&T)	High Efficiency
Drive	Electric	Drives_Scheduling	Drives - Scheduling	High Efficiency
Drive	Electric	Machinery	Machinery	High Efficiency
Drive	Electric	Efficienct_machinery	Efficient Machinery	High Efficiency
Drive	Electric	Energy_Star_Transformers_Drive	Drive ENERGY STAR Transformers	High Efficiency
IndHeat	Electric	Bakery_Process	Bakery - Process	High Efficiency
IndHeat	Electric	Drying_(UV_IR)	Drying (UV/IR)	High Efficiency
IndHeat	Electric	Heat_Pumps_Drying	Heat Pumps - Drying	High Efficiency
IndHeat	Electric	Top-Heating_(glass)	Top-Heating (glass)	High Efficiency
IndHeat	Electric	Efficient_Electric_Melting	Efficient Electric Melting	High Efficiency
IndHeat	Electric	Intelligent_Extruder_(DOE)	Intelligent Extruder (DOE)	High Efficiency
IndHeat	Electric	Near_Net_Shape_Casting	Near Net Shape Casting	High Efficiency
IndHeat	Electric	Heating_Process_Control	Heating - Process Control	High Efficiency
IndHeat	Electric	Efficient_Curing_Ovens	Efficient Curing Ovens	High Efficiency
IndHeat	Electric	Heating_Optimization_Process (MT)	Heating - Optimization Process (maintenance and training)	High Efficiency
IndHeat	Electric	Heating_Scheduling	Heating - Scheduling	High Efficiency
IndHeat	Electric	Energy_Star_Transformers_Heating	ENERGY STAR Transformers	High Efficiency
IndRef	Electric	Efficient_Refrigeration_Operations	Efficient Refrigeration - Operations	High Efficiency
IndRef	Electric	Optimization_Refrigeration	Optimization Refrigeration	High Efficiency
IndRef	Electric	Energy_Star_Transformers_Refrigeration	ENERGY STAR Transformers	High Efficiency
IndProcess	Electric	Other)_Process_Controls_(batch_+_site)	Other Process Controls (batch + site)	High Efficiency
IndProcess	Electric	Efficient_Desalter	Efficient Desalter	High Efficiency

Table A-95 (cont'd.): Industrial Electric Measures

Use	Fuel Type	Tech Id	Measure Description	Efficiency Level
IndProcess	Electric	New_transformers_welding	New transformers Welding	High Efficiency
IndProcess	Electric	Efficient_processes_(welding_etc.)	Efficient Processes (welding, etc.)	High Efficiency
IndProcess	Electric	Process_control_process	Process Control	High Efficiency
IndProcess	Electric	Power_recovery_process	Power Recovery	High Efficiency
IndProcess	Electric	Refinery_Controls_Process	Refinery Controls	High Efficiency
IndOther	Electric	Replace_V-belts_other	Replace V-belts	High Efficiency
IndOther	Electric	Membranes_for_Wastewater	Membranes for Wastewater	High Efficiency
IndOther	Electric	Energy_Star_Transformers_Other	ENERGY STAR Transformers	High Efficiency
IndCool	Electric	Base_Centrifugal_Chiller_0.58_kW_ton_500_tons	Base Centrifugal Chiller, 0.58 kW/ton, 500 tons	Base
IndCool	Electric	Centrifugal_Chiller_0.51_kW_ton_500_tons	High Efficiency Centrifugal Chiller, 0.51 kW/ton, 500 tons	High Efficiency
IndCool	Electric	Window_Film_Chiller	Window Film - Chiller	High Efficiency
IndCool	Electric	EMS_Chiller	EMS - Chiller	High Efficiency
IndCool	Electric	Cool_Roof_Chiller	Cool Roof - Chiller	High Efficiency
IndCool	Electric	Chiller_Tune_Up_Diagnostics	Chiller Tune Up/Diagnostics	High Efficiency
IndCool	Electric	Cooling_Circ_Pumps_VSD	Cooling Circ. Pumps - VSD	High Efficiency
IndCool	Electric	Energy_Star_Transformers_chiller	ENERGY STAR Transformers	High Efficiency
IndCool	Electric	Base_DX_Packaged_System_EER=10.3_10_tons	Base DX Packaged System, EER=10.3, 10 tons	Base
IndCool	Electric	DX_Packaged_System_EER=10.9_10_tons	High Efficiency DX Packaged System, EER=10.9, 10 tons	High Efficiency
IndCool	Electric	DX_Tune_Up_Advanced_Diagnostics	DX Tune Up/ Advanced Diagnostics	High Efficiency
IndCool	Electric	Window_Film_DX	Window Film - DX	High Efficiency
IndCool	Electric	Evaporative_Pre-Cooler	Evaporative Pre-Cooler	High Efficiency
IndCool	Electric	Prog._Thermostat_DX	Prog. Thermostat - DX	High Efficiency
IndCool	Electric	Cool_Roof_DX	Cool Roof - DX	High Efficiency
IndCool	Electric	ENERGY_STAR_Transformers_DX	ENERGY STAR Transformers	High Efficiency
IndLight	Electric	RET_2L4_Premium_T8_1EB	RET 2L4' Premium T8, 1EB	High Efficiency
IndLight	Electric	CFL_Hardwired_Modular_36W	CFL Hard-wired, Modular 36W	High Efficiency

Table A-95 (cont'd.): Industrial Electric Measures

Use	Fuel Type	Tech Id	Measure Description	Efficiency Level
IndLight	Electric	Metal_Halide_50W	Metal Halide, 50W	High Efficiency
IndLight	Electric	Occupancy_Sensor_4L4_Fluorescent_Fixtures	Occupancy Sensor, 4L4' Fluorescent Fixtures	High Efficiency
IndLight	Electric	ENERGY_STAR_Transformers_Lighting	ENERGY STAR Transformers	High Efficiency
HVAC	Gas	Boiler_Base	Base Boiler	Base
HVAC	Gas	Boiler_95	High efficiency boiler, 95%	High Efficiency
Boiler	Gas	Improved_Process_Control	Improved Process Control	High Efficiency
Boiler	Gas	Maintain_Boilers	Maintain Boilers	High Efficiency
Boiler	Gas	Flue_Gas_Heat_Recovery_Economizer	Flue Gas Heat Recovery/Economizer	High Efficiency
Boiler	Gas	Blowdown_Steam_Heat_Recovery	Blowdown Steam Heat Recovery	High Efficiency
Boiler	Gas	Upgrade_Burner_Efficiency	Upgrade Burner Efficiency	High Efficiency
Boiler	Gas	Water_Treatment	Water Treatment	High Efficiency
Boiler	Gas	Load_Control	Load Control	High Efficiency
Boiler	Gas	Improved_Insulation	Improved Insulation	High Efficiency
Boiler	Gas	Steam_Trap_Maintenance	Steam Trap Maintenance	High Efficiency
Boiler	Gas	Automatic_Steam_Trap_Monitoring	Automatic Steam Trap Monitoring	High Efficiency
Boiler	Gas	Leak_Repair	Leak Repair	High Efficiency
Boiler	Gas	Condensate_Return	Condensate Return	High Efficiency
HVAC	Gas	Improve_Ceiling_Insulation	Improve Ceiling Insulation	High Efficiency
HVAC	Gas	Stack_Heat_Exchanger	Stack Heat Exchanger	High Efficiency
HVAC	Gas	Duct_Insulation	Duct Insulation	High Efficiency
HVAC	Gas	EMS_Install	EMS Install	High Efficiency
HVAC	Gas	EMS_Optimization	EMS Optimization	High Efficiency
Process	Gas	Process_Controls_&_Management	Process Controls & Management	High Efficiency
Process	Gas	Heat_Recovery	Heat Recovery	High Efficiency
Process	Gas	Efficient_Burners	Efficient Burners	High Efficiency
Process	Gas	Process_Integration	Process Integration	High Efficiency
Process	Gas	Efficient_Drying	Efficient Drying	High Efficiency
Process	Gas	Closed_Hood	Closed Hood	High Efficiency

Table A-95 (cont'd.): Industrial Electric Measures

Use	Fuel Type	Tech Id	Measure Description	Efficiency Level
Process	Gas	Extended_Nip_Press	Extended Nip Press	High Efficiency
Process	Gas	Improved_Separation_Processes	Improved Separation Processes	High Efficiency
Process	Gas	Thermal_Oxidizers	Thermal Oxidizers	High Efficiency
Process	Gas	Flare_Gas_Controls_And_Recovery	Flare Gas Controls And Recovery	High Efficiency
Process	Gas	Fouling_Control	Fouling Control	High Efficiency
Process	Gas	Furnace_Base	Base Furnaces	Base
Process	Gas	Furnace_HE	Efficient Furnaces	High Efficiency
Process	Gas	Oxyfuel	Oxyfuel	High Efficiency
Process	Gas	Batch_Cullet_Preheating	Batch Cullet Preheating	High Efficiency
Process	Gas	Preventative_Maintenance	Preventative Maintenance	High Efficiency
Process	Gas	Combustion_Controls	Combustion Controls	High Efficiency
Process	Gas	Optimize_Furnace_Operations	Optimize Furnace Operations	High Efficiency
Process	Gas	Insulation/Reduce_Heat_Losses	Insulation/Reduce Heat Losses	High Efficiency

Measure Descriptions

Electric Measure Descriptions

Cross-Cutting Electricity Efficiency Measures

Replace Motors. This measure refers to the replacement of existing motors with high efficiency motors. High efficiency motors reduce energy losses through improved design, better materials, tighter tolerances, and improved manufacturing techniques. With proper installation, high efficiency motors can run cooler than standard motors and can consequently have higher service factors, longer bearing life, longer insulation life, and less vibration.

Adjustable Speed Drives (ASDs). Adjustable speed drives better match motor speed to load and can therefore lead to significant energy savings compared to constant speed motors. Typical energy savings associated with ASDs range from 7-60%.

Motor Practices. This measure refers to proper motor maintenance. The purposes of motor maintenance are to prolong motor life and to foresee a motor failure. Motor maintenance measures can be categorized as either preventive or predictive. Preventive measures, whose purpose is to prevent unexpected downtime of motors, include electrical consideration, voltage imbalance minimization, motor ventilation, alignment, and lubrication, and load consideration. The purpose of predictive motor maintenance is to observe ongoing motor temperature, vibration, and other operating data to identify when it becomes necessary to overhaul or replace a motor before failure occurs. The savings associated with ongoing motor maintenance could range from 2-30% of total motor system energy use.

Compressed Air—Operation and Maintenance (O&M). Inadequate maintenance can lower compression efficiency and increase air leakage or pressure variability, as well as lead to increased operating temperatures, poor moisture control, and excessive contamination. Improved maintenance will reduce these problems and save energy. Proper maintenance includes regular motor lubrication, replacement of air lubricant separators, fan, and pump inspection, and filter replacement.

Compressed Air—Controls. The objective of any control strategy is to shut off unneeded compressors or delay bringing on additional compressors until needed. Energy savings for sophisticated controls have been around 12% annually. Available controls for compressed air systems include start/stop, load/unload, throttling, multi-step, variable speed, and network controls.

Compressed Air—System Optimization. This is a general measure that refers to compressed air system improvements (besides sizing, controls, and maintenance) that allow it to perform at maximum energy efficiency. Such improvements could include reducing leaks, better load management, minimizing pressure drops throughout the system, reducing air inlet temperatures, and recovering waste compressor heat for other facility applications.

Compressed Air—Sizing. This measure refers to the proper sizing of compressors, regulators, and distribution pipes. Oversizing of compressors can result in wasted energy. By properly sizing regulators, compressed air will be saved that is otherwise wasted as excess air. Pipes must be sized correctly for optimal performance or resized to fit the current compressor system. Increasing pipe diameters typically reduces annual energy consumption by 3%.

Pumps—O&M. Inadequate maintenance can lower pump system efficiency, cause pumps to wear out more quickly, and increase costs. Better maintenance will reduce these problems and save energy. Proper pump system maintenance includes bearing inspection and repair, bearing lubrication, replacement of worn impellers, and inspection and replacement of mechanical seals.

Pumps—Controls. The objective of pump control strategies is to shut off unneeded pumps or, alternatively, to reduce pump load until needed. In addition to energy savings, proper pump control can lead to reduced maintenance costs and increased pump life.

Pumps—System Optimization. This is a general measure that refers to pump system improvements (besides sizing, controls, and maintenance) that allow it to perform at maximum energy efficiency. Such improvements could include pump demand reduction, high efficiency pumps, impeller trimming, and installing multiple pumps for variable loads.

Pumps—Sizing. Pumps that are sized inappropriately result in unnecessary losses. Where peak loads can be reduced, pump size can also be reduced. Replacing oversized pumps with pumps that are properly sized can save 15-25% of the electricity consumption of a pumping system (on average for U.S. industry).

Fans—O&M. This measure refers to the improvement of general O&M practice for fans, such as tightening belts, cleaning fans, and changing filters regularly.

Fans—Controls. The objective of fan control strategies is to shut off unneeded fans or, alternatively, to reduce fan load until needed. In addition to energy savings, proper fan control can lead to reduced maintenance costs and increased pump life.

Fans—System Optimization. This measure refers to general strategies for optimizing fans from a systems perspective, and includes such actions as better inlet and outlet design and reduction of fan sizing, where appropriate.

Fans—Improve Components. This measure refers to the improvement of fan components, such as replacing standard v-belts with cog v-belts and upgrading to the most energy efficient motors possible.

Replace T-12 by T-8 and Electronic Ballasts. T-12 tubes consume significant amounts of electricity, and have extremely poor efficacy, lamp life, lumen depreciation, and color rendering index. Replacing T-12 lamps with T-8 lamps (smaller diameter) approximately doubles the efficacy of the former. Electronic ballasts save 12-30% power over their magnetic predecessors; typical energy savings associated with replacing magnetic ballasts by electronic ballasts are estimated to be roughly 25%.

Metal Halides/Fluorescents. Metal halide lamps can replace mercury or fluorescent lamps with energy savings of 50%. For even further savings, high-intensity fluorescent lamps can be installed, which can yield 50% electricity savings over standard metal halide (high-intensity discharge) systems.

Switch Off/O&M. Lighting is often left on, even when the area or room is not occupied. Sensors can be installed (see below), but savings can also be realized by training personnel to switch off lights (and other equipment) when not needed. Furthermore, adapting switching to the use pattern of the building will enable to control the lighting in those areas where it is needed (e.g., in many assembly areas a single switch controls all lighting, even when lighting would only be needed in a few zones within the assembly hall).

Controls/Sensors. Lights can be turned off during non-working hours by automatic controls such as occupancy sensors, which turn off lights when a space becomes unoccupied. Manual controls can be used in combination with automatic controls to save additional energy in small areas.

Super T-8s. Super T-8 fluorescent systems are a further development of (standard) T-8 tubes. Super T-8s combine further improvement of the fluorescent tube (e.g., barrier coating, improved fill, enhanced phosphors) with electronic ballasts in a single system.

HVAC Management System. An energy monitoring and control system supports the efficient operation of HVAC systems by monitoring, controlling, and tracking system energy consumption. Such systems continuously manage and optimize HVAC system energy consumption while also providing building engineers and energy managers with a valuable diagnostic tool for tracking energy consumption and identifying potential HVAC system problems.

Cooling System Improvements. The efficiency of chillers can be improved by lowering the temperature of the condenser water, thereby increasing the chilled water temperature differential. This can reduce pumping energy requirements. Another possible efficiency measure is the installation of separate high-temperature chillers for process cooling.

Duct/Pipe Insulation/Leakage. Duct leakage can waste significant amounts of energy in HVAC systems. Measures for reducing duct leakage include installing duct insulation and performing regular duct inspection and maintenance, including ongoing leak detection and repair. Improved duct and pipe insulation can prevent excessive heat/cooling dissipation, thereby improving system energy efficiency.

Cooling Circulation Pumps—Variable Speed Drives. Variable speed drives better match motor speed to load and can therefore lead to significant energy savings compared to constant speed drives. This measure considers the installation of VSDs on cooling circulation pumps.

DX Tune-Up/Advanced Diagnostics. The tune-up includes cleaning the condenser and evaporator coils, establishing optimal refrigerant levels, and purging refrigerant loops of entrained air. The qualifying relative performance range for a tune-up is between 60 and 85% of the rated efficiency of the unit. This includes fresh air economizer controls providing demand control ventilation and consisting of a logic module, enthalpy sensor(s), and CO^2 sensors in appropriate applications.

DX Packaged System, EER=10.9, 10 tons. A single package air conditioning unit consists of a single package (or cabinet housing) containing a condensing unit, a compressor, and an indoor fan/coil. An additional benefit of package units is that there is no need for field-installed refrigerant piping, thus minimizing labor costs and the possibility of contaminating the system with dirt, metal, oxides, or non-condensing gases. This measure involves installation of a Tier 2 high efficiency unit (EER=10.9) versus a standard unit (EER=10.3.

Window Film. Low-emittance windows are an effective strategy for improving building insulation. Low-E windows can lower the heat transmitted into a building and, therefore, increase its insulating ability. There are two types of Low-E glass: high solar transmitting (for regions with higher winter utility bills) and low solar transmitting (for regions with higher summer utility bills).

Programmable Thermostat. A programmable thermostat controls temperature settings of space heating and cooling, and optimizes settings based on occupancy and building use. This will reduce unnecessary heating and cooling outside the hours of building use. It may also help in building cooling by using nighttime cooling.

Chiller O&M/Tune-Up. This measure refers to the proper inspection and maintenance of chilled water systems. This can include setting correct head pressure, maintaining correct levels of refrigerant, and selecting and running appropriate compressors for part load. Energy savings can also be achieved by cleaning the condensers and evaporators to prevent scale buildup.

Setback Temperatures (Weekends and Off Duty). Setting back building temperatures (i.e., turning building temperatures down in winter or up in summer) during periods of non-use, such as weekends or non-production times, can lead to significant savings in HVAC energy consumption.

Replace V-Belts. Inventory data suggest that 4% of pumps have V-belt drives, many of which can be replaced with direct couplings to save energy. Based on assessments in several industries, the savings associated with V-belt replacement are estimated at 4%.

ENERGY STAR Transformers. This measure refers to the replacement of existing transformers, where feasible, by the latest ENERGY STAR certified transformers. ENERGY STAR transformers ensure a high level of energy efficiency.

<u>Sector-Specific Efficiency Measures (Electricity)</u>

SIC 20. Food and Kindred Products

Efficient Refrigeration—Operations. Refrigeration is an important energy user in the food industries. Refrigeration system operations can be improved by applying appropriate settings, opening refrigerated space for as short a period as possible, reducing leakage by controlling doorways, making sure that refrigerated space is used optimally, optimizing the defrosting cycle, as well as other small operational changes.

Optimization Refrigeration. The refrigeration system can be optimized by improving the operation of the compressors, selecting cooling systems with high COP values, reducing losses in the coolant distribution system, improved insulation of the cooled space, variable speed drives on cooling system, and optimizing the temperature setting of the cooling system.

Bakery—Process. Process improvements in the bakery can reduce electricity consumption through selection of energy-efficient equipment for the different processes, optimization of electric ovens, and good housekeeping (e.g., switching equipment off when not in use).

Bakery—Process (Mixing). About 35% of electricity in bakeries is used to mix and knead the dough. When selecting equipment electricity use should be one of the considerations as energy is the largest cost on a life-cycle basis. Today, energy use is not a criterion. High efficiency motors, speed control, and other measures may reduce electricity consumption.

SIC 22. Textile Mill Products
SIC 23. Apparel and Other Textile Products

Drying (UV/IR). This measure refers to the use of direct heating methods, such as infrared dryers. Direct heating provides significant energy savings because it eliminates the inefficiency of transferring heat to air and from the air to the wet material. The energy efficiency of direct heating is about 90%.

Membranes for Wastewater. Membrane technologies focus on separating the water from the contaminants using semi-permeable membranes and applied pressure differentials. Membrane filtration of wastewater is typically more energy efficient than evaporation methods, and can lead to significant reductions in facility freshwater intake.

O&M of Spinning Machine Drives. Electric motors are the single largest electricity user in spinning mills. Optimization of motor use, proper maintenance procedures (e.g., preventative maintenance), use of new high efficiency motors instead of re-winding, and switching off equipment when not in use can help improve energy efficiency.

SIC 24. Lumber and Wood Products
SIC 25. Furniture and Fixtures

Air Conveying Systems. Pneumatic or air conveying systems are used to transport material (e.g., sawdust, fibers) in the lumber industry. Energy efficiency improvement is feasible by optimizing the layout of the systems, reducing leakages, reducing bends in the system, and improving compressor operations (see also with compressed air systems).

Optimize Drying Processes. This is a general measure, which refers to the optimization of drying systems through such actions as the use of controls, heat recovery, insulation, and good housekeeping/maintenance.

Heat Pumps—Drying. This measure refers to the recovery of low-grade heat from the drying process via a heat pump, where cost effective.

SIC 26. Paper and Allied Products

Gap Forming Paper Machine. The gap former produces a paper of equal and uniform quality at a higher rate of speed. Coupling the former with a press section rebuild or an improvement in the drying capacity increases production capacity by as much as 30%. Energy savings from gap formers come from reduced electricity consumption per ton of product produced.

High Consistency Forming. In high consistency forming, the furnish (process pulp) which enters at the forming stage has more than double the consistency (3%) than normal furnish. This measure increases forming speed, and reduces dewatering and vacuum power requirements. Application of this technology is limited to specific paper grades, especially low-basis weight grades such as tissue, toweling, and newsprint. Electricity savings are estimated at 8%.

Optimization Control Preventative Maintenance. Large electric motors are used to run the paper machine. Optimization of the paper machine will reduce electricity use of the drives. Improved control strategies will improve throughput, reduce breakage and downtime, improving the energy efficiency per unit of throughput. Variable speed drives may help to optimize the energy use in water pumps in the paper machine.

SIC 27. Printing and Publishing

Efficient Practices Printing Press. This involves optimizing the use of the printing press by reducing production losses, switching off the press when not in use, and other improved operational practices.

Efficient Printing Press (Fewer Cylinders). New printing press designs allow the use of fewer cylinders (or rollers). This reduces the electricity use to drive the printing machine.

Light Cylinders. Reducing the weight of the cylinders (or rollers) in the printing machine will reduce the power needed to drive the machine. Using lightweight materials for cylinders has been demonstrated in Europe.

SIC 28. Chemicals and Allied Products

Clean Room—Controls. Reduced recirculation air change rates, while still meeting quality control and regulatory standards, can reduce energy use. Additionally, optimized chilled water systems, reduction of clean room exhaust, and proper clean room cleanliness level classification can reduce energy use.

Clean Room—New Designs. When designing a clean room, energy use should be a primary consideration. Benchmarking tools and design tools are being developed to help improve the energy efficiency of new clean room systems. Furthermore, in the design phase, the system can be optimized for improved air filtration quality and efficiency and the use of cooling towers in lieu of water chillers.

Process Controls (Batch + Site). This is a general measure to implement computer-based process controls, where applicable, to monitor and optimize various processes from an energy consumption perspective. In general, by monitoring key process parameters, processes can be fine-tuned to minimize energy consumption while still meeting quality and productivity requirements. Control systems can also reduce the time required to perform complex tasks and can often improve product quality and consistency while optimizing process operations. This measure could include the installation of controls based on neural networks, knowledge-based systems, or improved sensor technology.

SIC 29. Petroleum and Coal Products

Controls: See discussion for SIC 28.

Power Recovery. Various processes run at elevated pressures, enabling the opportunity for power recovery from the pressure in the flue gas. The major application for power recovery in the petroleum refinery is the fluid catalytic cracker (FCC). However, power recovery can also be applied to hydrocrackers or other equipment operated at elevated pressures. A power recovery turbine or turbo expander is used to recover energy from the pressure. The recovered energy can be used to drive the FCC compressor or to generate power.

Efficient Desalter. Alternative designs for desalting include multi-stage desalters and a combination of AC and DC fields. These alternative designs may lead to increased efficiency and lower energy consumption.

SIC 30. Rubber and Miscellaneous Plastic Products

O&M—Extruders/Injection Molding. This includes improved operation and maintenance procedures of extruders, optimization of extruder settings, optimization of the extruder screw shape, optimization of the shape/thickness of the product, and reduction of standby time.

Extruders/Injection Molding—Multi-pump. The use of multiple pumps and an appropriate control system reduce the energy use of the extruder when not working at full capacity by only using the pump(s) needed.

Direct Drive Extruders. Use of a direct drive, instead of a gearbox or belt, will reduce losses by approximately 15% in extruders.

Injection Molding—Impulse Cooling. Impulse cooling regulates the cooling water use, increasing the cooling rate and reducing productivity (and downtime).

Injection Molding—Direct Drive. Use of a direct drive, instead of a gearbox or belt, will reduce losses by approximately 20% in injection molding machines.

SIC 32. Stone, Clay, Glass, and Concrete Products

Efficient Grinding. This is a general measure that refers to efficient grinding technologies, which can include the use of high efficiency classifiers or separators.

Process Controls. See discussion for SIC 28.

Top-Heating (Glass). Most electric furnaces use electrodes in the batch to melt the raw materials into glass. Newer designs with top-mounted electrodes can improve and maintain product quality, and obtain a higher share of salable glass, which leads to lower energy intensities (energy per kg of glass produced).

Autoclave Optimization. In various processes, autoclaves are used to press materials. Multiple autoclaves are used. By synchronizing the time of the use of the individual autoclaves, energy can be reduced by re-using the output of one to operate another.

SIC 33. Primary Metal Industries

Process Controls. See discussion for SIC 28.

Efficient Electric Melting. Electric arc furnaces are used in the steel industry to melt scrap. Only one mini-mill is operating in California. Multiple options are available to reduce the electricity consumption of the furnace, e.g., foamy slag, oxy-fuel injection, improved transformers, eccentric bottom tapping (EBT), as well as scrap preheating.

Near Net Shape Casting. Near net shape casting is the direct casting of the metal into very nearly the final shape, thereby eliminating other processing steps such as hot rolling, which can lead to significant energy savings.

SIC 34. Fabricated Metal Products
SIC 35. Industrial Machinery and Equipment
SIC 37. Transportation Equipment
SIC 38. Instruments and Related Products

Optimization Process (M&T). This is a general measure for optimizing the efficiency of painting processes, via such actions as the use of process controls, proper maintenance, and reducing the airflow rates in paint booths.

Scheduling. Optimization of the scheduling of various pieces of equipment can reduce downtime and hence save energy. Furthermore, improved control strategies can reduce standby energy use of equipment as part of an optimized scheduling system.

Efficient Curing Ovens. Efficiency options for curing ovens include the optimization of oven insulation, the use of heat recovery techniques, and the use of direct heating methods, such as infrared heating, microwave heating, and ultraviolet heating.

Machinery. Many machines (e.g., metal processing) use electricity or compressed air to drive the equipment. The use of compressed air systems should be minimized and replaced by direct drive systems, because of the low efficiency of the compressed air supply. Furthermore, many machines do not use high efficiency motors or speed controls.

SIC 36. Electrical and Electronic Products

Scheduling. See previous subsection.

Efficient Curing Ovens. See previous subsection.

Machinery. See previous subsection.

Efficient Processes (Welding, etc.). New more power efficient welding technology is developed. For welding robots, new servo-based systems reduce energy use. See also new transformers welding (see section 1.1).

SIC 39. Miscellaneous Manufacturing Industries

Scheduling. See discussion for SIC 34.

Efficient Machinery. See discussion for SIC 34.

Process Heating. Induction furnaces are often used for electric process heating. Improved operation and maintenance can reduce part-load operation, downtime, and tap-to-tap time. Furthermore, high frequency induction furnaces improve energy use.

Process Controls. See discussion for SIC 28.

<u>Natural Gas Measure Descriptions</u>

Cross-Cutting Efficiency Measures

Boilers

Improved Process Control. Flue gas monitors are used to maintain optimum flame temperature and monitor levels of carbon monoxide (CO), oxygen, and smoke in the flue gas. By combining an oxygen monitor with an intake airflow monitor, it is also possible to detect small leaks. Monitoring allows for improved control of the fuel/air mixture so that energy efficiency is maximized and pollutant emissions are minimized.

Maintain Boilers. Burners and condensate return systems can wear or get out of adjustment over time, which can cost a steam system up to 30% of its original efficiency over 2-3 years. Regular maintenance can ensure steam systems are operating at maximum efficiency.

Flue Gas Heat Recovery/Economizer. Heat from flue gases can be recovered using an economizer and used to preheat the feed water flowing into the boiler. By using waste heat to preheat feed water, the fuel consumption of the boiler can be reduced. This measure is fairly common in large boiler systems.

Blowdown Steam Heat Recovery. When water is blown from high-pressure boilers as part of regular blowdown procedures, the pressure reduction often produces substantial amounts of low-grade steam. This low-grade steam can be used for space heating and feed water preheating.

Upgrade Burner Efficiency. A boiler will run only as well as the burner performs. A poorly designed boiler with an efficient burner may perform better than a well-designed boiler with a poor burner. An efficient burner provides the proper air-to-fuel mixture throughout the full range of firing rates, without constant adjustment. An efficient natural gas burner requires only 2-3% excess oxygen, or 10-15% excess air in the flue gas, to burn fuel without forming excessive carbon monoxide.

Water Treatment. Water impurities can form scale on heat transfer tubes and surfaces and lead to corrosion of system components, which can steadily degrade the energy efficiency of a steam system. Water treatment can reduce scale and corrosion, and therefore help to maintain a steam system's optimal energy performance over time.

Load Control. A boiler economic load allocation system optimizes the loading of multiple boilers by providing steam to a common header to obtain the lowest cost per unit of steam. Modern, multiple burner load control, coupled with air trim control, can result in steam system fuel savings of 3-5%.

Improved Insulation. Advancements in insulating materials have produced a new generation of insulation with low heat capacity and better insulating capabilities. Energy savings of 6-26% can be achieved by upgrading boiler insulation and installing improved heater circuit controls (improved controls are often necessary to maintain proper output temperatures for older firebrick systems).

Steam Trap Maintenance. A simple program of checking steam traps to ensure they are operating properly can save significant amounts of energy. Without regular maintenance, steam traps can malfunction, wasting up to 10% of the energy consumed by a steam system.

Automatic Steam Trap Monitoring. Attaching automated monitors to steam traps allows for the quick diagnosis and correction of steam trap malfunction. This measure can lead to energy savings beyond the energy savings achieved through regular steam trap maintenance.

Leak Repair. As with steam traps, steam distribution pipes often have leaks that go unnoticed without a regular program of pipe inspection and maintenance. In addition to detecting and repairing leaks, thereby reducing wasted energy, this measure can also prevent small problems from developing into major leaks, which are often more difficult and expensive to repair.

Condensate Return. Returning the hot condensate that occurs within a steam system to the boiler can save energy and reduce the need to treat boiler feed water. The substantial savings in energy costs and purchased chemical costs associated with this measure often make the building of a return piping system financially attractive.

HVAC

Improve Ceiling Insulation. Installing fiberglass or cellulose insulation material in floor, wall, or roof cavities will reduce heat transfer across these surfaces. The type of building construction limits insulation possibilities. Choice of insulation material will vary depending on the roof construction type. The assumed scenario for this measure is to increase insulation from R-5 to R-24.

Install High Efficiency (95%) Condensing Furnace/Boiler. High efficiency condensing gas furnaces and boilers have AFUEs of greater than 90% compared to base efficiencies in the 80% range. For furnaces, efficiencies above 90% can be achieved with a number of technologies, pulse combustion being just one of many design approaches. Condensing boilers are available that operate with thermal efficiencies as high as 95% or more. These condensing units achieve their high efficiency by operating with stack gas temperatures around 100°F.

Stack Heat Exchanger. Air-to-air heat exchangers can be used to transfer heat between the intake ventilation air stream and the HVAC exhaust air stream. During periods when the outside air is colder than the inside air, the heat exchanger transfers heat from the exhaust air to the incoming air reducing heating energy use. When the outside air is warmer than the inside air, the heat exchanger transfers heat from the incoming air to the exhaust air, lowering the temperature of the incoming air and reducing cooling energy use.

Duct Insulation. Insulation material inhibits the transfer of heat through the air-supply duct. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated flexible duct, duct board, duct wrap, tacked or glued rigid insulation, and water proof hard shell materials for exterior ducts.

EMS Install. The term Energy Management System (EMS) refers to a complete building control system which usually can include controls for both lighting and HVAC systems. The HVAC control system may include on/off scheduling and warm-up routines. The complete lighting and HVAC control systems are generally integrated using a personal computer with control system software.

EMS Optimization. Energy management systems are frequently underutilized and have hundreds of minor inefficiencies throughout the system. Optimization of the existing system frequently results in substantial savings to the measures controlled by the EMS (e.g., lighting, HVAC) by minimizing waste.

Sector-Specific Natural Gas Efficiency Measures

SIC 20. Food and Kindred Products

Controls. This is a general measure to implement computer-based process controls, where applicable, to monitor and optimize various processes from an energy consumption perspective. In general, by monitoring key process parameters, processes can be fine-tuned to minimize energy consumption while still meeting quality and productivity requirements. Control systems can also reduce the time required to perform complex tasks and can often improve product quality and consistency while optimizing process operations. This measure could include the installation of controls based on neural networks, knowledge-based systems, or improved sensor technology.

Process Heat Recovery. This is a general measure to recover waste heat from processes wherever possible for use in other processes and/or facility applications, such as process feed preheating, space heating, water heating, and process air preheating.

Process Integration. Process integration refers to the exploitation of potential synergies that are inherent in any system that consists of multiple components working together. In plants that have multiple heating and cooling demands, the use of process integration techniques may significantly improve plant energy efficiency. Developed in the early 1970s, it is now an established methodology for continuous processes. The methodology involves the linking of hot and cold streams in a process in a thermodynamic optimal way. Process integration is the art of ensuring that the components are well suited and matched in terms of size, function, and capability.

Efficient Drying. Replacing existing dryers with the most efficient dryer technology can lead to energy savings. The most efficient dryers are those that recapture otherwise lost waste heat. Direct dryers are typically more efficient than indirect dryers. Typical efficiencies for direct dryers range from 95-98%, while indirect dryers typically have efficiencies in the range of 70-85%.

SIC 26. Paper and Allied Products

Controls. See discussion for SIC 20.

Closed Hood. Paper machines with enclosed hoods require about one-half the amount of air per tonne of water evaporated that paper machines with a canopy hoods require. Enclosing the paper machine reduces thermal energy demands since a smaller volume of air is heated.

Process Integration. See discussion for SIC 20.

Extended Nip Press. After paper is formed, it is pressed to remove as much water as possible. Normally, pressing occurs between two felt liners pressed between two rotating cylinders. Extended nip presses use a large concave shoe instead of one of the rotating cylinders. The additional pressing area allows for greater water extraction, (about 5-7% more water removal) to a level of 35-50% dryness. Since this technology reduces the load on the dryer, it allows plants to increase capacity up to 25% in cases where the plant was dryer limited.

SIC 28. Chemicals and Allied Products

Controls. See discussion for SIC 20.

Process Integration. See discussion for SIC 20.

Improved Separation Processes. Separation processes are important energy users, for which energy efficiency improvement is often possible. The most common separation processes in the chemical industry are distillation, crystallization, adsorption, extraction, and membranes. Improved separation processes that can lead to energy savings include combined reaction and distillation (e.g., reactive distillation), ion exchange and bio-separation, and hybrid processes.

Thermal Oxidizers. In many facilities VOC emissions are controlled by thermal oxidizers. The VOC-containing waste gas stream is mixed with natural gas and combusted, incinerating the VOCs. Regenerative thermal oxidizers can be used to recover some of the heat generated during the incineration. The heat can be used for preheating combustion air or steam generation.

SIC 29. Petroleum and Coal Products

Controls. See discussion for SIC 20.

Flare Gas Controls and Recovery. Flare gas recovery (or zero flaring) is a strategy evolving from the need to improve environmental performance. Reduction of flaring can be achieved by improved recovery systems, including installing recovery compressors and collection and storage tanks. Reduction of flaring will not only result in reduced air pollutant emissions, but also in increased energy efficiency replacing fuels, as well as less negative publicity around flaring.

Fouling Control. Fouling is a deposit build-up in heat transfer units and piping that impedes heat transfer, driving the combustion of additional fuel. Currently, various methods to reduce fouling focus on process control, temperature control, regular maintenance and cleaning of the heat exchangers (either mechanically or chemically), and retrofit of reactor tubes.

Process Integration. See discussion for SIC 20.

Efficient Furnaces. This measure considers improvements to furnace efficiency. The efficiency of furnaces can be improved by improving heat transfer characteristics, enhancing flame luminosity, installing recuperators or air-preheaters, and improved process controls. New burner designs can facilitate improved mixing of fuel and air and more efficient heat transfer. Many different concepts are developed to achieve these goals, including lean pre-mix burners, swirl burners, pulsating burners, and rotary burners.

SIC 32. Stone, Clay, Glass, and Concrete Products

Controls and Management. See discussion for SIC 20.

Efficient Burners. The efficiency of natural gas-fired process heaters is governed by burner performance. An efficient burner provides the proper air-to-fuel mixture throughout the full range of firing rates, without constant adjustment. An efficient natural gas burner requires only 2-3% excess oxygen, or 10-15% excess air in the flue gas, to burn fuel without forming excessive carbon monoxide.

Oxy-Fuel. Oxy-fuel furnaces provide an oxygen-rich combustion environment, which improves energy efficiency while reducing NOx emissions. The energy savings of converting to an oxy-fuel furnace depend on the energy use of the current furnace, use of electric boosting, and air leakage. Energy savings are typically between 20-45% (45% for replacing energy inefficient furnaces).

Batch Cullet Preheating. In a cullet preheater, the waste heat of the fuel-fired furnace is used to preheat the incoming cullet batch. Cullet preheaters are marketed by a number of companies, and are either direct or indirect preheaters. In the direct preheater, the cullet is in direct contact with the flue gas. The indirect preheater is a cross-flow plate heat exchanger. Energy savings of cullet preheaters are estimated to be between 12-20%.

SIC 33. Primary Metal Industries

Controls and management. See discussion for SIC 20.

Preventative Maintenance. Preventative maintenance involves training personnel to be attentive to energy consumption and efficiency. Successful programs have been launched in many industries. Examples in steel making include timely closing of furnace doors to reduce heat leakage and reducing material waste in the shaping steps. At an integrated steel plant in the Netherlands, 2% of total energy use was saved via preventative maintenance measures such as those cited above.

Efficient Burners. See discussion for SIC 32.

Heat Recovery. See discussion for SIC 20.

SIC 34. Fabricated Metal Products

Combustion Controls. Combustion controls aim to improve combustion efficiency by ensuring the proper air-to-fuel ratio is used, which generally requires establishing the proper amount of excess air.

Efficient Burners. See discussion for SIC 32.

Optimize Furnace Operations. The improvement opportunity addresses the losses that are associated with the combustion of fuel and the transfer of the energy from this fuel to the material within a furnace. Key improvement areas include controlling the air-to-fuel ratio, reducing excess air, preheating of combustion air or oxidant, recovering furnace waste heat, and oxygen enrichment.

Insulation/Reduce Heat Losses. This measure includes all opportunities for better heat containment within a furnace. Opportunities include improved insulation of furnace walls, reduction or elimination of air infiltration, repair and maintenance of furnace seals, and improved insulation of related piping and ductwork.

A.5 Complete Sector-Level Measure Lists

For reference, complete lists of the energy-efficiency measures for existing buildings in each sector are presented in this section. Field descriptions are explained in Section A.1.

Residential ASSET Model Measure Identifiers

A complete list of the residential sector energy-efficiency measures described in Section A.2 and simulated in the ASSET model are presented in Table A-96.

Table A-96: Complete List of Residential ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description	Decision Type
Lights	Elec	RLGT_40	R_Inc_40W	40 Watt - screw-in incandescent	ROB
Lights	Elec	RLGT_40	R_CFL_Under14W	Under 14 Watt - screw-in CFL	ROB
Lights	Elec	RLGT_75	R_Inc_60_to_100W	60 to 100 Watt - screw-in incandescent	ROB
Lights	Elec	RLGT_75	R_CFL_14_to_25W	14 to 25 Watt - screw-in CFL	ROB
Lights	Elec	RLGT_150	R_Inc_Over100W	Over 100 Watt - screw-in incandescent	ROB
Lights	Elec	RLGT_150	R_CFL_Over25W	Over 25 Watt - screw-in	ROB
Lights	Elec	RLGT_FIX	R_Inc_Fixture	Incandescent Fixture	CON
Lights	Elec	RLGT_FIX	R_CFL_Fixture	Modular CFL (Fixture)	CON
Lights	Elec	RLGT_REFL	R_Inc_Reflector	Incandescent Reflector - R30	ROB
Lights	Elec	RLGT_REFL	R_CFL_Reflector	CFL Reflector - R30, R40	ROB
Lights	Elec	RLGT_REFL20	R_Inc_Reflector20	Incandescent Reflector - R20	ROB
Lights	Elec	RLGT_REFL20	R_LED_Reflector_CET	LED Reflector, Current Emerging Tech	ROB
Lights	Elec	RLGT_TOR1	R_Inc_Torchiere	Non-CFL Torchiere	CON
Lights	Elec	RLGT_TOR1	R_CFL_Torchiere	CFL Torchiere	CON
Lights	Elec	RLGT_EX	R_LED_EXIT	LED Exit Sign	RET
Lights	Elec	RLGT_XMAS	R_Inc_XMAS	Incandescent Christmas Lights	ROB
Lights	Elec	RLGT_XMAS	R_LEDXMAS_CET	LED Christmas Lights, Current Emerging Tech	ROB
Lights	Elec	ROCC	R_OCC_Sensor	Occupancy Sensor - Ceiling or Wall Box	RET
Lights	Elec	RLGT_EXTC	R_ExtLite_Control	Photocell, Time Clock	RET

Table A-96 (cont'd): Complete List of Residential ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description	Decision Type
Lights	Elec	RLGT_T12T8	R_T12_4ft	T12 Fluorescent Lighting	CON
Lights	Elec	RLGT_T12T8	R_T8_4ft	Premium T8 El Ballast	CON
Lights	Elec	RLGT_TBL	R_Inc_Table	Incandescent Table Lamp	CON
Lights	Elec	RLGT_TBL	R_CFL_Table	CFL Table Lamp	CON
Misc.	Elec	RRRCY	R_REF_Recyl	Refrigerator Recycling	RET
Misc.	Elec	RFRCY	R_FRZ_Recyl	Freezer Recycling	RET
Misc.	Elec	RREF	R_REF_Base	Refrigerator – Base	ROB
Misc.	Elec	RREF	R_REF_ES	Refrigerator – ENERGY STAR	ROB
Misc.	Elec	R_POOL	R_1SpeedPP_Base	Pool Pump	ROB
Misc.	Elec	R_POOL	R_1SpeedPP	Efficient Single-Speed Pool Pump, 1 hp	ROB
Misc.	Elec	R_POOL	R_2SpeedPP	Efficient Two-Speed Pool Pump	ROB
Water Heaters	Elec	RCW	R_CW_MEF1.04	Clothes Washer - Elec Water Heat MEF=1.04, 2.65 Capacity	ROB
Water Heaters	Elec	RCW	R_CW_MEF1.26	Clothes Washer - Elec Water Heat MEF=1.26, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Elec	RCW	R_CW_MEF1.60	Clothes Washer - Elec Water Heat MEF=1.60, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Elec	RCW	R_CW_MEF1.80	Clothes Washer - Elec Water Heat MEF=1.80, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Elec	RCW	R_CW_MEF2.0	Clothes Washer - Elec Water Heat MEF=2.0, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Elec	RCW	R_CW_MEF2.2	Clothes Washer - Elec Water Heat MEF=2.2, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Elec	RDW	R_DW_EF0.46	Dishwasher - Elec Water Heat, 215 wash cycles EF=0.46	ROB
Water Heaters	Elec	RDW	R_DW_EF0.58	Dishwasher - Elec Water Heat, EF=0.58	ROB
Water Heaters	Elec	RDW	R_DW_EF0.62	Dishwasher - Elec Water Heat, EF=0.62	ROB
Water Heaters	Elec	RDW	R_DW_EF0.68	Dishwasher - Elec Water Heat, EF=0.68	ROB

Table A-96 (cont'd): Complete List of Residential ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description	Decision Type
Water Heaters	Elec	RWH	R_WHEle_EF0.88	Base Efficiency Water Heater - Electric, EF=0.88	ROB
Water Heaters	Elec	RWH	R_WHEle_EF0.93	High Efficiency Water Heater - Electric, EF=0.93	ROB
Water Heaters	Elec	RSOLWH	R_WHEle_Solar_CET	Solar Water Heater - Retrofit	RET
Water Heaters	Elec	RFA	R_WH_FA	Faucet Aerators, Elec Water Heat	RET
Water Heaters	Elec	RPW	R_WH_PW	Pipe Wrap, Elec Water Heat	RET
Water Heaters	Elec	RSHW	R_WH_Shw	Low Flow Showerhead, Elec Water Heat	RET
Water Heaters	Gas	RCW_G	R_CW_MEF1.04_G	Clothes Washer - Gas Water Heat & Dry, 2.65 Capacity MEF=1.04	ROB
Water Heaters	Gas	RCW_G	R_CW_MEF1.26_G	Clothes Washer - Gas Water Heater & Dry, MEF=1.26, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Gas	RCW_G	R_CW_MEF1.60_G	Clothes Washer - Gas Water Heater & Dry, MEF=1.60, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Gas	RCW_G	R_CW_MEF1.80_G	Clothes Washer - Gas Water Heater & Dry, MEF=1.80, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Gas	RCW_G	R_CW_MEF2.0_G	Clothes Washer - Gas Water Heater & Dry, MEF=2.0, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Gas	RCW_G	R_CW_MEF2.2_G	Clothes Washer - Gas Water Heater & Dry, MEF=2.2, 3.5 Capacity for Single family and 2.65 Capicity for Multifamily	ROB
Water Heaters	Both	RDW_G	R_DW_EF0.46_G	Dishwasher - Gas Water Heat, 215 wash cycles EF=0.46	ROB
Water Heaters	Both	RDW_G	R_DW_EF0.58_G	Dishwasher - Gas Water Heater, EF=0.58	ROB
Water Heaters	Both	RDW_G	R_DW_EF0.62_G	Dishwasher - Gas Water Heater, EF=0.62	ROB
Water Heaters	Both	RDW_G	R_DW_EF0.68_G	Dishwasher - Gas Water Heater, EF=0.68	ROB

Table A-96 (cont'd): Complete List of Residential ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description	Decision Type
Water Heaters	Gas	RWH_G	R_WHGas_EF0.60	Base Efficiency Water Heater - Gas, EF = 0.60	ROB
Water Heaters	Gas	RWH_G	R_WHGas_EF0.63	High Efficiency Water Heater - Gas, EF = 0.63	ROB
Water Heaters	Gas	RWH_G	R_WHGAS_POU	Point of Use Water Heater - Gas	ROB
Water Heaters	Gas	RSOLWH_G	R_WHGAS_Solar_CET	Solar Water Heater - Retrofit	RET
Water Heaters	Gas	RBOILER_G	R_BoilerMF_Base	Standard Efficiency Small Boiler	ROB
Water Heaters	Gas	RBOILER_G	R_BoilerMF	High Efficiency Small Multifamily Boiler – AFUE 82%	ROB
Water Heaters	Gas	RWHBC_G	R_Bcontroler_MF	Circulation Pump Time Clock, Multifamily Boiler Controller	RET
Water Heaters	Gas	RFA_G	R_WH_FA_G	Faucet Aerator, Gas Water Heat	RET
Water Heaters	Gas	RPW_G	R_WH_PW_G	Pipe Wrap, Gas Water Heat	RET
Water Heaters	Gas	RSHW_G	R_WH_Shw_G	Low Flow Showerhead, Gas Water Heat	RET
HVAC	Elec	RCAC	R_CAC_SEER10	CAC 10 SEER	ROB
HVAC	Elec	RCAC	R_CAC_SEER13	CAC 13 SEER (w/Duct, 2007+)	ROB
HVAC	Elec	RCAC	R_CAC_SEER15	CAC 15 SEER (w/Duct, 2007+)	ROB
HVAC	Elec	RHP	R_HP_SEER10	AC Heat Pump 10 SEER	ROB
HVAC	Elec	RHP	R_HP_SEER13	AC Heat Pump 13 SEER (w/Duct, 2007+)	ROB
HVAC	Elec	RHP	R_HP_SEER15	AC Heat Pump 15 SEER (12.70 EER)/8.8 HSPF (3.74 COP) (w/Duct, 2007+)	ROB
HVAC	Elec	RRAC	R_RAC_Base	Room A/C SEER=8.8	ROB
HVAC	Elec	RRAC	R_RAC_ES	Room A/C SEER=10.3	ROB
HVAC	Elec	RFAN	R_WholeHFan	Whole House Fan	RET
HVAC	Elec	RDIAG	R_AC_Tuneup	AC Diagnostic and Tune-up	RET
HVAC	Elec	RNECON	R_NiteEcon_CET	Night Economizer, Current Emerging Technology	RET

Table A-96 (cont'd): Complete List of Residential ASSET Model Measure Identifiers

End Use	Fuel Type	Competition Group ID	TechID	Measure Description	Decision Type
HVAC	GAS	RFURN	R_Furn_AFUE81	Central Gas Furnace AFUE = 81	ROB
HVAC	GAS	RFURN	R_Furn_AFUE90	Central Gas Furnace AFUE = 90	ROB
HVAC	GAS	RFURN	R_Furn_AFUE92	Central Gas Furnace AFUE = 92	ROB
HVAC	GAS	RFURN	R_Furn_AFUE96	Central Gas Furnace AFUE = 96	ROB
HVAC	Elec	RWIND	R_Window_Base	Base Window	ROB
HVAC	Elec	RWIND	R_Window_U25	U-0.25 (tint) Window	ROB
HVAC	Elec	RWINSLE	R_WallIns_R0R13E	Wall Blow-In R-0 to R-13 Insulation - Electric Space Heat, CAC	RET
HVAC	Both	RWINSLG	R_WallIns_R0R13G	Wall Blow-In R-0 to R-13 Insulation - Gas Space Heat, CAC	RET
HVAC	Elec	RAINSLE	R_CeilIns_R19R30E	Ceiling Insulation R19 to R30 - Electric Space Heat, CAC	RET
HVAC	Both	RAINSLG	R_CeilIns_R19R30G	Ceiling Insulation R19 to R30 - Gas Space Heat, CAC	RET
HVAC	Elec	RDUCTE	R_DUCTR_E	Duct Repair – Electric Space Heat, CAC	RET
HVAC	Both	RDUCTG	R_DUCTR_G	Duct Repair – GAS Space Heat, CAC	RET
HVAC	Elec	RROOF	R_Roof	Base Roof	ROB
HVAC	Elec	RROOF	R_CoolRoof_CET	Cool Roof, Current Emerging Technology	ROB

Commercial ASSET Model Measure Identifiers

A complete list of the commercial sector energy-efficiency measures as described in Section A.3 and simulated in the ASSET model is presented in Table A-97.

Table A-97: Commercial Sector Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Lights	Elec	T12T8_4Ft	C_T12_Fixture_4Ft	T12 fixture, 4 ft, 2 lamp	CON
Lights	Elec	T12T8_4Ft	C_T8_Fixture_4Ft	T8 Fixture, 4 ft 2 lamp	CON
Lights	Elec	T12T8_4Ft	C_T8_2G_4Ft	Second generation T8, 4ft, 2 lamp	CON
Lights	Elec	T12T8_8Ft	C_T12_Fixture_8Ft	T12 fixture, 8 ft, 2 lamp	CON
Lights	Elec	T12T8_8Ft	C_T8_Fixture_8Ft	T8 Fixture, 8 ft 2 lamp	CON
Lights	Elec	T12T8_8Ft	C_T8_2G_8Ft	Second generation T8, 8 ft, 2 lamp	CON
Lights	Elec	IncFix1	C_INC_Fixture_Under61W	Fixture, Incandescent Bulb less than 61 watts	CON
Lights	Elec	IncFix1	C_CFL_Fixture_Under15W	Fixture, Pin based CFL less than 15 watts	CON
Lights	Elec	IncFix2	C_INC_Fixture_61_to_99W	Fixture, Incandescent Bulb 60-99 watts	CON
Lights	Elec	IncFix2	C_CFL_Fixture_16_24W	Fixture, Pin based CFL 15-24 watts	CON
Lights	Elec	IncFix3	C_INC_Fixture_100_to_150W	Fixture, Incandescent Bulb 100-150 watts	CON
Lights	Elec	IncFix3	C_CFL_Fixture_Over24W	Fixture, Pin based CFL greater than 24 watts	CON
Lights	Elec	Inc1	C_INC_Under61W	Incandescent Bulb less than 61 watts	ROB
Lights	Elec	Inc1	C_CFL_Under15W	Screw-in CFL less than 15 watts	ROB
Lights	Elec	Inc2	C_INC_61_to_99W	Incandescent Bulb 60-99 watts	ROB
Lights	Elec	Inc2	C_CFL_16_24W	Screw-in CFL 15-24 watts	ROB
Lights	Elec	Inc3	C_INC_100_to_150W	Incandescent Bulb 100-150 watts	ROB
Lights	Elec	Inc3	C_CFL_Over24W	Screw-in CFL greater than 24 watts	ROB
Lights	Elec	IncRefl	C_Reflector_INC	Incandescent reflector	ROB
Lights	Elec	IncRefl	C_Reflector_CFL	CFL reflector	ROB
Lights	Elec	DL1	C_Lt_DLInst	Daylighting with dimmable ballast	RET

Table A-97 (cont'd): Commercial Sector Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Lights	Elec	Exit1	C_LT_EXLED	LED Exit Sign	RET
Lights	Elec	HighBayT8	C_MV_HighBay	High Bay Mercury Vapor (Over 14 ft)	CON
Lights	Elec	HighBayT8	C_T8_HighBay	High Bay T8 (Over 14 ft)	CON
Lights	Elec	INTHID1i	C_INC_150_to_500W_Int	Interior Incandescent 150-500 watts	CON
Lights	Elec	INTHID1i	C_PSMH_Under151W_Int_INC	Interior Pulse Start Metal Halide under 151 watts	CON
Lights	Elec	INTHID1mv	C_MV_Under301W_Int	Interior Mercury Vapor under 301 watts	CON
Lights	Elec	INTHID1mv	C_PSMH_Under151W_Int_MV	Interior Pulse Start Metal Halide under 151 watts	CON
Lights	Elec	INTHID2mv	C_MV_Over300W_Int	Interior Mercury Vapor over 300 watts	CON
Lights	Elec	INTHID2mv	C_PSMH_Over150W_Int	Interior Pulse Start Metal Halide over 150 watts	CON
Lights	Elec	T12Delamp4FT	C_T12_Delamping_4Ft	Delamping 4 Ft T12 to T8	RET
Lights	Elec	T12Delamp8FT	C_T12_Delamping_8Ft	Delamping 8 Ft T12 to T8	RET
Lights	Elec	EXTHID1i	C_INC_150_to_500W_Ext	Exterior Incandescent 150-500 watts	CON
Lights	Elec	EXTHID1i	C_PSMH_Under151W_Ext_INC	Exterior Pulse Start Metal Halide under 151 watts	CON
Lights	Elec	EXTHID1mv	C_MV_Under301W_Ext	Exterior Mercury Vapor under 301 watts	CON
Lights	Elec	EXTHID1mv	C_PSMH_Under151W_Ext_MV	Exterior Pulse Start Metal Halide under 151 watts	CON
Lights	Elec	EXTHID2mv	C_MV_Over300W_Ext	Exterior Mercury Vapor over 300 watts	CON
Lights	Elec	EXTHID2mv	C_PSMH_Over150W_Ext	Exterior Pulse Start Metal Halide over 150 watts	CON
Lights	Elec	Signs	C_NeonSignage	Neon Signs	CON
Lights	Elec	Signs	C_LEDSignage	LED Signs	CON
Lights	Elec	OCC1	C_OCCSensor_Motion	Motion sensor	RET
Lights	Elec	OCCPL	C_OCCSensor_Plugload	Plug load motion sensor	RET
Lights	Elec	ExtLTCtrl	C_LT_PCNoCtrl	No exterior lighting control	CON
Lights	Elec	ExtLTCtrl	C_LT_PCPC	Photo cell exterior lighting control	CON
Lights	Elec	ExtLTCtrl	C_LT_PCTC	Time clock exterior lighting control	CON
Lights	Elec	ExtLTCtrl	C_LT_PCPT	Photo cell and time clock exterior lighting control	CON

Table A-97 (cont'd): Commercial Sector Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Food	Elec	C_FD_ConvecOven_Elec	C_Oven_Convec_Elec_Base	Convection Oven (Electric) Base	ROB
Food	Elec	C_FD_ConvecOven_Elec	C_Oven_Convec_Elec_HE	Convection Oven (Electric) HE ≥70%	ROB
Food	Gas	C_FD_ConvecOven_Gas	C_Oven_Convec_Gas_Base	Convection Oven (Gas) Base	ROB
Food	Gas	C_FD_ConvecOven_Gas	C_Oven_Convec_Gas_HE	Convection Oven (Gas) HE ≥40%	ROB
Food	Elec	C_FD_Fryer_Elec	C_Fryer_Elec_Base	Fryer (Electric) Base	ROB
Food	Elec	C_FD_Fryer_Elec	C_Fryer_Elec_ES	Fryer (Electric) EStar ≥80%	ROB
Food	Gas	C_FD_Fryer_Gas	C_Fryer_Gas_Base	Fryer (Gas) Base	ROB
Food	Gas	C_FD_Fryer_Gas	C_Fryer_Gas_ES	Fryer (Gas) EStar ≥50%	ROB
Food	Elec	C_FD_Griddle_Elec	C_Griddle_Elec_Base	Griddle (Electric) Base	ROB
Food	Elec	C_FD_Griddle_Elec	C_Griddle_Elec_HE	Griddle (Electric) HE ≥70%	ROB
Food	Gas	C_FD_Griddle_Gas	C_Griddle_Gas_Base	Griddle (Gas) Base	ROB
Food	Gas	C_FD_Griddle_Gas	C_Griddle_Gas_HE	Griddle (Gas) HE ≥38%	ROB
Food	Elec	C_FD_HoldingCB_Elec	C_HoldCabinet_Elec_Base	Holding Cabinet (Electric) Base	ROB
Food	Elec	C_FD_HoldingCB_Elec	C_HoldCabinet_Elec_HE	Holding Cabinet (Electric) HE (<=20W/ft3)	ROB
Food	Elec	C_FD_Steamer_Elec	C_Steamer_Elec_Base	Pressureless Steamer (Electric) Base	ROB
Food	Elec	C_FD_Steamer_Elec	C_Steamer_Elec_ES	Pressureless Steamer (Electric) EStar ≥50%	ROB
Food	Gas	C_FD_Steamer_Gas	C_Steamer_Gas_Base	Pressureless Steamer (Gas) Base	ROB
Food	Gas	C_FD_Steamer_Gas	C_Steamer_Gas_ES	Pressureless Steamer (Gas) EStar ≥38%	ROB
Food	Elec	C_FD_Oven_Elec	C_Oven_Elec_Base	Combination Oven (Electric) Base	ROB
Food	Elec	C_FD_Oven_Elec	C_Oven_Elec_HE	Combination Oven (Electric) HE ≥60%	ROB
Food	Gas	C_FD_Oven_Gas	C_Oven_Gas_Base	Combination Oven (Gas) Base	ROB
Food	Gas	C_FD_Oven_Gas	C_Oven_Gas_HE	Combination Oven (Gas) HE ≥40%	ROB
Food	Elec	C_FD_IceMaker	C_Ref_IceMaker_Base	Commercial Ice Machine Base	ROB
Food	Elec	C_FD_IceMaker	C_Ref_IceMaker_T2	Commercial Ice Machine Tier 2	ROB
Food	Elec	C_FD_SD_Refrig	C_Ref_SD_Refrig_Base	Solid-Door Reach-In Refrigerator Base	ROB
Food	Elec	C_FD_SD_Refrig	C_Ref_SD_Refrig_T2	Solid-Door Reach-In Refrigerator Tier 2	ROB

Table A-97 (cont'd): Commercial Sector Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Food	Elec	C_FD_SD_Freezer	C_Ref_SD_Freezer_Base	Solid-Door Reach-In Freezer Base	ROB
Food	Elec	C_FD_SD_Freezer	C_Ref_SD_Freezer_T2	Solid-Door Reach-In Freezer Tier 2	ROB
Food	Elec	C_FD_GD_Refrig	C_Ref_GD_Refrig_Base	Glass-Door Reach-In Refrigerator Base	ROB
Food	Elec	C_FD_GD_Refrig	C_Ref_GD_Refrig_T2	Glass-Door Reach-In Refrigerator Tier 2	ROB
HVAC	Elec	C_HV_ChillerCent	C_HV_ChCent_Base	Base Centrifugal Chiller	ROB
HVAC	Elec	C_HV_ChillerCent	C_HV_ChCent_HE	High-Efficiency Centrifugal Chiller	ROB
HVAC	Elec	C_HV_ChillerRecip	C_HV_ChRec_Base	Reciprocating Chillers Base	ROB
HVAC	Elec	C_HV_ChillerRecip	C_HV_ChRec_HE	Reciprocating Chillers	ROB
HVAC	Elec	C_HV_ChillerAux	C_HV_ChillerAux	VSD Chilled Water Loop Pumps	RET
HVAC	Elec	C_HV_Shell_CoolRoof	C_HV_CoolRoof	Cool Roofs	RET
HVAC	Elec	C_HV_Shell_WindFilm	C_HV_WindowFilm	Window Film	RET
HVAC	Gas	C_HV_Boiler	C_HV_Boiler_80	Gas Space Heating Boilers 80%	ROB
HVAC	Gas	C_HV_Boiler	C_HV_Boiler_85	Gas Space Heating Boilers 85%	ROB
HVAC	Gas	C_HV_Boiler	C_HV_Boiler_95_CET	Gas Space Heating Boilers 95% - current emerging tech	ROB
HVAC	Gas	C_HV_Furnace	C_HV_Furn_AFUE80	Gas Furnace Base - AFUE 80	ROB
HVAC	Gas	C_HV_Furnace	C_HV_Furn_AFUE92	HE Gas Furnace - AFUE 85	ROB
HVAC	Gas	C_HV_Furnace	C_HV_Furn_AFUE94	Condensing Gas Furnace - AFUE 94	ROB
HVAC	Elec	C_HV_Motor_0-10	C_HV_Motor_0-10_Base	0-10 hp Vent Motor BaseEff	ROB
HVAC	Elec	C_HV_Motor_0-10	C_HV_Motor_0-10	0-10 hp Vent Motor PremEff	ROB
HVAC	Elec	C_HV_Motor_11-25	C_HV_Motor_11-25_Base	11-25 hp Vent Motor BaseEff	ROB
HVAC	Elec	C_HV_Motor_11-25	C_HV_Motor_11-25	11-25 hp Vent Motor PremEff	ROB
HVAC	Elec	C_HV_Motor_26-49	C_HV_Motor_26-49_Base	26-49 hp Vent Motor BaseEff	ROB
HVAC	Elec	C_HV_Motor_26-49	C_HV_Motor_26-49	26-49 hp Vent Motor PremEff	ROB
HVAC	Elec	C_HV_Motor_50+	C_HV_Motor_50+_Base	50+ hp Vent Motor BaseEff	ROB
HVAC	Elec	C_HV_Motor_50+	C_HV_Motor_50+	50+ hp Vent Motor PremEff	ROB
HVAC	Elec	C_HV_Paclt65	C_HV_PAClt65_10	Packaged A/C (<65k 10 SEER)	ROB
HVAC	Elec	C_HV_Paclt65	C_HV_PAClt65_13	Packaged A/C (<65k 13 SEER)	ROB
HVAC	Elec	C_HV_Paclt65	C_HV_PAClt65_15	Packaged A/C (<65k 15 SEER)	ROB
HVAC	Elec	C_HV_Pacgt65	C_HV_PACgt65_10	Packaged A/C (>=65k 10 EER)	ROB

Table A-97 (cont'd): Commercial Sector Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
HVAC	Elec	C_HV_Pacgt65	C_HV_PACgt65_11	Packaged A/C (>=65k 11 EER)	ROB
HVAC	Elec	C_HV_Pacgt65	C_HV_PACgt65_12	Packaged A/C (>=65k 12 EER)	ROB
HVAC	Elec	C_HV_PTAC	C_HV_PTAC_Base	PTAC (< 9 EER)	ROB
HVAC	Elec	C_HV_PTAC	C_HV_PTAC_HE	PTAC (> 9 EER)	ROB
HVAC	Elec	C_HV_PTHP	C_HV_PTHP_Base	PTHP (9 EER)	ROB
HVAC	Elec	C_HV_PTHP	C_HV_PTHP_HE	PTHP 10 EER & 3 COP	ROB
HVAC	Elec	C_HV_PkgAC_Tuneup	C_HV_PkgAC_Tuneup	Package AC/DX Tune Up	RET
HVAC	Elec	C_HV_Retro_Vent	C_HV_Retro_Vent	Retro-commissioning	RET
HVAC	Elec	C_HV_Retro_Chiller	C_HV_Retro_Chiller	Electric Chiller Retro-commissioning	RET
HVAC	Elec	C_HV_VSD_Motor_10-25	C_HV_VSD_Motor_10-25	10-25 hp VSD for VAV System	RET
HVAC	Elec	C_HV_VSD_Motor_26-49	C_HV_VSD_Motor_26-49	26-49 hp VSD for VAV System	RET
HVAC	Elec	C_HV_VSD_Motor_50-100	C_HV_VSD_Motor_50-100	50-100 hp VSD for VAV System	RET
WH	Gas	C_WH_Boiler	C_WH_Boiler_80	Gas Water Heating Boiler - Base 80	ROB
WH	Gas	C_WH_Boiler	C_WH_Boiler_85	Gas Water Heating Boiler - HE 85	ROB
WH	Gas	C_WH_Boiler	C_WH_Boiler_95_CET	Gas Water Heating Boiler - HE 95 - CET	ROB
WH	Gas	C_WH_Washer	C_ClothesWasher_Base	Commercial Clothes Washer - Base (Gas)	ROB
WH	Gas	C_WH_Washer	C_ClothesWasher_HE	Commercial Clothes Washer - HE (Gas)	ROB
WH	Gas	C_WH_WaterHeater	C_WH_Storage_Base	Gas Storage Water Heater - Base	ROB
WH	Gas	C_WH_WaterHeater	C_WH_Storage_HE	Gas Storage Water Heater - HE (EF>=0.86)	ROB
WH	Gas	C_WH_WaterHeater	C_WH_Instant	Instantaneous Water Heater - Gas	ROB
WH	Gas	C_WH_SolarWH	C_WH_Storage_Solar	Solar Water Heating back-up for Gas Storage Water Heater	RET
WH	Gas	C_WH_CircCtrl	C_WH_CircTimer	Water Heater Setback Gas	RET
Refrig	Elec	C_Ref_NCover_Frz	C_Ref_NCover_Frz	Night Covers - LowTemp Coffin Cases	RET
Refrig	Elec	C_Ref_NCover_Ref	C_Ref_NCover_Ref	Night Covers - MedTemp Vertical Cases	RET
Refrig	Elec	C_Ref_SDAutoClose	C_Ref_SDAutoClose	Auto Closer for Walk-in Solid-Door	RET
Refrig	Elec	C_Ref_GDAutoClose	C_Ref_GDAutoClose	Auto Closer for Walk-In Glass-Doors	RET
Refrig	Elec	C_Ref_StripCurt	C_Ref_StripCurt	Strip Curtains for Walk-ins	RET

Table A-97 (cont'd): Commercial Sector Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Refrig	Elec	C_Ref_Gaskets	C_Ref_Gaskets	Walk-In Cooler/Freezer Door Gaskets	RET
Refrig	Elec	C_Ref_ASHCtrl	C_Ref_ASHCtrl	Anti-Sweat Heater Controls	RET
Refrig	Elec	C_Ref_SucLnIns	C_Ref_SucLnIns	Suction Line Insulation	RET
Refrig	Elec	C_Ref_EvapFan_Ctrl	C_Ref_EvapFan_Ctrl	Evaporator Fan Controller for Walk-Ins	RET
Refrig	Elec	C_Ref_EvapFanMT	C_Ref_EvapFan_Base	Evaporator Fan Motors - Shaded Pole	ROB
Refrig	Elec	C_Ref_EvapFanMT	C_Ref_EvapFan_PSC	Evaporator Fan Motors - PSC	ROB
Refrig	Elec	C_Ref_EvapFanMT	C_Ref_EvapFan_ECM	Evaporator Fan Motors - ECM	ROB
Refrig	Elec	C_Ref_OpenMDToGD	C_Ref_OpenMDToGD_Base	Open Multi-Deck to New HiEff Glass Door Reach-in (Base)	ROB
Refrig	Elec	C_Ref_OpenMDToGD	C_Ref_OpenMDToGD_HE	Open Multi-Deck to New HiEff Glass Door Reach-in (HiEff)	ROB
Refrig	Elec	C_Ref_NoASHGD	C_Ref_NoASHGD_Base	New HiEff LowTemp NoASH Glass Door Case (Base)	ROB
Refrig	Elec	C_Ref_NoASHGD	C_Ref_NoASHGD_HE	New HiEff LowTemp NoASH Glass Door Case (Base)	ROB
Refrig	Elec	C_Ref_Sngl2Mplx_AirC	C_Ref_Sngl2Mplx_AirC_Base	Single Compressor to Multiplex AirCooled System - Base	CON
Refrig	Elec	C_Ref_Sngl2Mplx_AirC	C_Ref_Sngl2Mplx_AirC_HE	Single Compressor to Multiplex AirCooled System	CON
Refrig	Elec	C_Ref_Sngl2Mplx_EvapC	C_Ref_Sngl2Mplx_EvapC_Base	Single Compressor to Multiplex EvapCooled System - Base	CON
Refrig	Elec	C_Ref_Sngl2Mplx_EvapC	C_Ref_Sngl2Mplx_EvapC_HE	Single Compressor to Multiplex EvapCooled System	CON
Refrig	Elec	C_Ref_MplxBaseToFHP_AirCond	C_Ref_MplxBase_AirCond	Base Multiplex Air-Cooled Condenser System (noFHP or HE Cond)	CON
Refrig	Elec	C_Ref_MplxBaseToFHP_AirCond	C_Ref_MplxFHP_AirCond	Multiplex Air-Cooled System with FHP (Fixed setpoint)	CON
Refrig	Elec	C_Ref_MplxFHPToEE_AirCond	C_Ref_MplxEE_AirCond	Energy Efficient Air-Cooled Condenser	ROB
Refrig	Elec	C_Ref_MplxBaseToFHP_EvapCond	C_Ref_MplxBase_EvapCond	Base Multiplex Evap-Cooled Condenser System (noFHP or HE Cond)	CON
Refrig	Elec	C_Ref_MplxBaseToFHP_EvapCond	C_Ref_MplxFHP_EvapCond	Multiplex Evap-Cooled System with FHP (Fixed setpoint)	CON
Refrig	Elec	C_Ref_MplxFHPToEE_EvapCond	C_Ref_MplxEE_EvapCond	Energy Efficient Evap-Cooled Condenser	ROB

Table A-97 (cont'd): Commercial Sector Measure Identifiers

End Use	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Other	Elec	C_MS_Copier	C_Copier_Base	Small Copier Base	ROB
Other	Elec	C_MS_Copier	C_Copier_ES	Small Copier ENERGY STAR	ROB
Other	Elec	C_MS_80Plus	C_Computer_Base	Computer with std power supply	ROB
Other	Elec	C_MS_80Plus	C_Computer_80Plus	Computer with 80+ power supply	ROB
Other	Elec	C_MS_RefVendCtrl	C_RefVendCtrl	Refrigerated Vending Machine Controller	RET
Other	Elec	C_MS_NRefVendCtrl	C_NRefVendCtrl	Vending Machine (NonRefrigerated) Controller	RET
Other	Gas	C_WH_PoolHeater	C_PoolHeater_Base	Commercial Gas Pool Heater - Base	ROB
Other	Gas	C_WH_PoolHeater	C_PoolHeater_HE	Commercial Gas Pool Heater - HE	ROB

Industrial ASSET Model Measure Identifiers

A complete list of the industrial sector measures as described in Section A.4 and simulated in the ASSET model is presented in Table A-98.

Table A-98: Industrial Sector Measure Identifiers

EndUse	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
CompAir	Elec	Compressed_Air-OM	Compressed_Air-OM	Compressed_Air-OM	RET
CompAir	Elec	Compressed_Air_Controls	Compressed_Air_Controls	Compressed_Air_Controls	RET
CompAir	Elec	Compressed_Air_System_Optimization	Compressed_Air_System_Optimization	Compressed_Air_System_Optimization	RET
CompAir	Elec	Compressed_AirSizing	Compressed_AirSizing	Compressed_AirSizing	RET
CompAir	Elec	Comp_Air_1-5_HPmotor	Comp_Air_Base_1-5_HPmotor	Comp_Air_Base_1-5_HPmotor	ROB
CompAir	Elec	Comp_Air_1-5_HPmotor	Comp_Air_Replace_1-5_HP_motor	Comp_Air_Replace_1-5_HP_motor	ROB
CompAir	Elec	Comp_Air_ASD_(1-5_hp)	Comp_Air_ASD_(1-5_hp)	Comp_Air_ASD_(1-5_hp)	RET
CompAir	Elec	Comp_Air_Motor_practices-1_(1-5_HP)	Comp_Air_Motor_practices-1_(1-5_HP)	Comp_Air_Motor_practices-1_(1-5_HP)	RET
CompAir	Elec	Comp_Air_6-100_HPmotor	Comp_Air_Base_6-100_HPmotor	Comp_Air_Base_6-100_HPmotor	ROB
CompAir	Elec	Comp_Air_6-100_HPmotor	Comp_Air_Replace_6-100_HP_motor	Comp_Air_Replace_6-100_HP_motor	ROB
CompAir	Elec	Comp_Air_ASD_(6-100_hp)	Comp_Air_ASD_(6-100_hp)	Comp_Air_ASD_(6-100_hp)	RET
CompAir	Elec	Comp_Air_Motor_practices-1_(6-100_HP)	Comp_Air_Motor_practices-1_(6-100_HP)	Comp_Air_Motor_practices-1_(6-100_HP)	RET
CompAir	Elec	Comp_Air_100+_HPmotor	Comp_Air_Base_100+_HPmotor	Comp_Air_Base_100+_HPmotor	ROB
CompAir	Elec	Comp_Air_100+_HPmotor	Comp_Air_Replace_100+_HP_motor	Comp_Air_Replace_100+_HP_motor	ROB
CompAir	Elec	Comp_Air_ASD_(100+_hp)	Comp_Air_ASD_(100+_hp)	Comp_Air_ASD_(100+_hp)	RET
CompAir	Elec	Comp_Air_Motor_practices-1_(100+_HP)	Comp_Air_Motor_practices-1_(100+_HP)	Comp_Air_Motor_practices-1_(100+_HP)	RET
CompAir	Elec	Power_recovery_Comp_Air	Power_recovery_Comp_Air	Power_recovery	RET
CompAir	Elec	Refinery_Controls_Comp_Air	Refinery_Controls_Comp_Air	Refinery_Controls	RET
CompAir	Elec	Energy_Star_Transformers_Comp_Air	Energy_Star_Transformers_Comp_Air	Energy_Star_Transformers_Comp_Air	RET
Fan	Elec	Fans_OM	Fans_OM	Fans_OM	RET
Fan	Elec	Fans_Controls	Fans_Controls	Fans_Controls	RET
Fan	Elec	Fans_System_Optimization	Fans_System_Optimization	Fans_System_Optimization	RET
Fan	Elec	FansImprove_components	FansImprove_components	FansImprove_components	RET
Fan	Elec	Fan_1-5_HPmotor	Fan_Base_1-5_HPmotor	Fan_Base_1-5_HPmotor	ROB
Fan	Elec	Fan_1-5_HPmotor	Fans_Replace_1-5_HP_motor	Fans_Replace_1-5_HP_motor	ROB

Table A-98 (cont'd): Industrial Sector Measure Identifiers

EndUse	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Fan	Elec	Fans_ASD_(1-5_hp)	Fans_ASD_(1-5_hp)	Fans_ASD_(1-5_hp)	RET
Fan	Elec	Fans_Motor_practices-1_(1-5_HP)	Fans_Motor_practices-1_(1-5_HP)	Fans_Motor_practices-1_(1-5_HP)	RET
Fan	Elec	Fan_6-100_HPmotor	Fan_Base_6-100_HPmotor	Fan_Base_6-100_HPmotor	ROB
Fan	Elec	Fan_6-100_HPmotor	Fans_Replace_6-100_HP_motor	Fans_Replace_6-100_HP_motor	ROB
Fan	Elec	Fans_ASD_(6-100_hp)	Fans_ASD_(6-100_hp)	Fans_ASD_(6-100_hp)	RET
Fan	Elec	Fans_Motor_practices-1_(6-100_HP)	Fans_Motor_practices-1_(6-100_HP)	Fans_Motor_practices-1_(6-100_HP)	RET
Fan	Elec	Fan_100+_HPmotor	Fan_Base_100+_HPmotor	Fan_Base_100+_HPmotor	ROB
Fan	Elec	Fan_100+_HPmotor	Fans_Replace_100+_HP_motor	Fans_Replace_100+_HP_motor	ROB
Fan	Elec	Fans_ASD_(100+_hp)	Fans_ASD_(100+_hp)	Fans_ASD_(100+_hp)	RET
Fan	Elec	Fans_Motor_practices-1_(100+_HP)	Fans_Motor_practices-1_(100+_HP)	Fans_Motor_practices-1_(100+_HP)	RET
Fan	Elec	Optimize_drying_process	Optimize_drying_process	Optimize_drying_process	RET
Fan	Elec	Power_recovery_Fans	Power_recovery_Fans	Power_recovery	RET
Fan	Elec	Refinery_Controls_Fans	Refinery_Controls_Fans	Refinery_Controls	RET
Fan	Elec	Energy_Star_Transformers_Fan	Energy_Star_Transformers_Fan	Energy_Star_Transformers_Fan	RET
Pump	Elec	Pumps_OM	Pumps_OM	Pumps_OM	RET
Pump	Elec	Pumps_Controls	Pumps_Controls	Pumps_Controls	RET
Pump	Elec	Pumps_System_Optimization	Pumps_System_Optimization	Pumps_System_Optimization	RET
Pump	Elec	Pumps_Sizing	Pumps_Sizing	Pumps_Sizing	RET
Pump	Elec	Pump_1-5_HPmotor	Pump_Base_1-5_HPmotor	Pump_Base_1-5_HPmotor	ROB
Pump	Elec	Pump_1-5_HPmotor	Pumps_Replace_1-5_HP_motor	Pumps_Replace_1-5_HP_motor	ROB
Pump	Elec	Pumps_ASD_(1-5_hp)	Pumps_ASD_(1-5_hp)	Pumps_ASD_(1-5_hp)	RET
Pump	Elec	Pumps_Motor_practices-1_(1-5_HP)	Pumps_Motor_practices-1_(1-5_HP)	Pumps_Motor_practices-1_(1-5_HP)	RET
Pump	Elec	Pump_6-100_HPmotor	Pump_Base_6-100_HPmotor	Pump_Base_6-100_HPmotor	ROB
Pump	Elec	Pump_6-100_HPmotor	Pumps_Replace_6-100_HP_motor	Pumps_Replace_6-100_HP_motor	ROB
Pump	Elec	Pumps_ASD_(6-100_hp)	Pumps_ASD_(6-100_hp)	Pumps_ASD_(6-100_hp)	RET
Pump	Elec	Pumps_Motor_practices-1_(6-100_HP)	Pumps_Motor_practices-1_(6-100_HP)	Pumps_Motor_practices-1_(6-100_HP)	RET
Pump	Elec	Pump_100+_HPmotor	Pump_Base_100+_HPmotor	Pump_Base_100+_HPmotor	ROB
Pump	Elec	Pump_100+_HPmotor	Pumps_Replace_100+_HP_motor	Pumps_Replace_100+_HP_motor	ROB
Pump	Elec	Pumps_ASD_(100+_hp)	Pumps_ASD_(100+_hp)	Pumps_ASD_(100+_hp)	RET
Pump	Elec	Pumps_Motor_practices-1_(100+_HP)	Pumps_Motor_practices-1_(100+_HP)	Pumps_Motor_practices-1_(100+_HP)	RET

Table A-98 (cont'd): Industrial Sector Measure Identifiers

EndUse	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Pump	Elec	Power_recovery_Pumps	Power_recovery_Pumps	Power_recovery	RET
Pump	Elec	Refinery_Controls_Pumps	Refinery_Controls_Pumps	Refinery_Controls	RET
Pump	Elec	Energy_Star_Transformers_Pumps	Energy_Star_Transformers_Pumps	Energy_Star_Transformers_Pumps	RET
IndLight	Elec	RET_2L4_Premium_T8_1EB	RET_2L4_Premium_T8_1EB	RET_2L4_Premium_T8_1EB	RET
IndLight	Elec	CFL_Hardwired_Modular_36W	CFL_Hardwired_Modular_36W	CFL_Hardwired_Modular_36W	RET
IndLight	Elec	Metal_Halide_50W	Metal_Halide_50W	Metal_Halide_50W	RET
IndLight	Elec	Occupancy_Sensor_4L4_Fluorescent_Fixtures	Occupancy_Sensor_4L4_Fluorescent_Fixtures	Occupancy_Sensor_4L4_Fluorescent_Fixtures	RET
IndLight	Elec	Energy_Star_Transformers_Lighting	Energy_Star_Transformers_Lighting	Energy_Star_Transformers_Lighting	RET
IndOther	Elec	Replace_V-belts_Other	Replace_V-belts_Other	Replace_V-belts	RET
IndOther	Elec	Membranes_for_wastewater	Membranes_for_wastewater	Membranes_for_wastewater	RET
IndOther	Elec	Energy_Star_Transformers_Other	Energy_Star_Transformers_Other	Energy_Star_Transformers_Other	RET
Pump	Elec	Bakery_Process_(Mixing)_OM	Bakery_Process_(Mixing)_OM	Bakery_Process_(Mixing)_OM	RET
Pump	Elec	OM_drives_spinning_machines	OM_drives_spinning_machines	OM_drives_spinning_machines	RET
Pump	Elec	Air_conveying_systems	Air_conveying_systems	Air_conveying_systems	RET
Pump	Elec	Replace_V-Belts_Drives	Replace_V-Belts_Drives	Replace_V-Belts	RET
Drive	Elec	Drives_EE_motor	Drives_EE_motor	Drives_EE_motor	RET
Drive	Elec	Gap_Forming_papermachine	Gap_Forming_papermachine	Gap_Forming_papermachine	RET
Drive	Elec	High_Consistency_forming	High_Consistency_forming	High_Consistency_forming	RET
Drive	Elec	Optimization_control_PM	Optimization_control_PM	Optimization_control_PM	RET
Drive	Elec	Efficient_practices_printing_press	Efficient_practices_printing_press	Efficient_practices_printing_press	RET
Drive	Elec	Efficient_Printing_press_(fewer_cylinders)	Efficient_Printing_press_(fewer_cylinders)	Efficient_Printing_press_(fewer_cylinders)	RET
Drive	Elec	Light_cylinders	Light_cylinders	Light_cylinders	RET
Drive	Elec	Efficient_drives	Efficient_drives	Efficient_drives	RET
Drive	Elec	Clean_Room_Controls	Clean_Room_Controls	Clean_Room_Controls	RET
Drive	Elec	Clean_Room_New_Designs	Clean_Room_New_Designs	Clean_Room_New_Designs	RET
Drive	Elec	Drives_Process_Controls_(batch_+_site)	Drives_Process_Controls_(batch_+_site)	Drives_Process_Controls_(batch_+_site)	RET
Drive	Elec	Process_Drives_ASD	Process_Drives_ASD	Process_Drives_ASD	RET
Drive	Elec	OM_Extruders_Injection_Moulding	OM_Extruders_Injection_Moulding	OM_Extruders_Injection_Moulding	RET
Drive	Elec	Extruders_injection_Moulding-multipump	Extruders_injection_Moulding-multipump	Extruders_injection_Moulding-multipump	RET

Table A-98 (cont'd): Industrial Sector Measure Identifiers

EndUse	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Drive	Elec	Direct_drive_Extruders	Direct_drive_Extruders	Direct_drive_Extruders	RET
Drive	Elec	Injection_Moulding_Impulse_Cooling	Injection_Moulding_Impulse_Cooling	Injection_Moulding_Impulse_Cooling	RET
Drive	Elec	Injection_Moulding_Direct_drive	Injection_Moulding_Direct_drive	Injection_Moulding_Direct_drive	RET
Drive	Elec	Efficient_grinding	Efficient_grinding	Efficient_grinding	RET
Drive	Elec	Process_control_Drives	Process_control_Drives	Process_control	RET
Drive	Elec	Process_optimization	Process_optimization	Process_optimization	RET
Drive	Elec	Drives_Process_Control	Drives_Process_Control	Drives_Process_Control	RET
Drive	Elec	Efficient_drives_rolling	Efficient_drives_rolling	Efficient_drives_rolling	RET
Drive	Elec	Drives_Optimization_process_(MT)	Drives_Optimization_process_(MT)	Drives_Optimization_process_(MT)	RET
Drive	Elec	Drives_Scheduling	Drives_Scheduling	Drives_Scheduling	RET
Drive	Elec	Machinery	Machinery	Machinery	RET
Drive	Elec	Efficient_Machinery	Efficient_Machinery	Efficient_Machinery	RET
Drive	Elec	Energy_Star_Transformers_Drives	Energy_Star_Transformers_Drives	Energy_Star_Transformers_Drives	RET
IndHeat	Elec	Bakery_Process	Bakery_Process	Bakery_Process	RET
IndHeat	Elec	Drying_(UV_IR)	Drying_(UV_IR)	Drying_(UV_IR)	RET
IndHeat	Elec	Heat_Pumps_Drying	Heat_Pumps_Drying	Heat_Pumps_Drying	RET
IndHeat	Elec	Top-heating_(glass)	Top-heating_(glass)	Top-heating_(glass)	RET
IndHeat	Elec	Efficient_electric_melting	Efficient_electric_melting	Efficient_electric_melting	RET
IndHeat	Elec	Intelligent_extruder_(DOE)	Intelligent_extruder_(DOE)	Intelligent_extruder_(DOE)	RET
IndHeat	Elec	Near_Net_Shape_Casting	Near_Net_Shape_Casting	Near_Net_Shape_Casting	RET
IndHeat	Elec	Heating_Process_Control	Heating_Process_Control	Heating_Process_Control	RET
IndHeat	Elec	Efficient_Curing_ovens	Efficient_Curing_ovens	Efficient_Curing_ovens	RET
IndHeat	Elec	Heating_Optimization_process_(MT)	Heating_Optimization_process_(MT)	Heating_Optimization_process_(MT)	RET
IndHeat	Elec	Heating_Scheduling	Heating_Scheduling	Heating_Scheduling	RET
IndHeat	Elec	Energy_Star_Transformers_Heating	Energy_Star_Transformers_Heating	Energy_Star_Transformers_Heating	RET
IndRef	Elec	Efficient_Refrigeration_Operations	Efficient_Refrigeration_Operations	Efficient_Refrigeration_Operations	RET
IndRef	Elec	Optimization_Refrigeration	Optimization_Refrigeration	Optimization_Refrigeration	RET
IndRef	Elec	Energy_Star_Transformers_Refrigeration	Energy_Star_Transformers_Refrigeration	Energy_Star_Transformers	RET
IndProcess	Elec	Other_Process_Controls_(batch_+_site)	Other_Process_Controls_(batch_+_site)	Other_Process_Controls_(batch_+_site)	RET
IndProcess	Elec	Efficient_desalter	Efficient_desalter	Efficient_desalter	RET
IndProcess	Elec	New_transformers_welding	New_transformers_welding	New_transformers_welding	RET

Table A-98 (cont'd): Industrial Sector Measure Identifiers

EndUse	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
IndProcess	Elec	Efficient_processes_(welding_etc.)	Efficient_processes_(welding_etc.)	Efficient_processes_(welding_etc.)	RET
IndProcess	Elec	Process_control_Process	Process_control_Process	Process_control	RET
IndProcess	Elec	Power_recovery_Process	Power_recovery_Process	Power_recovery	RET
IndProcess	Elec	Refinery_Controls_Process	Refinery_Controls_Process	Refinery_Controls	RET
IndProcess	Elec	Energy_Star_Transformers_Process	Energy_Star_Transformers_Process	Energy_Star_Transformers_Process	RET
IndCool	Elec	Centrifugal_Chiller_500_tons	Base_Centrifugal_Chiller_0.58_kW_ton_500_tons	Base_Centrifugal_Chiller_0.58_kW_ton_500_tons	ROB
IndCool	Elec	Centrifugal_Chiller_500_tons	Centrifugal_Chiller_0.51_kW_ton_500_tons	Centrifugal_Chiller_0.51_kW_ton_500_tons	ROB
IndCool	Elec	Window_Film_Chiller	Window_Film_Chiller	Window_Film_Chiller	RET
IndCool	Elec	EMS_Chiller_	EMS_Chiller_	EMS_Chiller_	RET
IndCool	Elec	Cool_Roof_Chiller	Cool_Roof_Chiller	Cool_Roof_Chiller	RET
IndCool	Elec	Chiller_Tune_Up_Diagnostics	Chiller_Tune_Up_Diagnostics	Chiller_Tune_Up_Diagnostics	RET
IndCool	Elec	Cooling_Circ._Pumps_VSD_	Cooling_Circ._Pumps_VSD_	Cooling_Circ._Pumps_VSD_	RET
IndCool	Elec	Energy_Star_Transformers_Chiller	Energy_Star_Transformers_Chiller	Energy_Star_Transformers	RET
IndCool	Elec	DX_Packaged_System_10_tons	Base_DX_Packaged_System_EER=10.3_10_tons	Base_DX_Packaged_System_EER=10.3_10_tons	ROB
IndCool	Elec	DX_Packaged_System_10_tons	DX_Packaged_System_EER=10.9_10_tons	DX_Packaged_System_EER=10.9_10_tons	ROB
IndCool	Elec	DX_Tune_Up__Advanced_Diagnostics	DX_Tune_Up__Advanced_Diagnostics	DX_Tune_Up__Advanced_Diagnostics	RET
IndCool	Elec	Window_Film_DX	Window_Film_DX	Window_Film_DX	RET
IndCool	Elec	Evaporative_Pre-Cooler	Evaporative_Pre-Cooler	Evaporative_Pre-Cooler	RET
IndCool	Elec	Prog._Thermostat_DX	Prog._Thermostat_DX	Prog._Thermostat_DX	RET
IndCool	Elec	Cool_Roof_DX	Cool_Roof_DX	Cool_Roof_DX	RET
IndCool	Elec	Energy_Star_Transformers_DX	Energy_Star_Transformers_DX	Energy_Star_Transformers_Cooling	RET
HVAC	Gas	Boiler	Boiler_Base	Boiler_Base	ROB
HVAC	Gas	Boiler	Boiler_95	Boiler_95	ROB
Boiler	Gas	Improved_process_control	Improved_process_control	Improved_process_control	RET
Boiler	Gas	Maintain_boilers	Maintain_boilers	Maintain_boilers	RET
Boiler	Gas	Flue_gas_heat_recovery_economizer	Flue_gas_heat_recovery_economizer	Flue_gas_heat_recovery_economizer	RET
Boiler	Gas	Blowdown_steam_heat_recovery	Blowdown_steam_heat_recovery	Blowdown_steam_heat_recovery	RET
Boiler	Gas	Upgrade_burner_efficiency	Upgrade_burner_efficiency	Upgrade_burner_efficiency	RET
Boiler	Gas	Water_treatment	Water_treatment	Water_treatment	RET
Boiler	Gas	Load_control	Load_control	Load_control	RET

Table A-98 (cont'd): Industrial Sector Measure Identifiers

EndUse	Fuel Type	Competition Group ID	Tech ID	Measure Description	Decision Type
Boiler	Gas	Improved_insulation	Improved_insulation	Improved_insulation	RET
Boiler	Gas	Steam_trap_maintenance	Steam_trap_maintenance	Steam_trap_maintenance	RET
Boiler	Gas	Automatic_steam_trap_monitoring	Automatic_steam_trap_monitoring	Automatic_steam_trap_monitoring	RET
Boiler	Gas	Leak_repair	Leak_repair	Leak_repair	RET
Boiler	Gas	Condensate_return	Condensate_return	Condensate_return	RET
HVAC	Gas	Improve_ceiling_insulation	Improve_ceiling_insulation	Improve_ceiling_insulation	RET
HVAC	Gas	Stack_heat_exchanger	Stack_heat_exchanger	Stack_heat_exchanger	RET
HVAC	Gas	Duct_insulation	Duct_insulation	Duct_insulation	RET
HVAC	Gas	EMS_install	EMS_install	EMS_install	RET
HVAC	Gas	EMS_optimization	EMS_optimization	EMS_optimization	RET
Process	Gas	Process_Controls_&_Management	Process_Controls_&_Management	Process_Controls_&_Management	RET
Process	Gas	Heat_Recovery	Heat_Recovery	Heat_Recovery	RET
Process	Gas	Efficient_burners	Efficient_burners	Efficient_burners	RET
Process	Gas	Process_integration	Process_integration	Process_integration	RET
Process	Gas	Efficient_drying	Efficient_drying	Efficient_drying	RET
Process	Gas	Closed_hood	Closed_hood	Closed_hood	RET
Process	Gas	Extended_nip_press	Extended_nip_press	Extended_nip_press	RET
Process	Gas	Improved_separation_processes	Improved_separation_processes	Improved_separation_processes	RET
Process	Gas	Thermal_oxidizers	Thermal_oxidizers	Thermal_oxidizers	RET
Process	Gas	Flare_gas_controls_and_recovery	Flare_gas_controls_and_recovery	Flare_gas_controls_and_recovery	RET
Process	Gas	Fouling_control	Fouling_control	Fouling_control	RET
Process	Gas	Efficient_furnaces	Furnace_Base	Furnace_Base	ROB
Process	Gas	Efficient_furnaces	Furnace_HE	Furnace_HE	ROB
Process	Gas	Oxyfuel	Oxyfuel	Oxyfuel	RET
Process	Gas	Batch_cullet_preheating	Batch_cullet_preheating	Batch_cullet_preheating	RET
Process	Gas	Preventative_maintenance	Preventative_maintenance	Preventative_maintenance	RET
Process	Gas	Combustion_controls	Combustion_controls	Combustion_controls	RET
Process	Gas	Optimize_furnace_operations	Optimize_furnace_operations	Optimize_furnace_operations	RET
Process	Gas	Insulation/reduce_heat_losses	Insulation/reduce_heat_losses	Insulation/reduce_heat_losses	RET

Appendix B

Utility Specific Supply Curves

The study produced both electric and gas supply curves. This appendix presents the utility specific electric and gas supply curves. The supply curves consists of two axes—one that captures the cost per unit of savings (e.g., levelalized $/kWh) and the other that shows the amount of energy savingsor mitigation that could be achieved at each level of cost. The curve is built up across individual measures that are applied to specific base-case technologies. Savings are sorted on a least-cost basis, and total technical savings potential are calculated incrementally with respect to measures that proceeded them.[1] It is common for supply curve to reflect diminishing retures, i.e. costs increase rapidly and savings decrease significantly at the end of the supply curve.

B.1 PG&E Supply Curves

Figure B-1 presents the PG&E electric supply curve. The data represented by the illustration are presented in Table B-1. The data presented in the table are ordered by their levelized supply cost. The table also presents data on the levelized supply cost with PG&E programs and the technical electric energy efficiency potential of the measure in 2016. The sum of PG&E's technical potential in 2016 is approximately 20,418 GWh.[2] The technical potential is approximately 21% of the CEC forecast of PG&E energy consumpumption in 2016.[3]

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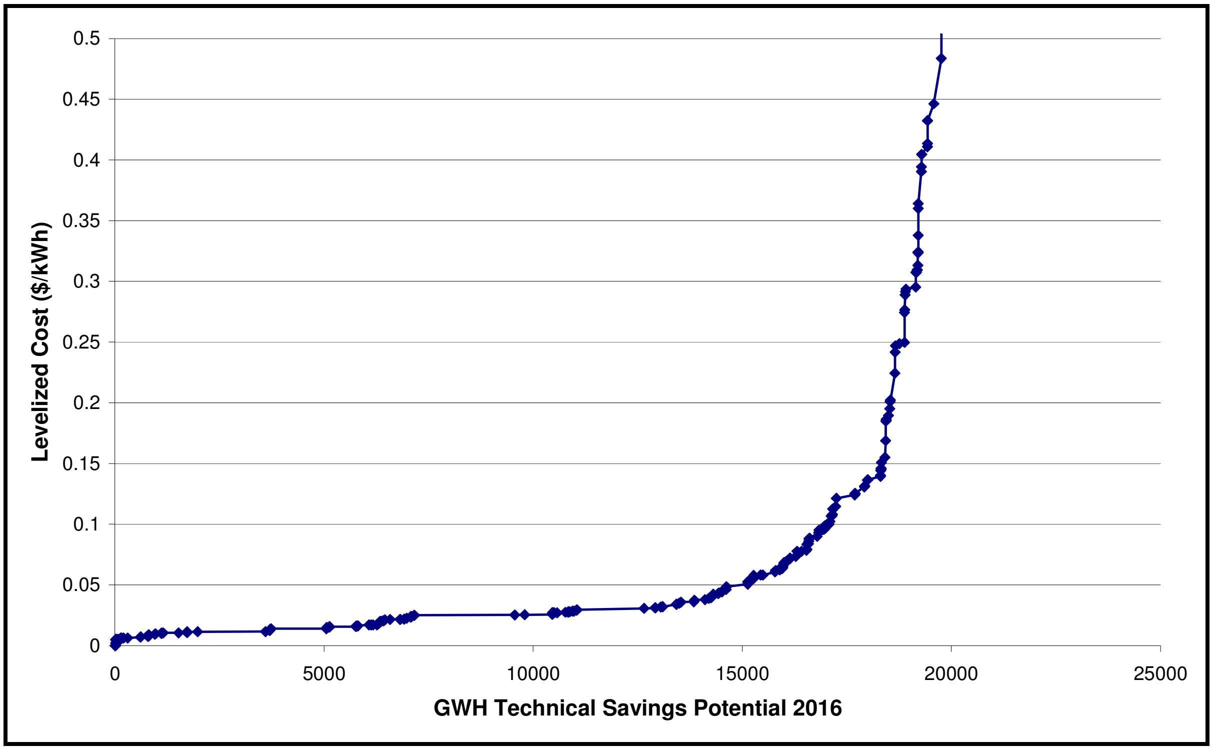
1 An interactive multiplier was used to reduce the incremental savings within enduses with multiple measures that would interact, working to reduce the incremental savings of measures installed after the installation of the first measure. For example, installing insulation then high efficiency windows reduces the incremental savings associated with stand alone window installations. The interactive multipliers were applied assuming that the customer installs the measures sequentially relative to their TRC values.

2 Note, this is slightly less than the technical potential presented in Section 4 (the Aggregation Section). The supply curves only include measures with non-zero technical potential in 2016. The highest efficiency pool pump modeled in the study becomes the base technology prior to 2016 and has no technical potential in 2016.

3 The CEC forecast of PG&E energy consumption in 2016 includes approximately 60-80% of the market forecast of energy efficiency savings. The CEC's attempts to include expected energy efficiency savings in the consumption forecast, reduces the forecast of consumption, thereby increasing the apparent ratio of technical potential savings to forecast consumption. The CEC's forecast of consumption is from Form 1.1c PG&E bundled and direct access deliveries, *California Energy Demand 2008-2018 Staff Revised Forecast*, Nov 2007.

Figure B-1: PG&E Electric Supply Curve



As the data in the table illustrate, the measures with the lowest levelized cost are in the industrial new construction and the existing industrial sectors. In part, the lower levelized costs within the indusrial sectors are due to the longer run times associated with this sector. In addition, the packages analyzed within the new construction sector allowed for the downsizing of HVAC equipment when high efficiency shell measures were installed. The downsizing of HVAC equipment could lead to a reduction in costs for the highest efficiency packages. In 2016, the technical potential in the industrial new construction (INC) sector is 132 GWh and 2,605 GWh in the existing industrial sector. Results presented within the body of the analysis, however, indicate that the market net-to-gross ratio within the INC and the existing industrial sectors are lower than in other sectors. The lower net-to-gross ratio is consistent with the lower levelized costs and the long running experience of energy management within the industrial sector.

The lower cost measures within the commercial sector include CFL lighting motors, and refrigeration measures. The low cost measures within the existing residential sector include CFL lighting and refrigerator and freezer recycling.

Table B-1: PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
S04_0515	INC	0.000	0.005	4.549
S01_0515	INC	0.000	0.005	13.356
WWT_PDW	INC	0.002	0.007	0.08
CRm_ExOp	INC	0.005	0.010	0.41
CRm_HECh	INC	0.005	0.010	4.52
S36_HEVC	INC	0.005	0.010	0.729
Fans_ASD_(6-100_hp)	Existing Industrial	0.005	0.012	27.33
Comp_Air_ASD_(6-100_hp)	Existing Industrial	0.005	0.012	31.33
Pumps_ASD_(6-100_hp)	Existing Industrial	0.005	0.012	54.46
CRm_UAS	INC	0.005	0.010	3.01
WWT_Des	INC	0.006	0.011	1.83
CRm_POHP	INC	0.006	0.011	1.31
CRm_PrPl	INC	0.006	0.011	3.75
CRm_EfFS	INC	0.006	0.011	2.02
Fans_OM	Existing Industrial	0.006	0.014	11.94
Compressed_AirSizing	Existing Industrial	0.006	0.014	49.29
Pumps_OM	Existing Industrial	0.006	0.014	95.20
C_CFL_Over24W	Existing Commercial	0.007	0.035	305.09
CRm_PACR	INC	0.007	0.012	7.89
Compressed_Air-OM	Existing Industrial	0.008	0.015	172.52
CRm_VACS	INC	0.008	0.013	1.45
S36_ACrS	INC	0.008	0.013	1.16
CRm_LPDF	INC	0.008	0.013	2.43
WWT_VFD	INC	0.008	0.013	12.40
S04_0510	INC	0.008	0.013	0.00
CRm_PrPm	INC	0.009	0.014	0.42
CRm_PMEV	INC	0.009	0.014	0.30
CRm_PMEW	INC	0.009	0.014	0.21
C_CFL_Under15W	Existing Commercial	0.009	0.040	151.16

Table B-1 (cont'd.): PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
REF_FlSP	INC	0.010	0.015	9.82
S01_0510	INC	0.010	0.015	0.00
Compressed_Air_System_Optimization	Existing Industrial	0.010	0.017	136.92
REF_AVFD	INC	0.010	0.015	9.43
REF_EfCn	INC	0.010	0.015	0.39
C_HV_Motor_0-10	Existing Commercial	0.010	0.016	39.21
C_Reflector_CFL	Existing Commercial	0.010	0.047	365.90
C_CFL_16_24W	Existing Commercial	0.011	0.045	205.04
S36_Pmp	INC	0.011	0.016	1.67
Pumps_Controls	Existing Industrial	0.011	0.019	249.88
R_FRZ_Recyl	Existing Residential	0.011	0.016	1,620.17
Pumps_Sizing	Existing Industrial	0.013	0.020	95.19
FansImprove_components	Existing Industrial	0.013	0.020	11.94
CRm_HeLt	INC	0.013	0.018	0.10
C_Ref_SucLnIns	Existing Commercial	0.014	0.020	28.21
R_REF_Recyl	Existing Residential	0.014	0.019	1,321.59
C_HV_Motor_50+	Existing Commercial	0.014	0.019	8.01
S36_WtEc	INC	0.015	0.020	1.05
CRm_WtEc	INC	0.015	0.020	1.32
C_Ref_IceMaker_T2	Existing Commercial	0.015	0.021	58.52
C_Ref_MplxFHP_EvapCond	Existing Commercial	0.015	0.021	4.80
C_HV_Motor_11-25	Existing Commercial	0.016	0.021	8.51
R_CFL_Reflector	Existing Residential	0.016	0.021	622.14
REF_FlHP	INC	0.016	0.021	6.34
C_CFL_Fixture_Over24W	Existing Commercial	0.016	0.022	26.90
C_Ref_NCover_Ref	Existing Commercial	0.016	0.027	18.77
C_Computer_80Plus	Existing Commercial	0.017	0.033	264.29
Comp_Air_ASD_(100+_hp)	Existing Industrial	0.017	0.028	52.04
Fans_ASD_(100+_hp)	Existing Industrial	0.017	0.028	45.39
Pumps_ASD_(100+_hp)	Existing Industrial	0.017	0.028	90.46
Compressed_Air_Controls	Existing Industrial	0.018	0.025	41.07
Centrifugal_Chiller_0.51_kW_ton_500_tons	Existing Industrial	0.018	0.023	12.44
S36_TMD	INC	0.019	0.024	0.13
CRm_CTMD	INC	0.019	0.024	0.16
C_HV_ChRec_HE	Existing Commercial	0.020	0.024	21.78
C_Ref_MplxFHP_AirCond	Existing Commercial	0.020	0.025	28.54
R_LED_EXIT	Existing Residential	0.020	0.024	41.57
Prog._Thermostat_DX	Existing Industrial	0.020	0.028	19.20
C_CFL_Fixture_16_24W	Existing Commercial	0.021	0.027	27.41

Table B-1 (cont'd.): PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
C_T12_Delamping_4Ft	Existing Commercial	0.021	0.027	123.76
C_Ref_EvapFan_ECM	Existing Commercial	0.022	0.027	238.21
Energy_Star_Transformers_Lighting	Existing Industrial	0.022	0.026	2.14
Energy_Star_Transformers_DX	Existing Industrial	0.022	0.026	0.90
Energy_Star_Transformers_Chiller	Existing Industrial	0.022	0.026	0.51
C_RefVendCtrl	Existing Commercial	0.022	0.029	94.00
C_Ref_MplxEE_EvapCond	Existing Commercial	0.023	0.028	62.79
C_Ref_StripCurt	Existing Commercial	0.023	0.039	93.09
CRm_LFV	INC	0.024	0.028	3.03
S36_ACrL	INC	0.024	0.028	0.22
CRm_VACL	INC	0.024	0.028	0.28
C_LT_PCTC	Existing Commercial	0.024	0.033	0.00
Energy_Star_Transformers_Fan	Existing Industrial	0.024	0.028	1.91
Energy_Star_Transformers_Comp_Air	Existing Industrial	0.024	0.028	2.19
Energy_Star_Transformers_Other	Existing Industrial	0.024	0.028	1.19
Energy_Star_Transformers_Pumps	Existing Industrial	0.024	0.028	4.09
Energy_Star_Transformers_Process	Existing Industrial	0.024	0.028	0.39
Energy_Star_Transformers_Refrigeration	Existing Industrial	0.024	0.028	1.10
Energy_Star_Transformers_Heating	Existing Industrial	0.024	0.028	2.18
Energy_Star_Transformers_Drives	Existing Industrial	0.024	0.028	3.68
C_Steamer_Elec_ES	Existing Commercial	0.025	0.031	63.67
REF_LtC	INC	0.025	0.030	6.66
R_CFL_14_to_25W	Existing Residential	0.025	0.033	2,400.12
Pumps_System_Optimization	Existing Industrial	0.025	0.033	235.58
R_CFL_Over25W	Existing Residential	0.026	0.034	660.63
C_LT_PCPC	Existing Commercial	0.026	0.036	0.00
CRm_PVPV	INC	0.027	0.032	1.14
CRm_DWP	INC	0.027	0.032	0.82
Comp_Air_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.038	12.18
Fans_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.038	10.62
Pumps_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.038	21.17
C_Ref_MplxEE_AirCond	Existing Commercial	0.027	0.032	70.05
C_LT_EXLED	Existing Commercial	0.027	0.033	194.82
C_Ref_ASHCtrl	Existing Commercial	0.027	0.034	59.79
Comp_Air_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.035	11.73
Fans_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.035	10.23
Pumps_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.035	21.70
C_Ref_Gaskets	Existing Commercial	0.028	0.044	65.28
C_LT_PCPT	Existing Commercial	0.028	0.038	37.98

Table B-1 (cont'd.): PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
C_CFL_Fixture_Under15W	Existing Commercial	0.029	0.035	65.06
CRm_EFFU	INC	0.030	0.034	2.61
C_HV_Motor_26-49	Existing Commercial	0.030	0.035	4.20
CNC_05_15	CNC	0.031	0.036	1,603.71
C_PSMH_Under151W_Int_INC	Existing Commercial	0.031	0.037	267.16
CRm_DTCL	INC	0.031	0.036	0.99
R_LEDXMAS_CET	Existing Residential	0.032	0.035	134.84
Occupancy_Sensor_4L4_Fluorescent_Fixtures	Existing Industrial	0.032	0.039	42.80
Replace_V-belts_Other	Existing Industrial	0.032	0.043	0.12
C_T8_2G_4Ft	Existing Commercial	0.034	0.040	324.89
S36_VSD	INC	0.034	0.039	3.56
C_T12_Delamping_8Ft	Existing Commercial	0.035	0.041	69.88
Fans_System_Optimization	Existing Industrial	0.036	0.043	37.93
RET_2L4_Premium_T8_1EB	Existing Industrial	0.036	0.041	309.76
Window_Film_DX	Existing Industrial	0.037	0.045	13.39
R_CFL_Under14W	Existing Residential	0.038	0.046	252.85
Fans_Controls	Existing Industrial	0.039	0.046	89.55
C_HV_VSD_Motor_26-49	Existing Commercial	0.040	0.047	56.35
Drives_Optimization_process_(MT)	Existing Industrial	0.040	0.048	13.41
C_PSMH_Under151W_Ext_INC	Existing Commercial	0.040	0.046	14.49
C_Ref_NCover_Frz	Existing Commercial	0.041	0.052	7.73
C_T8_Fixture_4Ft	Existing Commercial	0.041	0.047	0.00
Comp_Air_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.047	3.15
Fans_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.047	2.87
Pumps_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.047	5.89
C_Ref_MplxEE_AirCond	Existing Commercial	0.04	0.05	4.44
C_Ref_NoASHGD_HE	Existing Commercial	0.043	0.049	115.17
R_WH_PW	Existing Residential	0.044	0.047	22.35
C_HV_VSD_Motor_10-25	Existing Commercial	0.044	0.051	65.40
C_HV_VSD_Motor_50-100	Existing Commercial	0.045	0.052	14.28
WWT_LPUV	INC	0.045	0.050	9.98
C_T8_HighBay	Existing Commercial	0.046	0.052	81.10
C_NRefVendCtrl	Existing Commercial	0.048	0.056	7.55
C_Ref_EvapFan_PSC	Existing Commercial	0.048	0.054	0.00
R_CFL_Torchiere	Existing Residential	0.050	0.056	505.47
WWT_PHR	INC	0.053	0.057	0.26
WWT_EfBl	INC	0.053	0.057	7.85
C_HV_ChillerAux	Existing Commercial	0.053	0.058	45.85
Heating_Optimization_process_(MT)	Existing Industrial	0.054	0.061	6.13

Table B-1 (cont'd.): PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
C_PSMH_Under151W_Int_MV	Existing Commercial	0.055	0.061	56.83
Comp_Air_Replace_100+_HP_motor	Existing Industrial	0.055	0.066	5.99
Fans_Replace_100+_HP_motor	Existing Industrial	0.055	0.066	5.14
Pumps_Replace_100+_HP_motor	Existing Industrial	0.055	0.066	10.51
C_Ref_MplxEE_EvapCond	Existing Commercial	0.06	0.06	2.53
REF_EfCM	INC	0.056	0.060	0.12
Process_control_Drives	Existing Industrial	0.058	0.065	3.43
C_OCCSensor_Motion	Existing Commercial	0.058	0.064	162.66
CFL_Hardwired_Modular_36W	Existing Industrial	0.058	0.074	60.96
C_Oven_Elec_HE	Existing Commercial	0.061	0.067	288.24
C_Ref_EvapFan_Ctrl	Existing Commercial	0.062	0.073	10.53
R_LED_Reflector_CET	Existing Residential	0.062	0.065	101.21
Drives_Scheduling	Existing Industrial	0.063	0.071	5.52
R_WHEle_EF0.93	Existing Residential	0.063	0.067	49.68
Window_Film_Chiller	Existing Industrial	0.064	0.071	12.37
Machinery	Existing Industrial	0.065	0.072	6.93
DX_Packaged_System_EER=10.9_10_tons	Existing Industrial	0.066	0.072	16.88
WWT_RPF	INC	0.068	0.073	2.58
C_Ref_SD_Freezer_T2	Existing Commercial	0.068	0.075	16.08
C_HV_ChCent_HE	Existing Commercial	0.069	0.074	42.63
C_HV_WindowFilm	Existing Commercial	0.071	0.076	86.26
New_transformers_welding	Existing Industrial	0.072	0.077	7.57
C_HV_PAClt65_15	Existing Commercial	0.074	0.079	137.91
C_PSMH_Over150W_Int	Existing Commercial	0.078	0.083	23.91
C_T8_2G_8Ft	Existing Commercial	0.078	0.083	109.84
C_PSMH_Under151W_Ext_MV	Existing Commercial	0.078	0.084	118.33
C_Oven_Convec_Elec_HE	Existing Commercial	0.079	0.086	7.64
C_HV_PACgt65_11	Existing Commercial	0.083	0.089	0.00
C_HV_Retro_Vent	Existing Commercial	0.084	0.095	39.26
C_LEDSignage	Existing Commercial	0.086	0.092	11.22
Fans_Replace_1-5_HP_motor	Existing Industrial	0.088	0.093	1.75
Comp_Air_Replace_1-5_HP_motor	Existing Industrial	0.088	0.093	2.04
Pumps_Replace_1-5_HP_motor	Existing Industrial	0.088	0.093	3.58
OM_Extruders_Injection_Moulding	Existing Industrial	0.088	0.094	10.41
Chiller_Tune_Up_Diagnostics	Existing Industrial	0.088	0.096	3.17
C_HV_PACgt65_12	Existing Commercial	0.090	0.095	178.19
C_Copier_ES	Existing Commercial	0.093	0.104	34.82
C_HoldCabinet_Elec_HE	Existing Commercial	0.095	0.101	6.31

Table B-1 (cont'd.): PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
C_HV_PkgAC_Tuneup	Existing Commercial	0.096	0.103	92.86
C_Ref_SDAutoClose	Existing Commercial	0.096	0.104	32.57
Efficient_Curing_ovens	Existing Industrial	0.096	0.101	16.41
C_T8_Fixture_8Ft	Existing Commercial	0.099	0.104	0.00
C_PSMH_Over150W_Ext	Existing Commercial	0.099	0.104	54.28
R_WH_Shw	Existing Residential	0.100	0.105	41.24
Bakery_Process_(Mixing)_OM	Existing Industrial	0.101	0.108	6.98
EMS_Chiller_	Existing Industrial	0.102	0.109	20.06
R_WH_FA	Existing Residential	0.107	0.112	30.03
Fans_Replace_6-100_HP_motor	Existing Industrial	0.107	0.114	5.70
Comp_Air_Replace_6-100_HP_motor	Existing Industrial	0.107	0.114	6.64
Pumps_Replace_6-100_HP_motor	Existing Industrial	0.107	0.114	3.04
Cool_Roof_DX	Existing Industrial	0.108	0.115	16.67
Fans_ASD_(1-5_hp)	Existing Industrial	0.112	0.118	3.84
Comp_Air_ASD_(1-5_hp)	Existing Industrial	0.112	0.118	4.21
Pumps_ASD_(1-5_hp)	Existing Industrial	0.112	0.118	7.87
R_DUCTR_E	Existing Residential	0.115	0.118	58.72
Efficient_Refrigeration_Operations	Existing Industrial	0.121	0.129	17.95
R_CFL_Fixture	Existing Residential	0.124	0.127	439.55
Gap_Forming_papermachine	Existing Industrial	0.125	0.130	1.27
Efficient_practices_printing_press	Existing Industrial	0.125	0.130	4.76
High_Consistency_forming	Existing Industrial	0.125	0.130	1.22
C_OCCSensor_Plugload	Existing Commercial	0.131	0.136	220.68
Cooling_Circ._Pumps_VSD_	Existing Industrial	0.132	0.137	10.71
C_HV_Retro_Chiller	Existing Commercial	0.136	0.147	64.16
Drives_EE_motor	Existing Industrial	0.137	0.144	9.48
R_REF_ES	Existing Residential	0.139	0.143	303.23
R_OCC_Sensor	Existing Residential	0.140	0.144	3.50
Near_Net_Shape_Casting	Existing Industrial	0.144	0.149	0.28
Air_conveying_systems	Existing Industrial	0.145	0.151	8.71
C_Griddle_Elec_HE	Existing Commercial	0.146	0.152	4.88
C_HV_PTAC_HE	Existing Commercial	0.151	0.156	6.16
R_CFL_Table	Existing Residential	0.155	0.158	80.63
DX_Tune_Up__Advanced_Diagnostics	Existing Industrial	0.169	0.185	21.19
Heating_Scheduling	Existing Industrial	0.185	0.192	1.73
Cool_Roof_Chiller	Existing Industrial	0.185	0.192	8.94
C_HV_PTHP_HE	Existing Commercial	0.186	0.192	2.88

Table B-1 (cont'd.): PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
C_Ref_GD_Refrig_T2	Existing Commercial	0.190	0.196	53.71
Bakery_Process	Existing Industrial	0.195	0.200	26.85
Clean_Room_Controls	Existing Industrial	0.201	0.208	8.67
Replace_V-Belts_Drives	Existing Industrial	0.202	0.209	5.91
C_Lt_DLInst	Existing Commercial	0.224	0.230	110.28
Top-heating_(glass)	Existing Industrial	0.242	0.250	1.99
Metal_Halide_50W	Existing Industrial	0.247	0.258	9.95
R_WallIns_R0R13E	Existing Residential	0.249	0.251	95.95
R_Window_U25	Existing Residential	0.250	0.252	120.71
R_CW_MEF1.60	Existing Residential	0.274	0.279	0.00
C_Ref_Sngl2Mplx_EvapC_HE	Existing Commercial	0.277	0.282	3.41
Efficient_processes_(welding_etc.)	Existing Industrial	0.289	0.294	9.76
Evaporative_Pre-Cooler	Existing Industrial	0.291	0.299	13.41
C_Fryer_Elec_ES	Existing Commercial	0.293	0.300	10.11
R_T8_4ft	Existing Residential	0.295	0.301	233.84
Refinery_Controls_Fans	Existing Industrial	0.307	0.315	1.38
Refinery_Controls_Comp_Air	Existing Industrial	0.307	0.315	2.26
Refinery_Controls_Pumps	Existing Industrial	0.307	0.315	8.95
Refinery_Controls_Process	Existing Industrial	0.307	0.315	0.01
C_Ref_SD_Refrig_T2	Existing Commercial	0.309	0.315	20.46
Process_Drives_ASD	Existing Industrial	0.309	0.317	0.70
C_Ref_GDAutoClose	Existing Commercial	0.313	0.322	13.95
Efficient_drives	Existing Industrial	0.324	0.331	1.00
Drives_Process_Controls_(batch_+_site)	Existing Industrial	0.324	0.331	10.51
Efficient_drives_rolling	Existing Industrial	0.324	0.331	1.40
R_CW_MEF1.80	Existing Residential	0.338	0.343	0.00
R_CW_MEF2.0	Existing Residential	0.360	0.365	0.00
Efficient_Machinery	Existing Industrial	0.364	0.371	0.04
R_DUCTR_G	Existing Residential	0.390	0.402	71.86
C_Ref_OpenMDToGD_HE	Existing Commercial	0.394	0.400	4.11
OM_drives_spinning_machines	Existing Industrial	0.404	0.412	0.92
Efficient_desalter	Existing Industrial	0.404	0.412	0.04
R_WHEle_Solar_CET	Existing Residential	0.411	0.414	142.24
Efficient_electric_melting	Existing Industrial	0.413	0.418	1.07
Heating_Process_Control	Existing Industrial	0.432	0.437	1.19
Drives_Process_Control	Existing Industrial	0.432	0.437	1.21
RNC_05_15	RNC	0.446	0.515	147.05
R_ExtLite_Control	Existing Residential	0.483	0.489	179.58

Table B-1 (cont'd.): PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
Membranes_for_wastewater	Existing Industrial	0.504	0.509	0.02
Optimization_control_PM	Existing Industrial	0.506	0.513	4.00
Optimize_drying_process	Existing Industrial	0.507	0.514	6.12
C_Ref_Sngl2Mplx_AirC_HE	Existing Commercial	0.522	0.528	26.41
R_AC_Tuneup	Existing Residential	0.547	0.551	32.99
Process_control_Process	Existing Industrial	0.576	0.581	0.00
Injection_Moulding_Impulse_Cooling	Existing Industrial	0.581	0.588	5.47
Extruders_injection_Moulding-multipump	Existing Industrial	0.581	0.588	12.49
Optimization_Refrigeration	Existing Industrial	0.606	0.611	27.48
Process_optimization	Existing Industrial	0.607	0.614	2.15
Power_recovery_Comp_Air	Existing Industrial	0.607	0.614	0.45
Power_recovery_Fans	Existing Industrial	0.607	0.614	0.28
Power_recovery_Pumps	Existing Industrial	0.607	0.614	1.92
Power_recovery_Process	Existing Industrial	0.607	0.614	0.00
Other_Process_Controls_(batch_+_site)	Existing Industrial	0.607	0.614	2.97
Efficient_Printing_press_(fewer_cylinders)	Existing Industrial	0.608	0.615	3.81
R_DW_EF0.62	Existing Residential	0.613	0.617	0.00
R_DW_EF0.58	Existing Residential	0.652	0.000	0.00
R_HP_SEER15	Existing Residential	0.673	0.676	15.66
Drying_(UV_IR)	Existing Industrial	0.693	0.702	0.18
R_DW_EF0.62_G	Existing Residential	0.744	0.752	0.00
R_DW_EF0.58_G	Existing Residential	0.792	0.000	0.00
R_CeilIns_R19R30E	Existing Residential	0.804	0.806	33.90
R_WallIns_R0R13G	Existing Residential	0.820	0.834	112.05
Injection_Moulding_Direct_drive	Existing Industrial	0.853	0.859	5.21
R_CW_MEF2.2	Existing Residential	0.884	0.889	50.72
Clean_Room_New_Designs	Existing Industrial	0.890	0.897	3.07
C_HV_CoolRoof	Existing Commercial	0.918	0.923	42.06
Direct_drive_Extruders	Existing Industrial	1.085	1.092	5.21
R_DW_EF0.68	Existing Residential	1.119	1.123	12.01
R_RAC_ES	Existing Residential	1.141	1.144	11.97
Heat_Pumps_Drying	Existing Industrial	1.154	1.159	1.73
R_DW_EF0.68_G	Existing Residential	1.359	1.367	65.68
Light_cylinders	Existing Industrial	1.418	1.425	1.90
R_CAC_SEER15	Existing Residential	1.474	1.477	53.45
Efficient_grinding	Existing Industrial	1.586	1.591	14.41

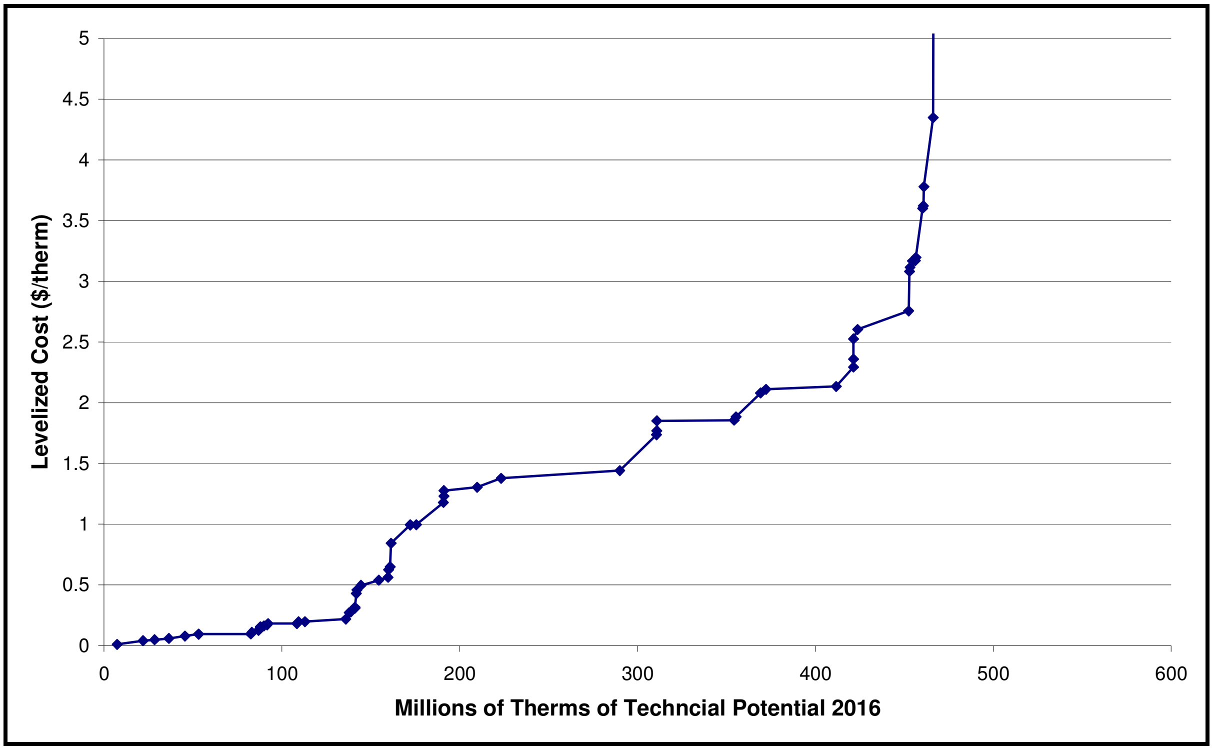
Table B-1 (cont'd.): PG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical GWH 2016
Intelligent_extruder_(DOE)	Existing Industrial	1.618	1.625	0.02
R_CoolRoof_CET	Existing Residential	2.617	2.619	11.45
R_CeilIns_R19R30G	Existing Residential	3.075	3.090	24.63
R_WholeHFan	Existing Residential	7.276	7.281	55.39
R_NiteEcon_CET	Existing Residential	11.862	11.866	11.08

Figure B-2 presents the PG&E natural gas supply curve. The data represented by the illustration are presented in Table B-2. The data presented in the table are ordered by their levelized supply cost. The table also presents data on the levelized supply cost with PG&E programs and the technical natural gas energy efficiency potential of the measure in 2016. The sum of PG&E's technical potential in 2016 is approximately 557 million therms. The CEC forecast of natural gas usage for PG&E gas planning area is 5,144 million therms. Therefore, the technical potential is approximately 11% of the CEC forecast of PG&E planning area natural gas consumpumption in 2016.[4]

[4] The CEC forecast of PG&E energy consumption in 2016 includes approximately 60-80% of the market forecast of energy efficiency savings. The CEC's attempts to include expected energy efficiency savings in the consumption forecast, reduces the forecast of consumption, thereby increasing the apparent ratio of technical potential savings to forecast consumption. The CEC's forecast of consumption is from Table 37, *California Energy Demand 2008-2018 Staff Revised Forecast*, Nov 2007.

Figure B-2: PG&E Gas Supply Curve



Review of the gas supply data presented in Table B-2, indicates that existing industrial measures have the lowest levelized supply costs for measures analyzed in this study. As with the electric measures, the existing industrial measure benefit from the assumed longer run times for the industrial sector. Boiler measures within the existing residential and commercial sectors also have very low levelized supply costs.[5]

5 The industrial new construction sector did not include tha analysis of gas measures.

Table B-2: PG&E Natural Gas Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential Millions of Therms 2016
Maintain_boilers	Existing Industrial	0.010	0.304	7.31
Load_control	Existing Industrial	0.041	0.091	14.63
Improved_process_control	Existing Industrial	0.048	0.098	6.47
R_BoilerMF	Existing Residential	0.060	0.090	8.00
Automatic_steam_trap_monitoring	Existing Industrial	0.079	0.130	9.15
C_WH_Boiler_95_CET	Existing Commercial	0.093	0.137	7.58
C_WH_Boiler_85	Existing Commercial	0.094	0.137	0.00
Improved_insulation	Existing Industrial	0.095	0.145	29.27
Condensate_return	Existing Industrial	0.109	0.159	0.73
Water_treatment	Existing Industrial	0.126	0.197	3.66
C_PoolHeater_HE	Existing Commercial	0.138	0.246	0.86
Duct_insulation	Existing Industrial	0.153	0.197	0.19
EMS_optimization	Existing Industrial	0.154	0.261	0.09
Upgrade_burner_efficiency	Existing Industrial	0.163	0.206	1.90
Leak_repair	Existing Industrial	0.171	0.464	1.76
Boiler_95	Existing Industrial	0.181	0.225	0.55
Process_Controls_&_Management	Existing Industrial	0.181	0.266	16.21
C_Steamer_Gas_ES	Existing Commercial	0.197	0.258	0.99
Flue_gas_heat_recovery_economizer	Existing Industrial	0.198	0.249	3.66
Steam_trap_maintenance	Existing Industrial	0.218	0.512	22.86
Blowdown_steam_heat_recovery	Existing Industrial	0.270	0.321	1.95
EMS_install	Existing Industrial	0.280	0.323	0.94
Improve_ceiling_insulation	Existing Industrial	0.307	0.351	2.28
Stack_heat_exchanger	Existing Industrial	0.316	0.360	0.03
C_WH_CircTimer	Existing Commercial	0.428	0.479	0.75
C_WH_Storage_HE	Existing Commercial	0.459	0.509	0.38
C_Fryer_Gas_ES	Existing Commercial	0.497	0.558	2.19
R_WH_PW_G	Existing Residential	0.538	0.575	10.03
Heat_Recovery	Existing Industrial	0.563	0.606	5.17
C_ClothesWasher_HE	Existing Commercial	0.624	0.694	0.33
C_Oven_Convec_Gas_HE	Existing Commercial	0.649	0.711	0.92
C_WH_Instant	Existing Commercial	0.842	0.904	0.51
Efficient_burners	Existing Industrial	0.993	1.064	10.79
C_HV_Boiler_85	Existing Commercial	0.996	1.040	0.00
C_HV_Boiler_95_CET	Existing Commercial	0.996	1.040	3.39
R_WH_FA_G	Existing Residential	1.178	1.226	15.28
Preventative_maintenance	Existing Industrial	1.231	1.338	0.22
RNC_05_10	RNC	1.276	1.490	0.00

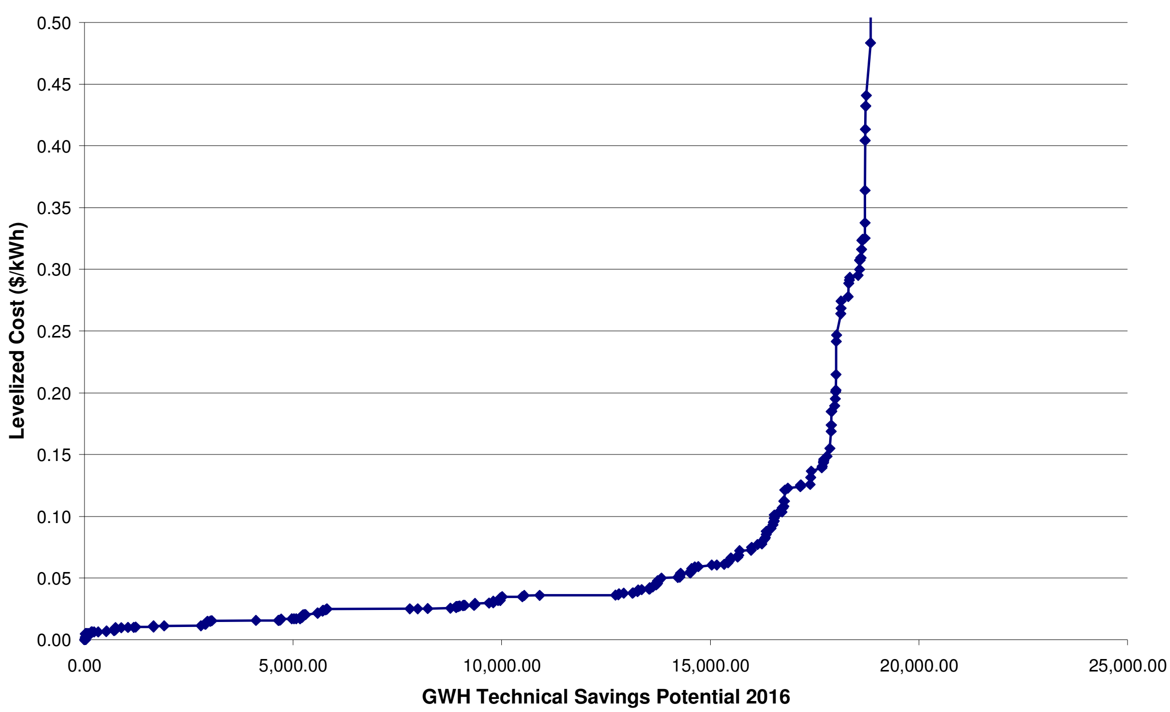
Table B-2 (cont'd.): PG&E Natural Gas Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential Millions of Therms 2016
R_WH_Shw_G	Existing Residential	1.305	1.353	18.77
R_DUCTR_G	Existing Residential	1.378	1.419	13.43
RNC_05_15	RNC	1.440	1.662	66.657
CNC_05_15	CNC	1.736	2.025	20.67
C_HV_Furn_AFUE94	Existing Commercial	1.769	1.813	0.21
C_HV_Furn_AFUE92	Existing Commercial	1.850	1.894	0.00
R_WallIns_R0R13G	Existing Residential	1.856	1.886	43.44
R_Bcontroler_MF	Existing Residential	1.884	1.920	1.13
Process_integration	Existing Industrial	2.080	2.131	13.76
Fouling_control	Existing Industrial	2.109	2.217	3.01
R_Furn_AFUE96	Existing Residential	2.135	2.165	39.54
R_WHGas_EF0.63	Existing Residential	2.293	2.332	9.57
R_Furn_AFUE92	Existing Residential	2.359	2.390	0.00
R_Furn_AFUE90	Existing Residential	2.525	2.555	0.00
Efficient_drying	Existing Industrial	2.602	2.646	2.43
R_WHGAS_POU	Existing Residential	2.755	2.794	28.70
Combustion_controls	Existing Industrial	3.080	3.165	0.40
Optimize_furnace_operations	Existing Industrial	3.114	3.185	0.31
Flare_gas_controls_and_recovery	Existing Industrial	3.167	3.217	1.40
Batch_cullet_preheating	Existing Industrial	3.170	3.220	1.63
Furnace_HE	Existing Industrial	3.195	3.239	0.33
C_Oven_Gas_HE	Existing Commercial	3.600	3.662	3.77
Improved_separation_processes	Existing Industrial	3.621	3.665	0.40
C_Griddle_Gas_HE	Existing Commercial	3.778	3.840	0.30
Oxyfuel	Existing Industrial	4.348	4.392	5.17
Thermal_oxidizers	Existing Industrial	6.334	6.385	0.30
R_CeilIns_R19R30G	Existing Residential	6.338	6.368	15.30
R_CW_MEF2.0_G	Existing Residential	6.766	6.814	0.00
R_DW_EF0.62_G	Existing Residential	7.448	7.526	0.00
R_CW_MEF1.80_G	Existing Residential	7.619	7.667	0.00
Extended_nip_press	Existing Industrial	7.972	8.016	0.57
R_CW_MEF2.2_G	Existing Residential	8.114	8.162	32.46
R_CW_MEF1.60_G	Existing Residential	8.348	8.396	0.00
R_DW_EF0.58_G	Existing Residential	8.470	0.000	0.00
Insulation/reduce_heat_losses	Existing Industrial	10.950	11.000	0.04
R_WHGAS_Solar_CET	Existing Residential	11.860	11.889	33.11
R_DW_EF0.68_G	Existing Residential	12.349	12.423	6.58
Closed_hood	Existing Industrial	12.678	12.729	0.19
C_WH_Storage_Solar	Existing Commercial	15.507	15.563	2.55

B.2 SCE Supply Curves

Figure B-3 presents the SCE electric supply curve. The data represented by the illustration are presented in Table B-3. The data presented in the table are ordered by their levelized supply cost. The table also presents data on the levelized supply cost with SCE programs and the technical electric energy efficiency potential of the measure in 2016. The sum of SCE's technical potential in 2016 is approximately 19,250 GWh.[6] The technical potential is approximately 19% of the CEC forecast of SCE energy consumpumption in 2016.[7]

Figure B-3: SCE Electric Supply Curve, 2016



As the data in the table illustrate, the measures with the lowest levelized cost are in the industrial new construction and the existing industrial sectors. In part, the lower levelized

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6 Note, this is slightly less than the technical potential presented in Section 4 (the Aggregation Section). The supply curves only include measures with non-zero technical potential in 2016. The highest efficiency pool pump modeled in the study becomes the base technology prior to 2016 and has no technical potential in 2016.

7 The CEC forecast of SCE energy consumption in 2016 includes approximately 60-80% of the market forecast of energy efficiency savings. The CEC's attempts to include expected energy efficiency savings in the consumption forecast, reduces the forecast of consumption, thereby increasing the apparent ratio of technical potential savings to forecast consumption. The CEC's forecast of consumption is from Form 1.1c SCE bundled and direct access deliveries, *California Energy Demand 2008-2018 Staff Revised Forecast*, Nov 2007.

costs within the indusrial sectors are due to the longer run times associated with this sector. In addition, the packages analyzed within the new construction sector allowed for the downsizing of HVAC equipment when high efficiency shell measures were installed. The downsizing of HVAC equipment could lead to a reduction in costs for the highest efficiency packages relative to base building techniques. In 2016, the technical potential in the industrial new construction (INC) sector is 153 GWh and 2,930 GWh in the existing industrial sector. Results presented within the body of the analysis, however, indicate that the market net-to-gross ratio within the INC and the existing industrial sectors are lower than in other sectors. The lower net-to-gross ratio is consistent with the lower levelized costs and the long running experience of energy management within the industrial sector.

The lower cost measures within the commercial sector include CFL lighting motors, and refrigeration measures. The low cost measures within the existing residential sector include CFL lighting and refrigerator and freezer recycling.

Table B-3: SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
S04_0515	INC	0.000	0.004	1.012
S01_0515	INC	0.000	0.004	0.198
S02_0515	INC	0.000	0.004	4.082
S03_0515	INC	0.000	0.004	20.134
WWT_PDW	INC	0.002	0.006	0.09
CRm_ExOp	INC	0.005	0.008	0.62
CRm_HECh	INC	0.005	0.009	6.79
S36_HEVC	INC	0.005	0.009	0.81
Fans_ASD_(6-100_hp)	Existing Industrial	0.005	0.011	32.51
Comp_Air_ASD_(6-100_hp)	Existing Industrial	0.005	0.011	32.01
Pumps_ASD_(6-100_hp)	Existing Industrial	0.005	0.011	55.64
CRm_UAS	INC	0.005	0.009	4.52
WWT_Des	INC	0.006	0.010	2.03
CRm_POHP	INC	0.006	0.010	1.96
CRm_PrPl	INC	0.006	0.010	5.62
CRm_EfFS	INC	0.006	0.010	3.04
Fans_OM	Existing Industrial	0.006	0.012	14.20
Compressed_AirSizing	Existing Industrial	0.006	0.012	50.35
Pumps_OM	Existing Industrial	0.006	0.012	97.24
C_CFL_Over24W	Existing Commercial	0.007	0.032	189.15
CRm_PACR	INC	0.007	0.011	11.84
Compressed_Air-OM	Existing Industrial	0.008	0.014	176.11

Table B-3 (cont'd.): SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
CRm_VACS	INC	0.008	0.011	2.17
S36_ACrS	INC	0.008	0.011	1.29
CRm_LPDF	INC	0.008	0.012	3.64
WWT_VFD	INC	0.008	0.012	13.80
REF_EfCn	INC	0.008	0.012	0.26
REF_AVFD	INC	0.008	0.012	6.31
S04_0510	INC	0.008	0.012	0.00
CRm_PrPm	INC	0.009	0.013	0.64
CRm_PMEV	INC	0.009	0.013	0.45
CRm_PMEW	INC	0.009	0.013	0.32
REF_FlSP	INC	0.010	0.014	6.57
S01_0510	INC	0.010	0.014	0.00
C_CFL_16_24W	Existing Commercial	0.010	0.035	140.97
C_CFL_Under15W	Existing Commercial	0.010	0.040	159.27
Compressed_Air_System_Optimization	Existing Industrial	0.010	0.016	139.79
C_HV_Motor_0-10	Existing Commercial	0.010	0.015	46.29
C_Reflector_CFL	Existing Commercial	0.010	0.043	423.88
S36_Pmp	INC	0.011	0.015	1.85
Pumps_Controls	Existing Industrial	0.011	0.017	255.08
R_FRZ_Recyl	Existing Residential	0.011	0.015	882.41
Pumps_Sizing	Existing Industrial	0.013	0.019	97.16
FansImprove_components	Existing Industrial	0.013	0.019	14.20
CRm_HeLt	INC	0.013	0.017	0.16
C_CFL_Fixture_Over24W	Existing Commercial	0.015	0.019	36.73
S36_WtEc	INC	0.015	0.019	1.17
CRm_WtEc	INC	0.015	0.019	1.97
C_HV_Motor_50+	Existing Commercial	0.015	0.019	4.10
C_Ref_IceMaker_T2	Existing Commercial	0.015	0.020	63.17
REF_FlHP	INC	0.015	0.019	4.25
C_HV_ChRec_HE	Existing Commercial	0.015	0.019	35.47
R_REF_Recyl	Existing Residential	0.016	0.019	1,062.27
R_CFL_Reflector	Existing Residential	0.016	0.020	536.09
C_HV_Motor_11-25	Existing Commercial	0.016	0.020	9.94
C_Ref_SucLnIns	Existing Commercial	0.016	0.022	30.19
C_Ref_NCover_Ref	Existing Commercial	0.017	0.028	24.50
C_Computer_80Plus	Existing Commercial	0.017	0.030	253.62
Comp_Air_ASD_(100+_hp)	Existing Industrial	0.017	0.026	53.13
Fans_ASD_(100+_hp)	Existing Industrial	0.017	0.026	53.97
Pumps_ASD_(100+_hp)	Existing Industrial	0.017	0.026	92.35

Table B-3 (cont'd.): SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
Compressed_Air_Controls	Existing Industrial	0.018	0.024	41.90
Centrifugal_Chiller_0.51_kW_ton_500_tons	Existing Industrial	0.018	0.022	17.10
S36_TMD	INC	0.019	0.023	0.14
CRm_CTMD	INC	0.019	0.023	0.24
C_Ref_MplxFHP_EvapCond	Existing Commercial	0.020	0.025	6.34
R_LED_EXIT	Existing Residential	0.020	0.023	35.31
Prog._Thermostat_DX	Existing Industrial	0.020	0.026	26.98
C_Ref_EvapFan_ECM	Existing Commercial	0.022	0.027	288.56
Energy_Star_Transformers_DX	Existing Industrial	0.022	0.025	1.27
Energy_Star_Transformers_Chiller	Existing Industrial	0.022	0.025	0.70
Energy_Star_Transformers_Lighting	Existing Industrial	0.022	0.025	2.63
C_RefVendCtrl	Existing Commercial	0.023	0.029	114.86
CRm_LFV	INC	0.024	0.027	4.56
S36_ACrL	INC	0.024	0.027	0.25
CRm_VACL	INC	0.024	0.027	0.42
C_LT_PCTC	Existing Commercial	0.024	0.032	0.00
Energy_Star_Transformers_Fan	Existing Industrial	0.024	0.027	2.26
Energy_Star_Transformers_Comp_Air	Existing Industrial	0.024	0.027	2.23
Energy_Star_Transformers_Other	Existing Industrial	0.024	0.027	1.30
Energy_Star_Transformers_Pumps	Existing Industrial	0.024	0.027	4.18
Energy_Star_Transformers_Process	Existing Industrial	0.024	0.027	0.64
Energy_Star_Transformers_Refrigeration	Existing Industrial	0.024	0.027	0.60
Energy_Star_Transformers_Heating	Existing Industrial	0.024	0.027	2.67
Energy_Star_Transformers_Drives	Existing Industrial	0.024	0.027	5.19
C_CFL_Fixture_16_24W	Existing Commercial	0.024	0.029	47.00
C_Steamer_Elec_ES	Existing Commercial	0.025	0.030	31.55
REF_LtC	INC	0.025	0.029	4.46
R_CFL_14_to_25W	Existing Residential	0.025	0.031	1,985.74
C_T12_Delamping_4Ft	Existing Commercial	0.025	0.030	187.70
Pumps_System_Optimization	Existing Industrial	0.025	0.031	240.03
R_CFL_Over25W	Existing Residential	0.026	0.032	546.59
C_Ref_StripCurt	Existing Commercial	0.026	0.042	134.27
C_LT_PCPC	Existing Commercial	0.026	0.035	0.00
CRm_PVPV	INC	0.027	0.031	1.71
CRm_DWP	INC	0.027	0.031	1.22
Comp_Air_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.036	12.42
Fans_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.036	12.62
Pumps_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.036	21.59

Table B-3 (cont'd.): SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
C_HV_Motor_26-49	Existing Commercial	0.027	0.031	5.13
C_Ref_MplxEE_EvapCond	Existing Commercial	0.027	0.033	34.46
C_CFL_Fixture_Under15W	Existing Commercial	0.028	0.032	73.77
Comp_Air_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.034	11.95
Fans_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.034	12.15
Pumps_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.034	22.17
C_LT_EXLED	Existing Commercial	0.028	0.033	221.01
C_LT_PCPT	Existing Commercial	0.028	0.037	17.96
CRm_EFFU	INC	0.030	0.033	3.92
C_PSMH_Under151W_Int_INC	Existing Commercial	0.030	0.035	338.10
C_Ref_Gaskets	Existing Commercial	0.030	0.046	96.26
C_Ref_MplxFHP_AirCond	Existing Commercial	0.031	0.036	4.81
CRm_DTCL	INC	0.031	0.035	1.48
R_LEDXMAS_CET	Existing Residential	0.032	0.034	111.59
Occupancy_Sensor_4L4_Fluorescent_Fixtures	Existing Industrial	0.032	0.038	52.72
Replace_V-belts_Other	Existing Industrial	0.032	0.041	0.13
S36_VSD	INC	0.034	0.038	3.96
C_Ref_MplxEE_AirCond	Existing Commercial	0.034	0.039	8.49
C_Ref_MplxEE_AirCond	Existing Commercial	0.03	0.04	28.41
R_WH_PW	Existing Residential	0.035	0.038	11.03
C_T8_2G_4Ft	Existing Commercial	0.035	0.040	478.26
Fans_System_Optimization	Existing Industrial	0.036	0.042	45.01
RET_2L4_Premium_T8_1EB	Existing Industrial	0.036	0.040	372.20
CNC_05_15	CNC	0.036	0.040	1,813.64
C_Ref_ASHCtrl	Existing Commercial	0.037	0.043	68.53
Window_Film_DX	Existing Industrial	0.037	0.043	18.81
C_T12_Delamping_8Ft	Existing Commercial	0.038	0.043	111.83
R_CFL_Under14W	Existing Residential	0.038	0.044	209.20
C_PSMH_Under151W_Ext_INC	Existing Commercial	0.038	0.043	15.94
Fans_Controls	Existing Industrial	0.039	0.045	106.22
Drives_Optimization_process_(MT)	Existing Industrial	0.040	0.047	13.93
C_T8_HighBay	Existing Commercial	0.041	0.045	89.14
C_Ref_NoASHGD_HE	Existing Commercial	0.041	0.047	176.45
Comp_Air_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.046	3.20
Fans_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.046	3.41
Pumps_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.046	6.02
C_T8_Fixture_4Ft	Existing Commercial	0.042	0.047	0.00
C_HV_VSD_Motor_26-49	Existing Commercial	0.043	0.049	66.95
C_Ref_NCover_Frz	Existing Commercial	0.043	0.054	6.14

Table B-3 (cont'd.): SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
C_PSMH_Under151W_Int_MV	Existing Commercial	0.044	0.049	78.84
C_Ref_MplxEE_EvapCond	Existing Commercial	0.04	0.05	4.51
WWT_LPUV	INC	0.045	0.049	11.10
C_HV_VSD_Motor_50-100	Existing Commercial	0.046	0.052	18.52
C_Ref_EvapFan_PSC	Existing Commercial	0.048	0.053	0.00
C_HV_VSD_Motor_10-25	Existing Commercial	0.050	0.056	94.25
R_CFL_Torchiere	Existing Residential	0.050	0.054	389.10
C_HV_ChCent_HE	Existing Commercial	0.051	0.055	51.71
WWT_PHR	INC	0.053	0.056	0.29
WWT_EfBl	INC	0.053	0.056	8.74
Heating_Optimization_process_(MT)	Existing Industrial	0.054	0.060	8.16
C_HV_PAClt65_15	Existing Commercial	0.054	0.058	232.88
Comp_Air_Replace_100+_HP_motor	Existing Industrial	0.055	0.064	6.12
Fans_Replace_100+_HP_motor	Existing Industrial	0.055	0.064	6.12
Pumps_Replace_100+_HP_motor	Existing Industrial	0.055	0.064	10.75
REF_EfCM	INC	0.056	0.059	0.08
C_NRefVendCtrl	Existing Commercial	0.056	0.062	6.09
Process_control_Drives	Existing Industrial	0.058	0.064	4.01
CFL_Hardwired_Modular_36W	Existing Industrial	0.058	0.071	75.25
C_HV_PACgt65_11	Existing Commercial	0.059	0.063	0.00
C_HV_WindowFilm	Existing Commercial	0.059	0.063	84.88
C_HV_PACgt65_12	Existing Commercial	0.061	0.065	324.31
C_Oven_Elec_HE	Existing Commercial	0.061	0.066	117.52
C_OCCSensor_Motion	Existing Commercial	0.061	0.066	178.42
R_LED_Reflector_CET	Existing Residential	0.062	0.064	87.26
Drives_Scheduling	Existing Industrial	0.063	0.070	6.34
R_WHEle_EF0.93	Existing Residential	0.063	0.066	18.17
Window_Film_Chiller	Existing Industrial	0.064	0.070	16.97
Machinery	Existing Industrial	0.065	0.071	8.70
DX_Packaged_System_EER=10.9_10_tons	Existing Industrial	0.066	0.071	23.73
C_HV_PkgAC_Tuneup	Existing Commercial	0.067	0.073	163.37
WWT_RPF	INC	0.068	0.072	2.87
C_Ref_SD_Freezer_T2	Existing Commercial	0.068	0.074	21.10
New_transformers_welding	Existing Industrial	0.072	0.077	19.85
R_Window_U25	Existing Residential	0.073	0.074	276.56
C_Ref_EvapFan_Ctrl	Existing Commercial	0.075	0.086	14.15
C_PSMH_Under151W_Ext_MV	Existing Commercial	0.077	0.082	139.73
C_T8_2G_8Ft	Existing Commercial	0.078	0.082	104.62

Table B-3 (cont'd.): SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
C_Oven_Convec_Elec_HE	Existing Commercial	0.079	0.085	4.38
C_HV_Retro_Vent	Existing Commercial	0.081	0.090	31.37
C_LEDSignage	Existing Commercial	0.082	0.086	30.19
R_WH_Shw	Existing Residential	0.083	0.086	17.17
C_PSMH_Over150W_Int	Existing Commercial	0.085	0.090	23.95
Fans_Replace_1-5_HP_motor	Existing Industrial	0.088	0.092	2.08
Comp_Air_Replace_1-5_HP_motor	Existing Industrial	0.088	0.092	2.08
Pumps_Replace_1-5_HP_motor	Existing Industrial	0.088	0.092	3.66
OM_Extruders_Injection_Moulding	Existing Industrial	0.088	0.093	26.63
Chiller_Tune_Up_Diagnostics	Existing Industrial	0.088	0.094	4.27
R_WH_FA	Existing Residential	0.088	0.092	12.95
C_HV_ChillerAux	Existing Commercial	0.090	0.094	55.74
C_Copier_ES	Existing Commercial	0.093	0.102	48.72
C_HoldCabinet_Elec_HE	Existing Commercial	0.095	0.100	8.34
Efficient_Curing_ovens	Existing Industrial	0.096	0.100	22.92
C_T8_Fixture_8Ft	Existing Commercial	0.099	0.103	0.00
Bakery_Process_(Mixing)_OM	Existing Industrial	0.101	0.107	3.82
C_Ref_SDAutoClose	Existing Commercial	0.101	0.110	53.00
EMS_Chiller_	Existing Industrial	0.102	0.108	27.50
C_PSMH_Over150W_Ext	Existing Commercial	0.103	0.108	104.35
Fans_Replace_6-100_HP_motor	Existing Industrial	0.107	0.113	6.78
Comp_Air_Replace_6-100_HP_motor	Existing Industrial	0.107	0.113	6.78
Pumps_Replace_6-100_HP_motor	Existing Industrial	0.107	0.113	2.52
Cool_Roof_DX	Existing Industrial	0.108	0.114	23.37
Fans_ASD_(1-5_hp)	Existing Industrial	0.112	0.117	4.57
Comp_Air_ASD_(1-5_hp)	Existing Industrial	0.112	0.117	4.21
Pumps_ASD_(1-5_hp)	Existing Industrial	0.112	0.117	8.05
Efficient_Refrigeration_Operations	Existing Industrial	0.121	0.127	9.82
C_HV_Retro_Chiller	Existing Commercial	0.123	0.132	72.86
R_CFL_Fixture	Existing Residential	0.124	0.126	299.91
Gap_Forming_papermachine	Existing Industrial	0.125	0.129	2.68
Efficient_practices_printing_press	Existing Industrial	0.125	0.129	7.47
High_Consistency_forming	Existing Industrial	0.125	0.129	2.58
C_OCCSensor_Plugload	Existing Commercial	0.126	0.130	219.67
Cooling_Circ._Pumps_VSD_	Existing Industrial	0.132	0.136	14.63
Drives_EE_motor	Existing Industrial	0.137	0.143	11.25
R_REF_ES	Existing Residential	0.139	0.142	256.83
C_HV_PTAC_HE	Existing Commercial	0.140	0.145	9.70
R_DUCTR_E	Existing Residential	0.143	0.146	27.68

Table B-3 (cont'd.): SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
Near_Net_Shape_Casting	Existing Industrial	0.144	0.148	1.20
Air_conveying_systems	Existing Industrial	0.145	0.150	5.66
C_Griddle_Elec_HE	Existing Commercial	0.146	0.151	4.75
R_AC_Tuneup	Existing Residential	0.149	0.152	75.00
R_CFL_Table	Existing Residential	0.155	0.157	66.10
DX_Tune_Up__Advanced_Diagnostics	Existing Industrial	0.169	0.182	29.73
C_HV_PTHP_HE	Existing Commercial	0.174	0.178	6.22
Heating_Scheduling	Existing Industrial	0.185	0.191	1.82
Cool_Roof_Chiller	Existing Industrial	0.185	0.191	12.20
C_Ref_GD_Refrig_T2	Existing Commercial	0.190	0.195	65.72
Bakery_Process	Existing Industrial	0.195	0.199	14.70
Clean_Room_Controls	Existing Industrial	0.201	0.207	11.59
Replace_V-Belts_Drives	Existing Industrial	0.202	0.208	3.84
R_OCC_Sensor	Existing Residential	0.215	0.219	3.11
Top-heating_(glass)	Existing Industrial	0.242	0.249	2.32
Metal_Halide_50W	Existing Industrial	0.247	0.256	11.29
C_Lt_DLInst	Existing Commercial	0.264	0.269	100.23
C_Ref_Sngl2Mplx_EvapC_HE	Existing Commercial	0.269	0.274	5.25
R_CW_MEF1.60	Existing Residential	0.274	0.278	0.00
RNC_05_15	RNC	0.278	0.317	171.84
Efficient_processes_(welding_etc.)	Existing Industrial	0.289	0.293	12.47
Evaporative_Pre-Cooler	Existing Industrial	0.291	0.298	18.61
C_Fryer_Elec_ES	Existing Commercial	0.293	0.299	7.51
R_T8_4ft	Existing Residential	0.295	0.300	198.00
R_WallIns_R0R13E	Existing Residential	0.300	0.302	38.08
Refinery_Controls_Fans	Existing Industrial	0.307	0.313	0.73
Refinery_Controls_Comp_Air	Existing Industrial	0.307	0.313	1.20
Refinery_Controls_Pumps	Existing Industrial	0.307	0.313	4.73
Refinery_Controls_Process	Existing Industrial	0.307	0.313	0.00
C_Ref_SD_Refrig_T2	Existing Commercial	0.309	0.314	21.24
Process_Drives_ASD	Existing Industrial	0.309	0.316	1.07
C_Ref_GDAutoClose	Existing Commercial	0.316	0.325	21.69
Efficient_drives	Existing Industrial	0.324	0.330	1.57
Drives_Process_Controls_(batch_+_site)	Existing Industrial	0.324	0.330	17.70
Efficient_drives_rolling	Existing Industrial	0.324	0.330	5.90
R_WHEle_Solar_CET	Existing Residential	0.325	0.327	51.78
R_CW_MEF1.80	Existing Residential	0.338	0.341	0.00
Efficient_Machinery	Existing Industrial	0.364	0.370	0.17
OM_drives_spinning_machines	Existing Industrial	0.404	0.410	5.41

Table B-3 (cont'd.): SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
Efficient_desalter	Existing Industrial	0.404	0.411	0.02
Efficient_electric_melting	Existing Industrial	0.413	0.417	4.47
Heating_Process_Control	Existing Industrial	0.432	0.437	4.97
Drives_Process_Control	Existing Industrial	0.432	0.437	5.08
R_HP_SEER15	Existing Residential	0.441	0.443	10.71
R_ExtLite_Control	Existing Residential	0.483	0.488	103.62
Membranes_for_wastewater	Existing Industrial	0.504	0.509	0.12
C_Ref_OpenMDToGD_HE	Existing Commercial	0.505	0.511	2.22
Optimization_control_PM	Existing Industrial	0.506	0.512	8.47
Optimize_drying_process	Existing Industrial	0.507	0.513	3.97
Process_control_Process	Existing Industrial	0.576	0.581	0.02
Injection_Moulding_Impulse_Cooling	Existing Industrial	0.581	0.587	13.94
Extruders_injection_Moulding-multipump	Existing Industrial	0.581	0.587	31.86
Optimization_Refrigeration	Existing Industrial	0.606	0.610	14.82
Process_optimization	Existing Industrial	0.607	0.613	2.50
Power_recovery_Comp_Air	Existing Industrial	0.607	0.613	0.24
Power_recovery_Fans	Existing Industrial	0.607	0.613	0.15
Power_recovery_Pumps	Existing Industrial	0.607	0.613	1.02
Power_recovery_Process	Existing Industrial	0.607	0.613	0.00
Other_Process_Controls_(batch_+_site)	Existing Industrial	0.607	0.613	4.39
Efficient_Printing_press_(fewer_cylinders)	Existing Industrial	0.608	0.614	5.96
R_DW_EF0.62	Existing Residential	0.613	0.616	0.00
R_CW_MEF2.0	Existing Residential	0.645	0.648	0.00
R_DW_EF0.58	Existing Residential	0.652	0.000	0.00
Drying_(UV_IR)	Existing Industrial	0.693	0.700	1.09
C_HV_CoolRoof	Existing Commercial	0.772	0.776	45.49
R_RAC_ES	Existing Residential	0.828	0.830	9.72
R_CAC_SEER15	Existing Residential	0.844	0.846	61.80
R_CeilIns_R19R30E	Existing Residential	0.851	0.853	18.70
Injection_Moulding_Direct_drive	Existing Industrial	0.853	0.858	13.25
C_Ref_Sngl2Mplx_AirC_HE	Existing Commercial	0.861	0.866	10.77
Clean_Room_New_Designs	Existing Industrial	0.890	0.896	4.54
R_CW_MEF2.2	Existing Residential	0.903	0.907	15.36
R_CoolRoof_CET	Existing Residential	1.040	1.042	19.10
Direct_drive_Extruders	Existing Industrial	1.085	1.091	13.23
R_DW_EF0.68	Existing Residential	1.119	1.122	4.30
Heat_Pumps_Drying	Existing Industrial	1.154	1.158	1.11
Light_cylinders	Existing Industrial	1.418	1.424	2.97

Table B-3 (cont'd.): SCE Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Techncial Potential GWh, 2016
Efficient_grinding	Existing Industrial	1.586	1.590	16.60
Intelligent_extruder_(DOE)	Existing Industrial	1.618	1.624	0.10
R_WholeHFan	Existing Residential	3.200	3.203	64.45
R_NiteEcon_CET	Existing Residential	7.759	7.762	17.01

B.3 SDG&E Supply Curves

Figure B-1 presents the SDG&E electric supply curve. The data represented by the illustration are presented inFigure B-4. The data presented in the table are ordered by their levelized supply cost. The table also presents data on the levelized supply cost with SDG&E programs and the technical electric energy efficiency potential of the measure in 2016. The sum of SDG&E's technical potential in 2016 is approximately 4,515 GWh.[8] The technical potential is approximately 19.5% of the CEC forecast of SDG&E energy consumpumption in 2016.[9]

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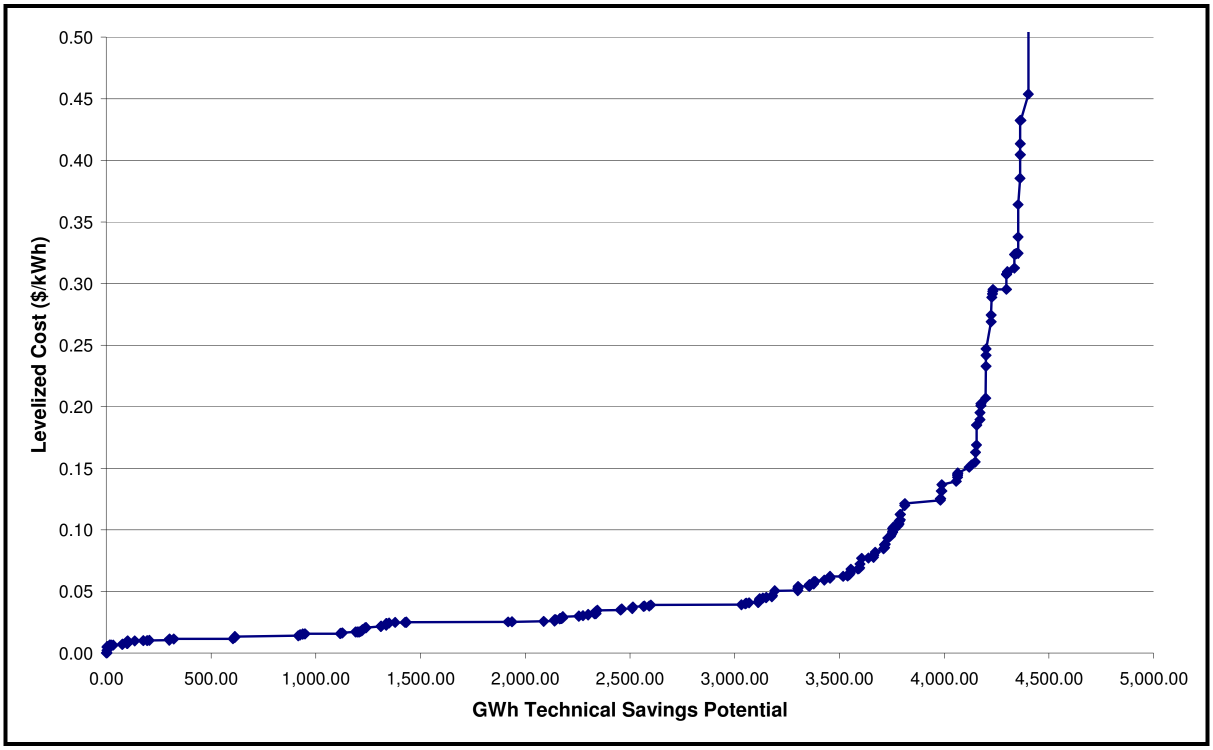
8 Note, this is slightly less than the technical potential presented in Section 4 (the Aggregation Section). The supply curves only include measures with non-zero technical potential in 2016. The highest efficiency pool pump modeled in the study becomes the base technology prior to 2016 and has no technical potential in 2016.

9 The CEC forecast of SDG&E energy consumption in 2016 includes approximately 60-80% of the market forecast of energy efficiency savings. The CEC's attempts to include expected energy efficiency savings in the consumption forecast, reduces the forecast of consumption, thereby increasing the apparent ratio of technical potential savings to forecast consumption. The CEC's forecast of consumption is from Form 1.1c SDG&E bundled and direct access deliveries, *California Energy Demand 2008-2018 Staff Revised Forecast*, Nov 2007.

Figure B-4: SDG&E Electric Supply Curve, 2016



As the data in the table illustrate, the measures with the lowest levelized cost are in the industrial new construction and the existing industrial sectors. In part, the lower levelized costs within the indusrial sectors are due to the longer run times associated with this sector. In addition, the packages analyzed within the new construction sector allowed for the downsizing of HVAC equipment when high efficiency shell measures were installed. The downsizing of HVAC equipment could lead to a reduction in costs for the highest efficiency packages relative to base building techniques. In 2016, the technical potential in the industrial new construction (INC) sector is 13 GWh and 306 GWh in the existing industrial sector. Results presented within the body of the analysis, however, indicate that the market net-to-gross ratio within the INC and the existing industrial sectors are lower than in other sectors. The lower net-to-gross ratio is consistent with the lower levelized costs and the long running experience of energy management within the industrial sector.

The lower cost measures within the commercial sector include CFL lighting motors, and refrigeration measures. The low cost measures within the existing residential sector include CFL lighting and refrigerator and freezer recycling.

Table B-4: SDG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, GWh, 2016
S04_0515	INC	0.000	0.003	0.301
S02_0515	INC	0.000	0.003	1.366
S03_0515	INC	0.000	0.003	1.820
WWT_PDW	INC	0.002	0.005	0.01
CRm_ExOp	INC	0.005	0.003	0.05
CRm_HECh	INC	0.005	0.008	0.53
S36_HEVC	INC	0.005	0.008	0.12
Fans_ASD_(6-100_hp)	Existing Industrial	0.005	0.010	2.47
Comp_Air_ASD_(6-100_hp)	Existing Industrial	0.005	0.010	4.09
Pumps_ASD_(6-100_hp)	Existing Industrial	0.005	0.010	4.52
CRm_UAS	INC	0.005	0.003	0.35
WWT_Des	INC	0.006	0.009	0.12
CRm_POHP	INC	0.006	0.009	0.15
CRm_PrPl	INC	0.006	0.003	0.44
CRm_EfFS	INC	0.006	0.009	0.23
Fans_OM	Existing Industrial	0.006	0.011	1.08
Compressed_AirSizing	Existing Industrial	0.006	0.011	6.44
Pumps_OM	Existing Industrial	0.006	0.011	7.90
C_CFL_Over24W	Existing Commercial	0.007	0.025	43.81
CRm_PACR	INC	0.007	0.010	0.92
Compressed_Air-OM	Existing Industrial	0.008	0.012	22.55
CRm_VACS	INC	0.008	0.011	0.17
S36_ACrS	INC	0.008	0.011	0.19
CRm_LPDF	INC	0.008	0.011	0.28
WWT_VFD	INC	0.008	0.011	0.80
REF_EfCn	INC	0.008	0.011	0.01
REF_AVFD	INC	0.008	0.011	0.26
S04_0510	INC	0.008	0.011	0.00
S03_0510	INC	0.008	0.012	0.00
CRm_PrPm	INC	0.009	0.012	0.05
CRm_PMEV	INC	0.009	0.012	0.03
CRm_PMEW	INC	0.009	0.012	0.02
REF_FlSP	INC	0.010	0.013	0.27
S02_0510	INC	0.010	0.013	0.00
C_CFL_16_24W	Existing Commercial	0.010	0.028	34.35
C_CFL_Under15W	Existing Commercial	0.010	0.032	40.84
Compressed_Air_System_Optimization	Existing Industrial	0.010	0.015	17.90
C_HV_Motor_0-10	Existing Commercial	0.010	0.013	10.41
C_Reflector_CFL	Existing Commercial	0.010	0.034	95.94

Table B-4 (cont'd.): SDG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, GWh, 2016
S36_Pmp	INC	0.011	0.015	0.28
Pumps_Controls	Existing Industrial	0.011	0.016	20.74
R_FRZ_Recyl	Existing Residential	0.011	0.016	283.05
Pumps_Sizing	Existing Industrial	0.013	0.017	7.90
FansImprove_components	Existing Industrial	0.013	0.017	1.08
CRm_HeLt	INC	0.013	0.016	0.01
R_REF_Recyl	Existing Residential	0.014	0.018	302.90
C_CFL_Fixture_Over24W	Existing Commercial	0.015	0.018	7.90
S36_WtEc	INC	0.015	0.018	0.17
CRm_WtEc	INC	0.015	0.018	0.15
C_Ref_IceMaker_T2	Existing Commercial	0.015	0.019	13.02
REF_FlHP	INC	0.015	0.019	0.18
C_HV_ChRec_HE	Existing Commercial	0.015	0.018	9.77
C_HV_Motor_50+	Existing Commercial	0.016	0.019	0.88
R_CFL_Reflector	Existing Residential	0.016	0.020	167.99
C_HV_Motor_11-25	Existing Commercial	0.016	0.019	2.34
C_Ref_SucLnIns	Existing Commercial	0.016	0.023	8.14
C_Computer_80Plus	Existing Commercial	0.017	0.027	62.73
Comp_Air_ASD_(100+_hp)	Existing Industrial	0.017	0.024	6.80
Fans_ASD_(100+_hp)	Existing Industrial	0.017	0.024	4.10
Pumps_ASD_(100+_hp)	Existing Industrial	0.017	0.024	7.51
C_Ref_NCover_Ref	Existing Commercial	0.018	0.029	6.06
Compressed_Air_Controls	Existing Industrial	0.018	0.023	5.37
CRm_DWP	INC	0.018	0.021	0.09
Centrifugal_Chiller_0.51_kW_ton_500_tons	Existing Industrial	0.018	0.021	2.52
S36_TMD	INC	0.019	0.022	0.02
CRm_CTMD	INC	0.019	0.022	0.02
R_LED_EXIT	Existing Residential	0.020	0.023	12.53
Prog._Thermostat_DX	Existing Industrial	0.020	0.025	4.11
C_Ref_MplxFHP_EvapCond	Existing Commercial	0.021	0.026	0.19
C_Ref_EvapFan_ECM	Existing Commercial	0.022	0.027	71.10
Energy_Star_Transformers_DX	Existing Industrial	0.022	0.024	0.19
Energy_Star_Transformers_Chiller	Existing Industrial	0.022	0.024	0.10
Energy_Star_Transformers_Lighting	Existing Industrial	0.022	0.024	0.35
C_RefVendCtrl	Existing Commercial	0.023	0.027	24.89
CRm_LFV	INC	0.024	0.027	0.35
S36_ACrL	INC	0.024	0.027	0.04
CRm_VACL	INC	0.024	0.027	0.03
C_LT_PCTC	Existing Commercial	0.024	0.030	0.00

Table B-4 (cont'd.): SDG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, GWh, 2016
Energy_Star_Transformers_Fan	Existing Industrial	0.024	0.026	0.17
Energy_Star_Transformers_Comp_Air	Existing Industrial	0.024	0.026	0.29
Energy_Star_Transformers_Other	Existing Industrial	0.024	0.026	0.16
Energy_Star_Transformers_Pumps	Existing Industrial	0.024	0.026	0.35
Energy_Star_Transformers_Drives	Existing Industrial	0.024	0.026	0.52
Energy_Star_Transformers_Process	Existing Industrial	0.024	0.026	0.13
Energy_Star_Transformers_Refrigeration	Existing Industrial	0.024	0.026	0.02
Energy_Star_Transformers_Heating	Existing Industrial	0.024	0.026	0.28
C_CFL_Fixture_16_24W	Existing Commercial	0.024	0.028	11.09
C_Ref_StripCurt	Existing Commercial	0.025	0.040	28.66
C_T12_Delamping_4Ft	Existing Commercial	0.025	0.028	47.39
C_Steamer_Elec_ES	Existing Commercial	0.025	0.029	6.37
REF_LtC	INC	0.025	0.028	0.19
R_CFL_14_to_25W	Existing Residential	0.025	0.032	485.63
Pumps_System_Optimization	Existing Industrial	0.025	0.030	19.56
R_CFL_Over25W	Existing Residential	0.026	0.033	150.82
C_LT_EXLED	Existing Commercial	0.026	0.029	52.12
C_LT_PCPC	Existing Commercial	0.026	0.032	0.00
CRm_PVPV	INC	0.027	0.030	0.13
C_HV_Motor_26-49	Existing Commercial	0.027	0.030	1.18
Comp_Air_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.034	1.59
Fans_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.034	0.96
Pumps_Motor_practices-1_(100+_HP)	Existing Industrial	0.027	0.034	1.76
C_CFL_Fixture_Under15W	Existing Commercial	0.028	0.031	18.27
Comp_Air_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.032	1.53
Fans_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.032	0.92
Pumps_Motor_practices-1_(6-100_HP)	Existing Industrial	0.028	0.032	1.69
C_Ref_MplxEE_EvapCond	Existing Commercial	0.028	0.033	5.48
C_LT_PCPT	Existing Commercial	0.028	0.034	4.61
CRm_EFFU	INC	0.030	0.033	0.30
C_PSMH_Under151W_Int_INC	Existing Commercial	0.030	0.033	76.78
C_Ref_MplxFHP_AirCond	Existing Commercial	0.030	0.035	0.69
C_Ref_ASHCtrl	Existing Commercial	0.030	0.037	19.35
C_Ref_Gaskets	Existing Commercial	0.031	0.047	24.81
CRm_DTCL	INC	0.031	0.034	0.11
R_LEDXMAS_CET	Existing Residential	0.032	0.034	29.70
Occupancy_Sensor_4L4_Fluorescent_Fixtures	Existing Industrial	0.032	0.036	7.02
Replace_V-belts_Other	Existing Industrial	0.032	0.039	0.01
S36_VSD	INC	0.034	0.037	0.59

Table B-4 (cont'd.): SDG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, GWh, 2016
C_Ref_MplxEE_AirCond	Existing Commercial	0.035	0.040	5.90
C_T8_2G_4Ft	Existing Commercial	0.035	0.038	110.73
C_Ref_MplxEE_AirCond	Existing Commercial	0.03	0.04	2.01
Fans_System_Optimization	Existing Industrial	0.036	0.040	3.43
RET_2L4_Premium_T8_1EB	Existing Industrial	0.036	0.039	50.90
Window_Film_DX	Existing Industrial	0.037	0.042	2.87
R_CFL_Under14W	Existing Residential	0.038	0.045	51.17
C_PSMH_Under151W_Ext_INC	Existing Commercial	0.038	0.041	4.43
C_T12_Delamping_8Ft	Existing Commercial	0.038	0.042	21.89
Fans_Controls	Existing Industrial	0.039	0.043	8.09
CNC_05_15	CNC	0.039	0.043	433.44
C_HV_VSD_Motor_26-49	Existing Commercial	0.040	0.044	17.24
C_HV_VSD_Motor_50-100	Existing Commercial	0.040	0.045	3.39
Drives_Optimization_process_(MT)	Existing Industrial	0.040	0.045	1.96
C_T8_HighBay	Existing Commercial	0.041	0.044	13.23
C_Ref_NoASHGD_HE	Existing Commercial	0.041	0.047	43.77
Comp_Air_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.045	0.41
Fans_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.045	0.26
Pumps_Motor_practices-1_(1-5_HP)	Existing Industrial	0.041	0.045	0.50
R_WH_PW	Existing Residential	0.042	0.046	3.62
C_T8_Fixture_4Ft	Existing Commercial	0.042	0.046	0.00
C_Ref_NCover_Frz	Existing Commercial	0.043	0.054	1.50
C_Ref_MplxEE_EvapCond	Existing Commercial	0.04	0.05	0.87
C_PSMH_Under151W_Int_MV	Existing Commercial	0.044	0.048	15.52
C_HV_ChillerAux	Existing Commercial	0.045	0.048	15.00
WWT_LPUV	INC	0.045	0.048	0.65
C_HV_VSD_Motor_10-25	Existing Commercial	0.046	0.050	26.75
C_NRefVendCtrl	Existing Commercial	0.047	0.051	1.43
C_Ref_EvapFan_PSC	Existing Commercial	0.047	0.052	0.00
C_HV_ChCent_HE	Existing Commercial	0.050	0.053	12.32
R_CFL_Torchiere	Existing Residential	0.050	0.055	110.49
WWT_PHR	INC	0.053	0.056	0.02
WWT_EfBl	INC	0.053	0.056	0.51
Heating_Optimization_process_(MT)	Existing Industrial	0.054	0.058	0.96
C_HV_PAClt65_15	Existing Commercial	0.054	0.057	51.95
Comp_Air_Replace_100+_HP_motor	Existing Industrial	0.055	0.062	0.79
Fans_Replace_100+_HP_motor	Existing Industrial	0.055	0.062	0.47
Pumps_Replace_100+_HP_motor	Existing Industrial	0.055	0.062	0.89
REF_EfCM	INC	0.056	0.059	0.00

Table B-4 (cont'd.): SDG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, GWh, 2016
C_HV_WindowFilm	Existing Commercial	0.056	0.059	19.22
Process_control_Drives	Existing Industrial	0.058	0.062	0.05
CFL_Hardwired_Modular_36W	Existing Industrial	0.058	0.068	7.39
C_OCCSensor_Motion	Existing Commercial	0.059	0.063	44.72
C_Oven_Elec_HE	Existing Commercial	0.061	0.064	26.12
C_HV_PACgt65_11	Existing Commercial	0.062	0.065	0.00
C_HV_PACgt65_12	Existing Commercial	0.062	0.065	62.15
R_LED_Reflector_CET	Existing Residential	0.062	0.065	21.87
Drives_Scheduling	Existing Industrial	0.063	0.068	1.10
R_WHEle_EF0.93	Existing Residential	0.063	0.067	6.94
Window_Film_Chiller	Existing Industrial	0.064	0.068	2.47
Machinery	Existing Industrial	0.065	0.069	1.35
DX_Packaged_System_EER=10.9_10_tons	Existing Industrial	0.066	0.070	3.65
WWT_RPF	INC	0.068	0.071	0.17
C_HV_PkgAC_Tuneup	Existing Commercial	0.068	0.073	33.99
C_Ref_SD_Freezer_T2	Existing Commercial	0.068	0.072	4.62
C_Ref_EvapFan_Ctrl	Existing Commercial	0.069	0.080	3.09
New_transformers_welding	Existing Industrial	0.072	0.075	2.38
C_HV_Retro_Vent	Existing Commercial	0.077	0.084	7.38
C_PSMH_Under151W_Ext_MV	Existing Commercial	0.077	0.080	32.15
C_T8_2G_8Ft	Existing Commercial	0.078	0.081	24.60
C_Oven_Convec_Elec_HE	Existing Commercial	0.079	0.083	0.94
C_LEDSignage	Existing Commercial	0.082	0.085	6.81
R_Window_U25	Existing Residential	0.085	0.087	40.74
C_PSMH_Over150W_Int	Existing Commercial	0.085	0.089	4.23
Fans_Replace_1-5_HP_motor	Existing Industrial	0.088	0.091	0.16
Comp_Air_Replace_1-5_HP_motor	Existing Industrial	0.088	0.091	0.27
Pumps_Replace_1-5_HP_motor	Existing Industrial	0.088	0.091	0.30
OM_Extruders_Injection_Moulding	Existing Industrial	0.088	0.092	1.03
Chiller_Tune_Up_Diagnostics	Existing Industrial	0.088	0.093	0.64
C_Copier_ES	Existing Commercial	0.093	0.100	13.45
C_Ref_SDAutoClose	Existing Commercial	0.095	0.103	10.97
C_HoldCabinet_Elec_HE	Existing Commercial	0.095	0.099	1.72
Efficient_Curing_ovens	Existing Industrial	0.096	0.099	4.12
R_WH_Shw	Existing Residential	0.098	0.102	5.76
C_T8_Fixture_8Ft	Existing Commercial	0.099	0.102	0.00
Bakery_Process_(Mixing)_OM	Existing Industrial	0.101	0.106	0.12
EMS_Chiller_	Existing Industrial	0.102	0.107	4.01

Table B-4 (cont'd.): SDG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, GWh, 2016
C_PSMH_Over150W_Ext	Existing Commercial	0.103	0.107	22.57
R_WH_FA	Existing Residential	0.105	0.109	4.17
Fans_Replace_6-100_HP_motor	Existing Industrial	0.107	0.111	0.52
Comp_Air_Replace_6-100_HP_motor	Existing Industrial	0.107	0.111	0.88
Pumps_Replace_6-100_HP_motor	Existing Industrial	0.107	0.111	0.14
Cool_Roof_DX	Existing Industrial	0.108	0.112	3.57
Fans_ASD_(1-5_hp)	Existing Industrial	0.112	0.116	0.35
Comp_Air_ASD_(1-5_hp)	Existing Industrial	0.112	0.116	0.55
Pumps_ASD_(1-5_hp)	Existing Industrial	0.112	0.116	0.67
C_HV_Retro_Chiller	Existing Commercial	0.120	0.126	20.04
Efficient_Refrigeration_Operations	Existing Industrial	0.121	0.126	0.32
R_CFL_Fixture	Existing Residential	0.124	0.127	170.28
Gap_Forming_papermachine	Existing Industrial	0.125	0.128	0.03
Efficient_practices_printing_press	Existing Industrial	0.125	0.128	1.41
High_Consistency_forming	Existing Industrial	0.125	0.128	0.03
C_HV_PTAC_HE	Existing Commercial	0.131	0.135	2.40
Cooling_Circ._Pumps_VSD_	Existing Industrial	0.132	0.135	2.14
Drives_EE_motor	Existing Industrial	0.137	0.141	0.29
R_REF_ES	Existing Residential	0.139	0.142	69.02
R_DUCTR_E	Existing Residential	0.143	0.145	6.19
Near_Net_Shape_Casting	Existing Industrial	0.144	0.147	0.02
Air_conveying_systems	Existing Industrial	0.145	0.149	0.38
C_Griddle_Elec_HE	Existing Commercial	0.146	0.150	0.95
C_OCCSensor_Plugload	Existing Commercial	0.151	0.154	53.83
R_AC_Tuneup	Existing Residential	0.153	0.157	11.31
R_CFL_Table	Existing Residential	0.155	0.158	18.34
C_HV_PTHP_HE	Existing Commercial	0.163	0.166	1.25
DX_Tune_Up__Advanced_Diagnostics	Existing Industrial	0.169	0.178	4.54
Heating_Scheduling	Existing Industrial	0.185	0.189	0.17
Cool_Roof_Chiller	Existing Industrial	0.185	0.190	1.79
C_Ref_GD_Refrig_T2	Existing Commercial	0.190	0.193	14.92
Bakery_Process	Existing Industrial	0.195	0.198	0.49
Clean_Room_Controls	Existing Industrial	0.201	0.205	3.09
Replace_V-Belts_Drives	Existing Industrial	0.202	0.207	0.26
R_DUCTR_G	Existing Residential	0.207	0.213	23.13
R_OCC_Sensor	Existing Residential	0.233	0.238	0.98
Top-heating_(glass)	Existing Industrial	0.242	0.247	0.03
Metal_Halide_50W	Existing Industrial	0.247	0.254	0.76

Table B-4 (cont'd.): SDG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, GWh, 2016
C_Lt_DLInst	Existing Commercial	0.269	0.272	24.11
R_CW_MEF1.60	Existing Residential	0.274	0.279	0.00
Efficient_processes_(welding_etc.)	Existing Industrial	0.289	0.292	3.21
Evaporative_Pre-Cooler	Existing Industrial	0.291	0.296	2.88
C_Fryer_Elec_ES	Existing Commercial	0.293	0.297	1.49
C_Ref_Sngl2Mplx_EvapC_HE	Existing Commercial	0.295	0.300	1.24
R_T8_4ft	Existing Residential	0.295	0.300	64.62
Refinery_Controls_Fans	Existing Industrial	0.307	0.312	0.00
Refinery_Controls_Comp_Air	Existing Industrial	0.307	0.312	0.00
Refinery_Controls_Pumps	Existing Industrial	0.307	0.312	0.01
Refinery_Controls_Process	Existing Industrial	0.307	0.312	0.00
C_Ref_SD_Refrig_T2	Existing Commercial	0.309	0.313	4.46
Process_Drives_ASD	Existing Industrial	0.309	0.314	0.30
RNC_05_15	RNC	0.312	0.352	33.41
Efficient_drives	Existing Industrial	0.324	0.328	0.30
Drives_Process_Controls_(batch_+_site)	Existing Industrial	0.324	0.328	2.54
C_Ref_GDAutoClose	Existing Commercial	0.324	0.333	5.53
Efficient_drives_rolling	Existing Industrial	0.324	0.329	0.08
R_WallIns_R0R13E	Existing Residential	0.324	0.327	8.80
R_CW_MEF1.80	Existing Residential	0.338	0.342	0.00
Efficient_Machinery	Existing Industrial	0.364	0.368	0.06
R_WHEle_Solar_CET	Existing Residential	0.385	0.388	9.51
OM_drives_spinning_machines	Existing Industrial	0.404	0.409	0.19
Efficient_desalter	Existing Industrial	0.404	0.409	0.00
Efficient_electric_melting	Existing Industrial	0.413	0.416	0.06
Drives_Process_Control	Existing Industrial	0.432	0.435	0.06
Heating_Process_Control	Existing Industrial	0.432	0.435	0.06
R_HP_SEER15	Existing Residential	0.432	0.435	3.92
R_WallIns_R0R13G	Existing Residential	0.454	0.459	35.74
Membranes_for_wastewater	Existing Industrial	0.504	0.507	0.00
Optimization_control_PM	Existing Industrial	0.506	0.510	0.11
Optimize_drying_process	Existing Industrial	0.507	0.511	0.27
R_ExtLite_Control	Existing Residential	0.524	0.529	23.40
C_Ref_OpenMDToGD_HE	Existing Commercial	0.533	0.540	0.52
R_DW_EF0.62	Existing Residential	0.569	0.573	0.00
Process_control_Process	Existing Industrial	0.576	0.579	0.01
R_CeilIns_R19R30E	Existing Residential	0.578	0.580	8.42

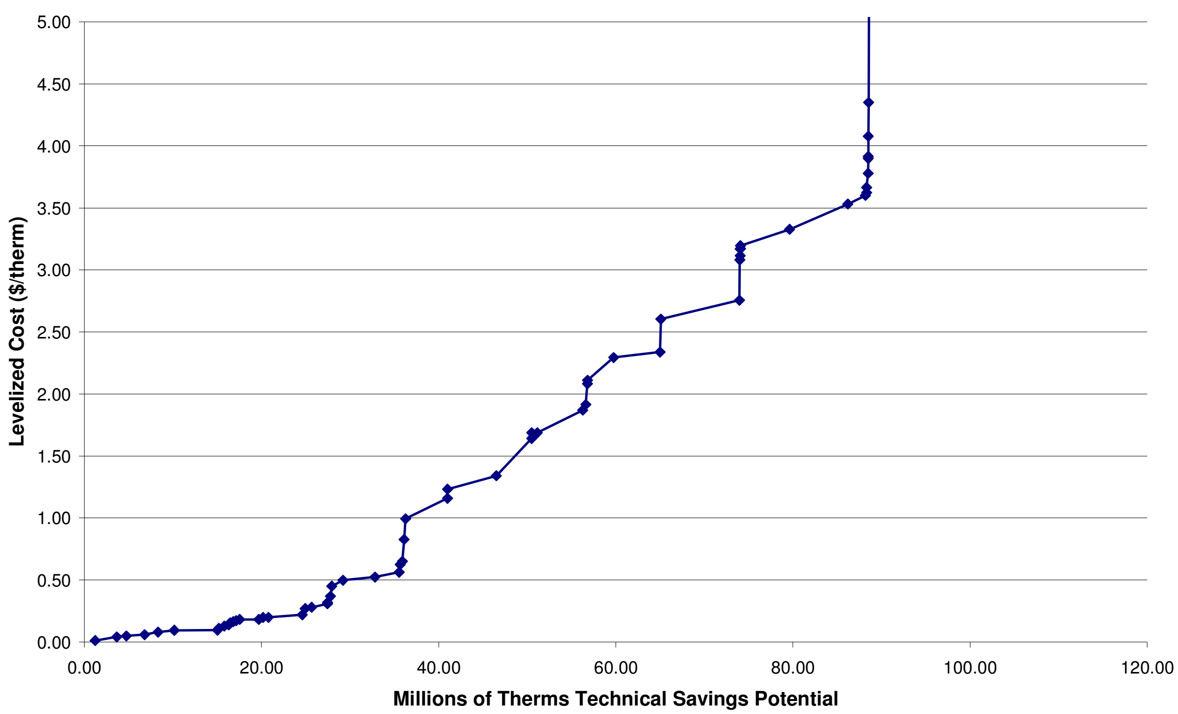
Table B-4 (cont'd.): SDG&E Electric Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, GWh, 2016
Injection_Moulding_Impulse_Cooling	Existing Industrial	0.581	0.585	0.54
Extruders_injection_Moulding-multipump	Existing Industrial	0.581	0.585	1.24
Optimization_Refrigeration	Existing Industrial	0.606	0.609	0.48
R_DW_EF0.58	Existing Residential	0.606	0.000	0.00
Process_optimization	Existing Industrial	0.607	0.611	0.03
Power_recovery_Comp_Air	Existing Industrial	0.607	0.611	0.00
Power_recovery_Fans	Existing Industrial	0.607	0.611	0.00
Power_recovery_Pumps	Existing Industrial	0.607	0.611	0.00
Power_recovery_Process	Existing Industrial	0.607	0.611	0.00
Other_Process_Controls_(batch_+_site)	Existing Industrial	0.607	0.611	1.21
Efficient_Printing_press_(fewer_cylinders)	Existing Industrial	0.608	0.612	1.13
R_CW_MEF2.0	Existing Residential	0.645	0.649	0.00
Drying_(UV_IR)	Existing Industrial	0.693	0.698	0.04
C_HV_CoolRoof	Existing Commercial	0.724	0.727	8.93
C_Ref_Sngl2Mplx_AirC_HE	Existing Commercial	0.783	0.788	2.61
Injection_Moulding_Direct_drive	Existing Industrial	0.853	0.856	0.52
R_CAC_SEER15	Existing Residential	0.853	0.856	8.41
Clean_Room_New_Designs	Existing Industrial	0.890	0.894	1.27
R_CW_MEF2.2	Existing Residential	0.903	0.907	5.71
R_DW_EF0.68	Existing Residential	1.039	1.042	2.07
Direct_drive_Extruders	Existing Industrial	1.085	1.089	0.52
R_DW_EF0.58_G	Existing Residential	1.090	0.000	0.00
R_DW_EF0.62_G	Existing Residential	1.108	1.115	0.00
Heat_Pumps_Drying	Existing Industrial	1.154	1.157	0.08
R_RAC_ES	Existing Residential	1.190	1.194	1.11
R_CeilIns_R19R30G	Existing Residential	1.229	1.235	17.49
Light_cylinders	Existing Industrial	1.418	1.422	0.56
Efficient_grinding	Existing Industrial	1.586	1.589	0.23
Intelligent_extruder_(DOE)	Existing Industrial	1.618	1.622	0.00
R_CoolRoof_CET	Existing Residential	1.627	1.629	1.84
R_DW_EF0.68_G	Existing Residential	2.205	2.212	13.45
R_WholeHFan	Existing Residential	4.154	4.158	8.80
R_NiteEcon_CET	Existing Residential	5.179	5.182	1.95

Figure B-5 presents the SDG&E natural gas supply curve. The data represented by the illustration are presented in Table B-2. The data presented in the table are ordered by their levelized supply cost. The table also presents data on the levelized supply cost with SDG&E programs and the technical natural gas energy efficiency potential of the measure in 2016. The sum of SDG&E's technical potential in 2016 is approximately 110 million therms. The

CEC forecast of natural gas usage for SDG&E gas planning area is 631 million therms. Therefore, the technical potential is approximately 17.5% of the CEC forecast of SDG&E planning area natural gas consumpumption in 2016.[10]

Figure B-5: SDG&E Natural Gas Supply Curve, 2016



Review of the gas supply data presented in Table B-5, indicates that high efficiency measures installed in the existing industrial sector have the lowest levelized supply costs for natural gas measures analyzed in this study. As with the electric measures, the existing industrial measure benefit from the assumed longer run times for the industrial sector. Boiler measures within the existing residential and commercial sectors also have very low levelized supply costs.[11]

10 The CEC forecast of SDG&E energy consumption in 2016 includes approximately 60-80% of the market forecast of energy efficiency savings. The CEC's attempts to include expected energy efficiency savings in the consumption forecast, reduces the forecast of consumption, thereby increasing the apparent ratio of technical potential savings to forecast consumption. The CEC's forecast of consumption is from Table 37, *California Energy Demand 2008-2018 Staff Revised Forecast*, Nov 2007.

11 The industrial new construction sector did not include tha analysis of gas measures.

Table B-5: SDG&E Natural Gas Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential Millions of Therms 2016
Maintain_boilers	Existing Industrial	0.010	0.304	1.22
Load_control	Existing Industrial	0.041	0.091	2.44
Improved_process_control	Existing Industrial	0.048	0.098	1.08
R_BoilerMF	Existing Residential	0.060	0.087	2.05
Automatic_steam_trap_monitoring	Existing Industrial	0.079	0.130	1.53
C_WH_Boiler_95_CET	Existing Commercial	0.093	0.120	1.83
C_WH_Boiler_85	Existing Commercial	0.094	0.120	0.00
Improved_insulation	Existing Industrial	0.095	0.145	4.89
Condensate_return	Existing Industrial	0.109	0.159	0.12
Water_treatment	Existing Industrial	0.126	0.197	0.61
C_PoolHeater_HE	Existing Commercial	0.138	0.204	0.51
Duct_insulation	Existing Industrial	0.153	0.197	0.15
EMS_optimization	Existing Industrial	0.154	0.261	0.07
Upgrade_burner_efficiency	Existing Industrial	0.163	0.206	0.32
Leak_repair	Existing Industrial	0.171	0.464	0.29
Boiler_95	Existing Industrial	0.181	0.225	0.43
Process_Controls_&_Management	Existing Industrial	0.181	0.266	2.16
C_Steamer_Gas_ES	Existing Commercial	0.197	0.234	0.47
Flue_gas_heat_recovery_economizer	Existing Industrial	0.198	0.249	0.61
Steam_trap_maintenance	Existing Industrial	0.218	0.512	3.82
Blowdown_steam_heat_recovery	Existing Industrial	0.270	0.321	0.33
EMS_install	Existing Industrial	0.280	0.323	0.73
Improve_ceiling_insulation	Existing Industrial	0.307	0.351	1.77
Stack_heat_exchanger	Existing Industrial	0.316	0.360	0.02
C_WH_CircTimer	Existing Commercial	0.369	0.400	0.33
C_WH_Storage_HE	Existing Commercial	0.450	0.480	0.15
C_Fryer_Gas_ES	Existing Commercial	0.497	0.534	1.27
R_WH_PW_G	Existing Residential	0.524	0.556	3.61
Heat_Recovery	Existing Industrial	0.563	0.606	2.74
C_ClothesWasher_HE	Existing Commercial	0.624	0.667	0.09
C_Oven_Convec_Gas_HE	Existing Commercial	0.649	0.687	0.26
C_WH_Instant	Existing Commercial	0.825	0.863	0.20
Efficient_burners	Existing Industrial	0.993	1.064	0.16
R_WH_FA_G	Existing Residential	1.158	1.200	4.72
Preventative_maintenance	Existing Industrial	1.231	1.338	0.00
R_WH_Shw_G	Existing Residential	1.340	1.383	5.52
R_DUCTR_G	Existing Residential	1.639	1.688	4.01
C_HV_Boiler_85	Existing Commercial	1.686	1.713	0.00
C_HV_Boiler_95_CET	Existing Commercial	1.687	1.714	0.61

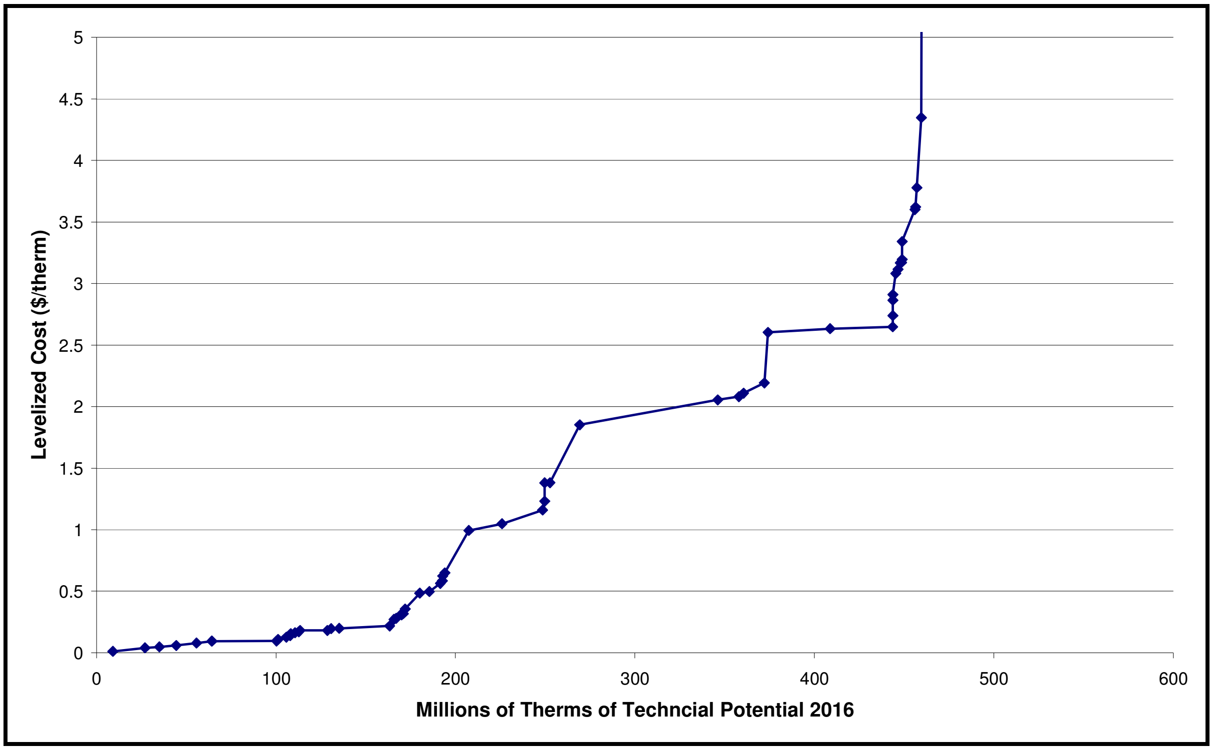
Table B-5 (cont'd.): SDG&E Natural Gas Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential Millions of Therms 2016
CNC_05_15	CNC	1.869	2.031	5.13
R_Bcontroler_MF	Existing Residential	1.914	1.947	0.34
Process_integration	Existing Industrial	2.080	2.131	0.20
Fouling_control	Existing Industrial	2.109	2.217	0.01
R_WHGas_EF0.63	Existing Residential	2.293	2.327	2.96
RNC_05_15	RNC	2.336	2.630	5.24
Efficient_drying	Existing Industrial	2.602	2.646	0.07
R_WHGAS_POU	Existing Residential	2.755	2.789	8.87
Combustion_controls	Existing Industrial	3.080	3.165	0.05
Optimize_furnace_operations	Existing Industrial	3.114	3.185	0.04
Flare_gas_controls_and_recovery	Existing Industrial	3.167	3.217	0.00
Batch_cullet_preheating	Existing Industrial	3.170	3.220	0.01
Furnace_HE	Existing Industrial	3.195	3.239	0.00
R_Furn_AFUE96	Existing Residential	3.326	3.353	5.55
R_WallIns_R0R13G	Existing Residential	3.530	3.568	6.58
C_Oven_Gas_HE	Existing Commercial	3.600	3.637	1.99
Improved_separation_processes	Existing Industrial	3.621	3.665	0.14
R_Furn_AFUE92	Existing Residential	3.664	3.691	0.00
C_Griddle_Gas_HE	Existing Commercial	3.778	3.815	0.17
C_HV_Furn_AFUE94	Existing Commercial	3.897	3.923	0.01
R_Furn_AFUE90	Existing Residential	3.914	3.941	0.00
C_HV_Furn_AFUE92	CNC	4.076	4.102	0.00
Oxyfuel	Existing Industrial	4.348	4.392	0.04
Thermal_oxidizers	Existing Industrial	6.334	6.385	0.11
R_CW_MEF2.0_G	Existing Residential	6.677	6.719	0.00
R_CeilIns_R19R30G	Existing Residential	7.393	7.428	3.05
R_CW_MEF1.80_G	Existing Residential	7.519	7.561	0.00
Extended_nip_press	Existing Industrial	7.972	8.016	0.00
R_CW_MEF2.2_G	Existing Residential	8.008	8.050	9.37
R_CW_MEF1.60_G	Existing Residential	8.239	8.281	0.00
Insulation/reduce_heat_losses	Existing Industrial	10.950	11.000	0.00
R_DW_EF0.62_G	Existing Residential	11.094	11.163	0.00
R_DW_EF0.58_G	Existing Residential	11.664	0.000	0.00
R_WHGAS_Solar_CET	Existing Residential	11.696	11.722	6.42
Closed_hood	Existing Industrial	12.678	12.729	0.00
C_WH_Storage_Solar	Existing Commercial	18.386	18.420	0.90
R_DW_EF0.68_G	Existing Residential	20.030	20.095	1.42

B.4 SCG Supply Curves

Figure B-6 presents the SCG natural gas supply curve. The data represented by the illustration are presented in Table B-6. The data presented in the table are ordered by their levelized supply cost. The table also presents data on the levelized supply cost with SCG programs and the technical natural gas energy efficiency potential of the measure in 2016. The sum of SCG's technical potential in 2016 is approximately 615 million therms. The CEC forecast of natural gas usage for SCG gas planning area is 631 million therms. Therefore, the technical potential is approximately 17.5% of the CEC forecast of SCG planning area natural gas consumpumption in 2016.[12]

Figure B-6: SCG Natural Gas Supply Curve, 2016



Review of the gas supply data presented in Table B-6, indicates that high efficiency measures installed in the existing industrial sector have the lowest levelized supply costs for natural gas measures analyzed in this study. As with the electric measures, the existing industrial measure benefit from the assumed longer run times for the industrial sector. Boiler measures

12 The CEC forecast of SCG energy consumption in 2016 includes approximately 60-80% of the market forecast of energy efficiency savings. The CEC's attempts to include expected energy efficiency savings in the consumption forecast, reduces the forecast of consumption, thereby increasing the apparent ratio of technical potential savings to forecast consumption. The CEC's forecast of consumption is from Table 37, *California Energy Demand 2008-2018 Staff Revised Forecast*, Nov 2007.

within the existing residential and commercial sectors also have very low levelized supply costs.[13]

Table B-6: SCG Natural Gas Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, Millions of Therms, 2016
Maintain_boilers	Existing Industrial	0.01	0.30	9.00
Load_control	Existing Industrial	0.04	0.09	18.01
Improved_process_control	Existing Industrial	0.05	0.10	7.97
R_BoilerMF	Existing Residential	0.06	0.11	9.40
Automatic_steam_trap_monitoring	Existing Industrial	0.08	0.13	11.25
C_WH_Boiler_95_CET	Existing Commercial	0.09	0.15	8.67
C_WH_Boiler_85	Existing Commercial	0.09	0.15	0.00
Improved_insulation	Existing Industrial	0.09	0.14	36.01
Condensate_return	Existing Industrial	0.11	0.16	0.90
Water_treatment	Existing Industrial	0.13	0.20	4.50
C_PoolHeater_HE	Existing Commercial	0.14	0.27	2.12
Duct_insulation	Existing Industrial	0.15	0.20	0.25
EMS_optimization	Existing Industrial	0.15	0.26	0.12
Upgrade_burner_efficiency	Existing Industrial	0.16	0.21	2.34
Leak_repair	Existing Industrial	0.17	0.46	2.16
Boiler_95	Existing Industrial	0.18	0.22	0.73
Process_Controls_&_Management	Existing Industrial	0.18	0.27	15.26
C_Steamer_Gas_ES	Existing Commercial	0.20	0.27	1.98
Flue_gas_heat_recovery_economizer	Existing Industrial	0.20	0.25	4.50
Steam_trap_maintenance	Existing Industrial	0.22	0.51	28.13
Blowdown_steam_heat_recovery	Existing Industrial	0.27	0.32	2.40
EMS_install	Existing Industrial	0.28	0.32	1.25
Improve_ceiling_insulation	Existing Industrial	0.31	0.35	3.04
Stack_heat_exchanger	Existing Industrial	0.32	0.36	0.04
C_WH_Storage_HE	Existing Commercial	0.32	0.38	0.80
C_WH_CircTimer	Existing Commercial	0.36	0.42	1.08
R_WH_PW_G	Existing Residential	0.48	0.55	8.10
C_Fryer_Gas_ES	Existing Commercial	0.50	0.57	5.38
Heat_Recovery	Existing Industrial	0.56	0.61	6.11
C_WH_Instant	Existing Commercial	0.58	0.66	1.07
C_ClothesWasher_HE	Existing Commercial	0.62	0.71	0.38
C_Oven_Convec_Gas_HE	Existing Commercial	0.65	0.72	1.09
Efficient_burners	Existing Industrial	0.99	1.06	13.42

13 The industrial new construction sector did not include tha analysis of gas measures.

Table B-6 (cont'd.): SCG Natural Gas Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, Millions of Therms, 2016
R_WH_FA_G	Existing Residential	1.05	1.13	18.45
R_WH_Shw_G	Existing Residential	1.16	1.24	22.65
Preventative_maintenance	Existing Industrial	1.23	1.34	1.12
C_HV_Boiler_85	Existing Commercial	1.38	1.43	0.00
C_HV_Boiler_95_CET	Existing Commercial	1.38	1.43	2.91
R_DUCTR_G	Existing Residential	1.85	1.95	16.61
R_WallIns_R0R13G	Existing Residential	2.05	2.12	76.96
Process_integration	Existing Industrial	2.08	2.13	11.78
Fouling_control	Existing Industrial	2.11	2.22	2.61
R_WHGas_EF0.63	Existing Residential	2.19	2.26	11.53
Efficient_drying	Existing Industrial	2.60	2.65	2.06
R_WHGAS_POU	Existing Residential	2.63	2.70	34.57
R_Furn_AFUE96	Existing Residential	2.65	2.70	34.87
C_HV_Furn_AFUE94	Existing Commercial	2.74	2.79	0.11
C_HV_Furn_AFUE92	Existing Commercial	2.86	2.92	0.00
R_Furn_AFUE92	Existing Residential	2.91	2.96	0.00
Combustion_controls	Existing Industrial	3.08	3.16	1.60
Optimize_furnace_operations	Existing Industrial	3.11	3.18	1.25
Flare_gas_controls_and_recovery	Existing Industrial	3.17	3.22	1.21
Batch_cullet_preheating	Existing Industrial	3.17	3.22	0.78
Furnace_HE	Existing Industrial	3.19	3.24	0.28
R_Furn_AFUE90	Existing Residential	3.34	3.39	0.00
C_Oven_Gas_HE	Existing Commercial	3.60	3.67	7.18
Improved_separation_processes	Existing Industrial	3.62	3.66	0.36
C_Griddle_Gas_HE	Existing Commercial	3.78	3.85	0.71
Oxyfuel	Existing Industrial	4.35	4.39	2.47
Thermal_oxidizers	Existing Industrial	6.33	6.38	0.27
R_CW_MEF2.0_G	Existing Residential	6.95	7.03	0.00
R_DW_EF0.62_G	Existing Residential	7.15	7.29	0.00
R_CW_MEF1.80_G	Existing Residential	7.82	7.91	0.00
Extended_nip_press	Existing Industrial	7.97	8.02	1.55
R_DW_EF0.58_G	Existing Residential	8.13	0.00	0.00
R_CeilIns_R19R30G	Existing Residential	8.38	8.44	20.57
R_CW_MEF2.2_G	Existing Residential	10.28	10.36	28.85
R_CW_MEF1.60_G	Existing Residential	10.57	10.66	0.00
Insulation/reduce_heat_losses	Existing Industrial	10.95	11.00	0.17
R_DW_EF0.68_G	Existing Residential	11.86	11.99	7.33
Closed_hood	Existing Industrial	12.68	12.73	0.50

Table B-6 (cont'd.): SCG Natural Gas Supply Curve Data, 2016

Technology	Sector	Levelized Supply Cost	Levelized Supply Cost with Programs	Technical Potential, Millions of Therms, 2016
R_WHGAS_Solar_CET	Existing Residential	12.74	12.79	34.02
C_WH_Storage_Solar	Existing Commercial	15.61	15.68	3.34
CNC_05_15	CNC	1.88	2.09	30.85
RNC_05_15	RNC	2.15	2.44	27.64

Appendix C

ASSET Inputs

The data described in this document are available in Access databases.

C.1 Applicability

The applicability limits the market to those situations where the technology is present. For replace-on-burnout technologies, the applicable market is the number of decaying units that are to be replaced (always 1). For conversion technologies, the applicable market is the cumulative conversion from the base option to other options within the competition group (always 1). For retrofits, the applicable market is the number of existing units with the qualifying configuration or equipment.

The fields in the applicability data table include domain, end use, segment, area, compgroup, tech, and applicability. Domain describes the sector being analyzed. Sectors include existing and new construction for residential, commercial, and industrial. Segment is the housing type, building type, or industrial SIC based classification. Area is a climate zone classification. The area value indicates either a standards climate zone or ALL. The ALL classification indicates a non-weather sensitive measure that is not analyzed at the climate zone level.

C.2 Avoided Costs

The study used the 2006 actual TOU schedule for each utility. Table C-1 through Table C-3 provides the TOU schedule used in the analysis.

Table C-1: Description of PG&E TOU Periods

Period	Definition	Number of Hours
Summer On Peak	Noon to 5:59 p.m. summer weekdays except holidays	762
Summer Part Peak	9:00 a.m. to 11:59 a.m. and 6:00 p.m. to 9:59 p.m. summer weekdays except holidays	889
Summer Off Peak	10:00 p.m. to 8:59 a.m. summer weekdays and all summer weekend and holiday hours	2765
Winter Part Peak	9:00 a.m. to 9:59 p.m. winter weekdays except holidays	1651
Winter Off Peak	10:00 p.m. to 8:59 a.m. winter weekdays and all winter weekend and holiday hours	2693
First Day of Summer	12:00 Midnight May 1	
First Day of Winter	12:00 a.m. November 1	

Table C-2: Description of SCE TOU Periods

Period	Definition	Number of Hours
Summer On Peak	Noon to 5:59 p.m. summer weekdays except holidays	498
Summer Part Peak	8:00 a.m. to 11:59 a.m. and 6:00 p.m. to 10:59 p.m. summer weekdays except holidays	747
Summer Off Peak	11:00 p.m. to 7:59 a.m. summer weekdays and all summer weekend and holiday hours	1611
Winter Part Peak	8:00 a.m. to 8:59 p.m. winter weekdays except holidays	2210
Winter Off Peak	9:00 p.m. to 7:59 a.m. winter weekdays and all winter weekend and holiday hours	3694
First Day of Summer	12:00 a.m. the first Sunday in June	
First Day of Winter	12:00 a.m. the first Sunday in October	

Table C-3: Description of SDG&E TOU Periods

Period	Definition	Number of Hours
Summer On Peak	11:00 a.m. to 5:59 p.m. summer weekdays except holidays	742
Summer Part Peak	6:00 a.m. to 10:59 a.m. and 6:00 p.m. to 9:59 p.m. summer weekdays except holidays	952
Summer Off Peak	10:00 p.m. to 5:59 a.m. summer weekdays and all summer weekend and holiday hours	1976
Winter On Peak	5:00 p.m. to 7:59 p.m. winter weekdays except holidays	444
Winter Part Peak	6:00 a.m. to 4:59 p.m. and 8:00 p.m. to 9:59 p.m. winter weekdays except holidays	1924
Winter Off Peak	10:00 p.m. to 5:59 a.m. winter weekdays and all winter weekend and holiday hours	2722
First Day of Summer	12:00 Midnight May 1	
First Day of Winter	12:00 a.m. October 1	

The avoided cost data tables include the utility, area, fuel, TOU period name, year, and the avoided cost. The electric avoided costs are provided by climate zone and averaged across all climate zones for non-weather sensitive measures. The gas and externality avoided costs are only provided averaged across all climate zones. The TOU period is the name of the period. The externalities are also in this table within the electric fuel classification. The TOU period name has been augmented with the term externality to designate the electric externalities.

C.3 Awareness

Awareness is defined such that the percent aware is the share of decision makers within the feasible market who have been exposed to a technology and have formed an opinion about the operating characteristics of that option. The awareness percentages were determined using professional judgment. The awareness of the base technology is assumed 100%.

The awareness data table includes the domain, scenario, competition group, technology, year, market awareness level, and naturally occurring awareness level. The domain describes the sector being analyzed. The sectors analyzed for this study include the existing and new construction residential, commercial, and industrial sectors. The awareness was allowed to grow faster for the Mid, Full, and Base with Higher Awareness scenarios than for the Base scenario. The awareness levels for all scenarios are listed in the data table.

Awareness levels are provided for the market and the naturally occurring forecasts. The awareness of the market is assumed to grow over time due to the marketing provided by ongoing energy efficiency programs. The awareness for the Base, Mid, and Full naturally occurring scenarios are assumed constant at their initial values. The naturally occurring scenario forecasts the level of adoptions and savings that would occur if there were no programs. The constant level of awareness after 2005 implies that the programs are discontinued in 2005 and the public's knowledge is not updated. The Base forecast with Higher Awareness was estimated to analyze the potential in a world with higher marketing budgets. The awareness for the naturally occurring Base with Higher Awareness forecast was also allowed to grow. The growth in the awareness for the naturally occurring forecast implies that programs have continued and the on-going programs are impacting the level of knowledge for the individuals who would purchase measures outside the program.

C.4 Willingness

Willingness is the fraction of the aware market that accepts the technology as being valid and useful. The willingness percentages were determined using professional judgment.

The willingness data table includes the domain, scenario, competition group, technology, year, market willingness level, and naturally occurring willingness level. The domain describes the sector being analyzed. The sectors analyzed for this study include the existing and new construction residential, commercial, and industrial sectors. The willingness was allowed to grow faster for the Mid, Full, and Base with Higher Awareness scenarios than for the Base scenario. The willingness levels for all scenarios are listed in the data table.

Willingness levels are provided for the market and the naturally occurring forecasts. The willingness of the market is assumed to grow over time due to the marketing provided by ongoing energy efficiency programs. The willingness for the Base, Mid, and Full naturally occurring scenarios are assumed constant at their initial values. The naturally occurring scenario forecasts the level of adoptions and savings that would occur if there were no programs. The constant level of willingness after 2005 implies that the programs are discontinued in 2005 and the public's knowledge is not updated. The Base forecast with Higher Awareness was estimated to analyze the potential in a world with higher marketing budgets. The willingness for the naturally occurring Base with Higher Awareness forecast was also allowed to grow over time. The growth in the willingness for the naturally occurring forecast implies that programs have continued and the on-going programs are impacting the level of knowledge for the individuals who would purchase measures outside the program.

C.5 Base Shares and Technology Density

The analysis derived most of the residential technology density information from the 2004 Residential Appliance Saturation Survey (RASS) and the 2005 California Lighting and Appliance Saturation Survey (CLASS).[12] The technology density describes the number of technology units per home. For lighting, the technology density gives the number of fixtures or light bulbs per home. The lighting technology density numbers were derived from the CLASS. For HVAC, the density is the number of pieces of equipment per home. For insulation and windows, the density is the number of square foot of applicable area. The HVAC technology density numbers were derived from the RASS.

The base shares are the fraction of homes with the measure by technology. The base share for retrofit models is the applicable market times the fraction of the market with the high efficiency technology. The residential base share numbers were derived from the RASS and the CLASS.

The commercial technology density and base share data were derived from the CEUS database.[3]

C.6 Feasibility

The feasibility percentage gives the share of the applicable market for which an individual measure is feasible given limitations on size, space, required level of service, and other configuration issues. The fraction effectively divides the applicable market into a segment where the measure is feasible and a segment where it is not. The feasibility percentages were derived using professional judgment.

The feasibility data table includes information on domain, segment, area, decision type, competition group, technology, and feasibility. The domains include the existing and new construction residential, commercial, and industrial sectors. Segment describes the housing type, building type, or industrial business. The area provides a climate zone designation for weather sensitive measures and all or a climate zone average for non-weather sensitive measures.

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1 KEMA-Xenergy, Inc. *California Statewide Residential Appliance Saturation Study.* Prepared for the California Energy Commission. June 2004.

2 RLW Analytics. *2005 California Statewide Lighting and Appliance Efficiency Saturation Survey*. Prepared for California's IOUs. August 23, 2005.

3 Itron, Inc. *California Commercial Energy Use Survey.* CEC-400-2006-005. Prepared for the California Energy Commission. March 2006.

C.7 Housing, Floor stock, and Industrial usage

The housing, floor stock, and industrial usage table provides information on the number of households, thousands of square feet of commercial floor stock, and the industrial usage. The CEC provided information on the housing and floor stock while KEMA provided Itron with information on the industrial usage. This data table includes information on the domain, segment, area, housing, floorstock, or usage, and a column describing the units of the stock variable.

C.8 Utility Rates

The rates data table includes information on domain, end use, building type, TOU period, rate name, tariff, energy unit. The domain describes the sector, including commercial, residential, and industrial. The building type is used to help determine the appropriate rate. Different rates were used for single family and multi family households due to the rate structure of IOU tariffs, single family household were assumed to have a higher marginal rate than multi family households. Different rates were also used for large verses small commercial business. Colleges, health care businesses, lodging, large offices, refrigerated warehouse, and schools were give a large commercial rate while grocery stores, miscellaneous, retail, restaurants, small offices, and warehouses were given a small business rate.

Appendix D

ASSET Outputs

The data described in this document are available in an Access databases. These data are a subset of the possible ASSET outputs. The IOUs will be provided with the actual ASSET outputs. This document is intended to describe a set of simplified outputs that provide information on first year program and total market potential adoptions and savings.

Each utility has been provided with three output databases. The three databases contain the existing and new residential results, the existing and new commercial results, and the existing and new industrial results. Each database includes four data tables and one aggregation data query. The contents of the tables and queries are described below.

D.1 Measure Descriptions and Lifetimes

The measure lifetime table includes many identifiers that help to describe measures included in other tables. Table D-1 lists the variables included in the table and a short description of each variable. The table includes information on the domain, end use, fuel, competition group, technology name, a very short description of the technology, the decision model name, the units of analysis, the decay rule name, and the mean expected useful life.

Table D-1: Information in the Measure Description and Lifetime Data Table

Column Name	Description of Column
Domain	Sector name
End Use	End use of the measure
Fuel Type	Electric, gas, or both
Competition Group ID	ASSET grouping identifier
Tech	ASSET name for the measure
Measure Description	Short description of the measure
Decision Type	Model used to analyze the measure.
Units	Technology units used in the analysis
Decay Rule	ASSET name of the decay rule used to determine expected useful life
Mean Life	Measure expected useful life

The domain describes the sector in which the high efficiency measure was analyzed. The fuel indicates if the measure was a high efficiency electric, gas, or dual fuel (both) measure. The very short description helps to identify the often cryptic ASSET technology name. The decision model indicates if the measure was analyzed as a replace on burnout, conversion, or retrofit measure. The units help to describe the adoption units, clarifying if the units are ovens, kBtu, bulbs, or tons. The decay rule is an internal ASSET name, which describes the function used to determine the measures expected useful life. For all measures other than CFL light bulbs, the measure decay was assumed to be linear.

D.2 Per-Unit Costs and Savings

The measure per-unit costs and savings are available in the technology per-unit table. Table D-2 lists the variables in the per-unit table and a short description of each variable. The table includes information to identify where the measure was installed such as the domain, segment, and area. The scenario and run describe the utility program level, TRC restrictions, and type of potential estimated (market, naturally occurring, economic, or technical) associated with the information.

Table D-2: Information in the Technology Per-Unit Table

Column Name	Description of Column
Utility	Utility
DBDOMAIN	Database domain or sector name
ENDUSE	End use of the measure
SCENARIO	ASSET scenario name
SEGMENT	Segment analyzed
AREA	Climate zone analyzed for weather sensitive measures, all for non-weather sensitive measures
DECTYPE	Model used to analyze the measure.
COMPGROUP	ASSET grouping identifier
TECH	ASSET name for the measure
Run	ASSET identifier for the potential analysis. A 0 is market potential, 1 is naturally occurring, 2 is economic, and 3 is technical potential.
Yr	The year of the analysis output. For this table, the values are constant after 2010, so only 2007-2010 are provided.
IncrementalMCost	Incremental measure cost
MaintCost	Maintenance cost.
RebatePerUnit	Rebate per unit
PaybackWRebate	Years of payback with the rebate
PAYBACK	Years of payback without the rebate
TRCBenperUnit	TRC benefit per unit
TRCCostperUnit	TRC cost per unit without the program costs
TRCCostWProgramPerUnit	TRC cost per unit with the program costs
KWHPerUnit	KWh savings per unit. These savings have been reduced by an interactive multiplier.
KWPerUnit	KW savings per unit. These savings have been reduced by an interactive multiplier.
ThermsPerUnit	Therm savings per unit. These savings have been reduced by an interactive multiplier.

The data in the technology per-unit table is available for 2007-2026. Most of the data in the table, however, do not change on a yearly level. The incremental costs and energy savings per unit are constant for most measures. The rebates can change over the period 2007-2010, but are constant for all later years. The avoided cost benefits and the TRC benefits per unit, however, change over time.

The energy savings listed in the per-unit tables are the per-unit assumed savings interacted with the measure level interactive multiplier. The interactive multiplier reduces savings for those measures within end uses where the installation of multiple measures with reduce the per-unit savings of a given measures. For example, the installation of insulation, high efficiency windows, and a SEER 15 air conditioner will lead to lower per-unit savings per measure than the installation of only a single measure. The interactive multipliers were developed using end use level consumption, per-unit incremental savings, and measure specific TRC values. The interactive multipliers were applied based on measure level TRC values, assuming that measures were installed from highest TRC value to lowest TRC value. Interactive multipliers are applied in the HVAC, refrigeration, and water heating end uses.

D.3 First year Program Savings

The first year program savings are available in the table called Tech_LvlDet_1yrProg. Table D-3 provides information on the fields in the first year program data table. The table includes information to identify where the measure was installed such as the domain, segment, and area. Scenario describes the utility program level and TRC restrictions associated with the information. Given that the data in the table are restricted to program savings, no run type information is necessary.[1]

[1] The run field distinguishes market, naturally occurring, economic and technical data. The results presented in the first year program savings table are from the market run for measures receiving a program rebate.

Table D-3: Information on the First Year Program Savings Table

Column Name	Description of Column
DBDOMAIN	Database domain or sector
ENDUSE	End use
Fuel	Electric, gas, or both
SCENARIO	ASSET Scenario name
SEGMENT	Segment analyzed
AREA	Climate zone analyzed for weather sensitive measures, all for non-weather sensitive measures
TECH	ASSET name for the measure
YR	Year
GROSSMEASURECOST	Gross incremental measure cost
GROSSPROGCOST	Gross non-incentive program costs
GROSSINCENT	Gross incentive
NETMEASURECOST	Net incremental measure cost
INCGROSSMTherms	Incremental gross millions of therms
INCGROSSSYSGWH	Incremental gross system GWh
INCGROSSSYSMW	Incremental gross system MW
INCGROSSUSRGWH	Incremental gross user GWh
INCGROSSUSRMW	Incremental gross user MW
INCNETSYSGWH	Incremental net system GWh
INCNETSYSMW	Incremental net system MW
INCNETUSRGWH	Incremental net user GWh
INCNETUSRMW	Incremental net user MW
INCNetMTherms	Incremental net millions of therms

The data in the first year program savings table are from 2007-2026, the twenty-year period of program potential analyzed for this study. The table includes information on gross measure costs and net measure costs, gross program costs, and gross incentives. The net measure costs reflect the model's estimate of the net-to-gross ratio.

The first year electric savings values included in the table are system and user values of energy and demand savings at the gross and net level.[2] The first year gas savings values included in the table are gross and net millions of therms. The net potential savings estimates reflect the model's estimate of the net-to-gross ratio.

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2 The individual utilities provided Itron with information on their line losses. The utility specific values were entered into the ASSET model and used to calculate the differences between the system and user values of electric savings potential.

D.4 Total Market Potential Savings

The total market potential savings are available in the table called TechLvlDetTotal. Table D-4 provides information on the fields in the total market savings data table. The table includes information to identify where the measure was installed such as the domain, segment and area. Scenario describes the utility program level and TRC restrictions associated with the information. Run designates if the potential savings estimates are for the market (0), naturally occurring (1), economic (2), or technical (3) analysis.

Table D-4: Information on the Total Market Savings Table

Column Name	Description of Column
Utility	Utility
DBDOMAIN	Database domain or sector
ENDUSE	End use
SCENARIO	ASSET scenario name
SEGMENT	Segment analyzed
AREA	Climate zone analyzed for weather sensitive measures, all for non-weather sensitive measures.
DECTYPE	Model used to analyze the measure
COMPGROUP	ASSET grouping identifier
TECH	ASSET name for the measures
Run	ASSET identifier for the potential analysis. A 0 is market potential, 1 is naturally occurring, 2 is economic, and 3 is technical potential.
YR	Year
TechIncAdoptions	Technology adoptions in the given year
HighEfficiency_TechTtlAdoptions	High efficiency technology adoptions in total. Incorporated decay.
TotalSysGWH	Total system GWh from all adoptions through the year that are still in place
TotalSysMW	Total system MW from all adoptions through the year that are still in place
TotalUsrGWH	Total user GWh from all adoptions through the year that are still in place
TotalUsrMW	Total user MW from all adoptions through the year that are still in place
TotalMillionTherms	Total millions of therms from all adoptions through the year that are still in place

The data in the total market savings table are from 2007-2026, the twenty-year period of market potential analyzed for this study.[3] The table includes information on first year adoptions of high and base efficiency measures (TechIncAdoptions). The output also includes information on the total number of high efficiency measures that have been installed from 2007 through the year of interest, that are still installed (HighEfficiency_TechTtlAdoptions). The total adoption of high efficiency measures is not the sum of the first year or incremental adoptions. As high and base efficiency measures reach the end of their expected useful life, the total technology adoptions declines by the number of measures that have reached the end of their lives. The death of a measure often leads to the measure re-entering the model and the model determines if a high efficiency or a base efficiency measure is purchased.[4]

The total electric savings values included in the table are system and user values of energy and demand savings at the gross and net level.[5] The first year gas savings values included in the table are gross and net millions of therms. The net potential savings estimates reflect the model's estimate of the net-to-gross ratio.

The total savings presented in this table is not the sum of the first year program savings presented in the first year program data table. The sum of first year program savings may differ from the total savings due to stock accounting and program restrictions.

The sum of the first year program savings may exceed the total market savings. The first year program savings table record the savings associated with the repurchase of a high efficiency measures at the end of its expected useful life if the measure received a program rebate. The total program savings table only reports a continuation of savings if a measure is repurchased at the end of its expected useful life. The continuation of savings in the total market data table reflects the death and replacement of a high efficiency measures. The addition of savings to the first year program savings data table reflects the repurchase of the measure under the program. These differences in the accounting of savings reflect the advanced stock accounting algorithms within the ASSET model.

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3 The model follows the total savings beyond 2026, continuing to track savings through 2056 when all measures install through 2026 are assumed to have reached the end of their expected useful lives. The data provided in these data tables, however, only follow the savings through the end of the analysis period. The IOUs will be provided with the raw output data that contain results through 2056.

4 If the measure is flagged as a measure that is automatically replaced, the model will automatically replace the measure in kind. In the residential and commercial sectors, lighting fixtures are automatically replaced in kind. In the industrial sector, all measures are automatically replaced in kind. Measures that are automatically replaced do not receive a rebate and are not account for in the first year program savings.

5 The individual utilities provided Itron with information on their line losses. The utility specific values were entered into the ASSET model and used to calculate the differences between the system and user values of electric savings potential.

The total potential savings may exceed the sum of the first year program potential savings due to program restrictions. Measures may be restricted out of the program due to low TRC values or automatic replacement assumptions. These measures, however, are still available in the market place and will continue to accrue adoptions and maintain savings (without receiving incentives) within the total market savings data table. Measures that are adopted without a program rebate, however, will also accrue in the naturally occurring savings potential. Measures restricted out of the program due to TRC restrictions or the assumption that they are automatically replaced without the receipt of a rebate, will have the same net savings in the incremental market and the incremental program savings.

D.5 Aggregated Total Market Potential Savings

The total market potential savings are aggregated across area, segment, and decision type in the query called aggregate_technology. Table D-5 provides information on the fields in the aggregate total market savings data table. The table includes information to identify the domain or sector, but the savings and adoptions are summed across segment, area, and decision type. Scenario describes the utility program level and TRC restrictions associated with the information. Run designates if the potential savings estimates are for the market (0), naturally occurring (1), economic (2), or technical (3) analysis.

Table D-5: Information on the Aggregated Total Market Savings Table

Column Name	Description of Column
Utility	Utility
DBDOMAIN	Database domain or sector
ENDUSE	End use
SCENARIO	ASSET scenario name
COMPGROUP	ASSET grouping identifier
TECH	ASSET name for the measures
Run	ASSET identifier for the potential analysis. A 0 is market potential, 1 is naturally occurring, 2 is economic, and 3 is technical potential.
YR	Year
TechIncAdoptions	Technology adoptions in the given year
HighEfficiency_TechTtlAdoptions	High efficiency technology adoptions in total. Incorporated decay.
TotalSysGWH	Total system GWh from all adoptions through the year that are still in place
TotalSysMW	Total system MW from all adoptions through the year that are still in place
TotalUsrGWH	Total user GWh from all adoptions through the year that are still in place
TotalUsrMW	Total user MW from all adoptions through the year that are still in place
TotalMillionTherms	Total millions of therms from all adoptions through the year that are still in place

Appendix E

Residential New Construction Methodology and ASSET Inputs

As part of the 2006 New Construction Potential study, Itron was charged with estimating the potential energy savings from constructing low-rise residential buildings in California that are higher than code (i.e., ENERGY STAR® Homes). The first and most important part of the study was to find the costs and savings for low-rise buildings to reach 15% and 25% above the 2001 Standards. This information was then used to create packages of high efficiency measures. The RFP for this study stated the contractor:

> *"shall utilize existing databases of buildings characteristics for the residential … new construction markets. These databases have been developed for the Residential Market Share Tracking Study …"*

These pre-existing databases were originally suggested because of the availability of the data, because the data had been analyzed previously, and building prototypes had been developed. However, the data consisted of on-site surveys of homes built under the 1998 Standards. Due to the age of the data, the project advisory committee agreed to await the completion of the 2003 Statewide Residential New Construction (RNC) Baseline Study, which consisted of more current data from homes built under the 2001 Standards. While developing new prototypes, and therefore new savings and cost estimates, was beyond the scope of work, the project advisory committee and managers felt that it was important to utilize the most recent data.

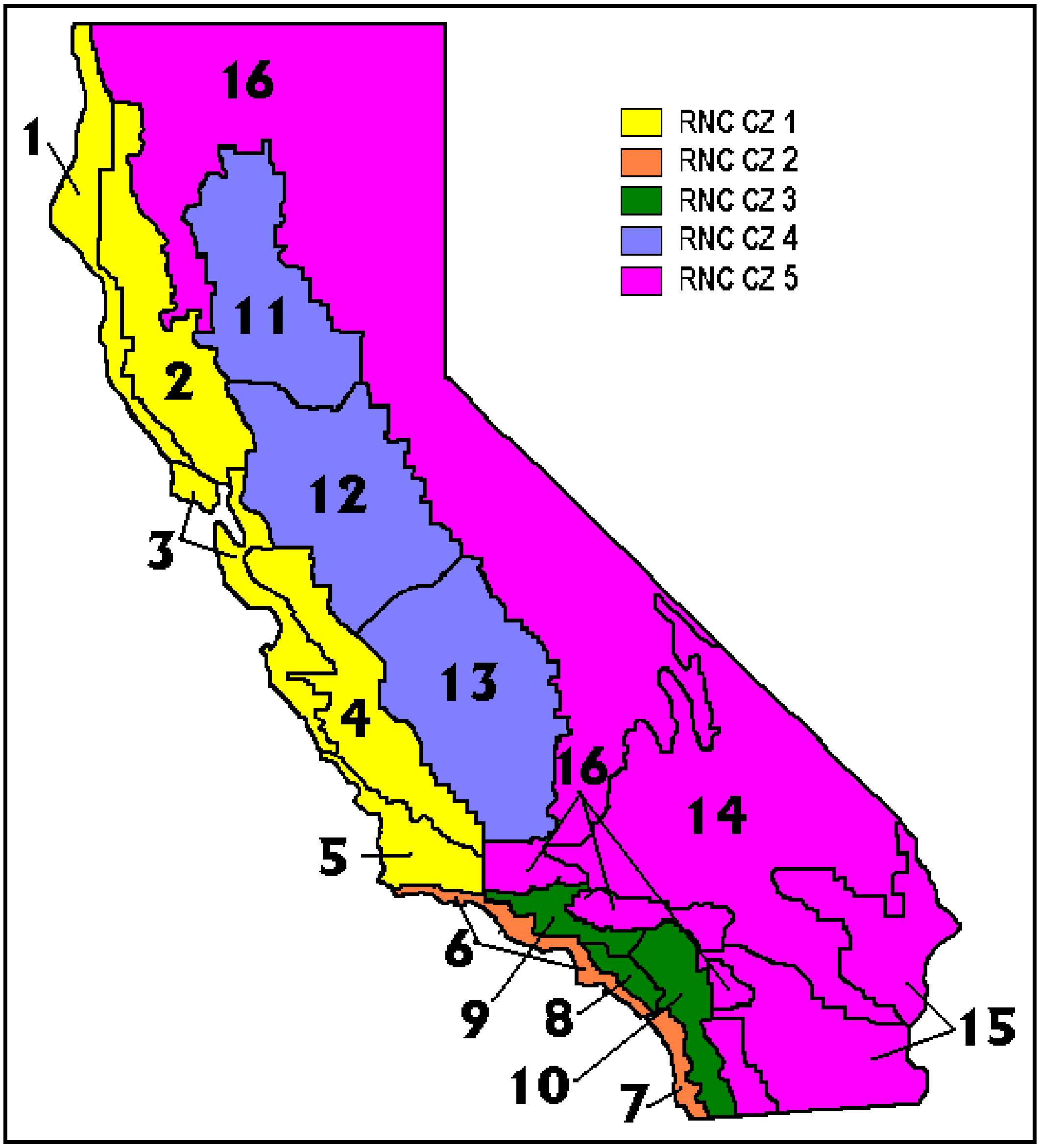
As the study progressed, time became a more pressing issue. This interim report was designed to include the cost and savings results most important to the program managers in helping design the 2006-2008 programs for the IOUs. This report summarizes the work completed to date on the residential portions of Tasks 3 and 4.

The remainder of this appendix summarizes the prototypes used as the baseline, the incremental measure cost of high efficiency measures, the bundles of measures included in the packages, and the proposed least-cost packages to reach the base and high activity levels presented in Table E-1.

E.1 Objectives

The objectives of the New Construction Potential Study included finding the saving potential for residential buildings that would approximate the building of ENERGY STAR homes under the new standards (reaching 10 and 15% above the 2005 codes), by Title 24 climate zone (as shown in Figure E-1). Further, unlike previous studies, the savings were to be calculated using "real" homes not "typical" homes, which are usually a box with windows spread evenly over each wall.

Figure E-1: California Energy Commission (CEC) Climate Zones



Source: California Energy Commission.

Table E-1: Measure Bundle Efficiency Levels

Scenario	Description	2004-2005 Level of Efficiency	2006-2013 Level of Efficiency
1	Code level	2001 Code	2005 Code
2	Base activity level	2001 Code +15%	2005 Code + 10%
3	High activity level	2001 Code + 25%	2005 Code + 15%

E.2 Single Family Detached Homes

A single family detached home is defined as a dwelling that has no walls or ceilings adjoining with any other dwellings.

Base Case Prototypes

The first step was to develop base case one-story and two-story homes for each RMST climate zone. These base case (prototype) homes were developed by first finding homes that matched closely with the average building shell characteristics (such as floor area and glazing area) of each CEC climate zone.[1,2] Once the best matching site was selected for each climate zone and story, the efficiency of the measures installed (HVAC, water heating, wall/roof insulations, window types) were adjusted. The first adjustment was made so that the measures in the prototypes more accurately reflect the average building practices in each climate zone found in the 2003 Statewide RNC Baseline Study.[3]

After the preliminary prototypes were developed, each was run under the 2001 Standards using MICROPAS 6.0. Next, the % compliance margin for each prototype was compared to the average % compliance margin found in each CEC climate zone during the 2003 study (baseline). This was done because it is important that each prototype not only reflects the average building characteristics of its respective CEC climate zone, but also closely matches the average compliance margin of homes. In cases where the % compliance margins of the prototype were not close to the baseline compliance margins, the efficiencies of the measures in the prototype were adjusted slightly and then reanalyzed using MICROPAS.[4] Table E-2 presents the building characteristics and the compliance margins of the 32 single family detached prototypes used in the analysis and approved by the New Construction Residential Advisory Group on September 2, 2004.

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1 Since the goal was to develop baseline building characteristics, the ENERGY STAR homes that were surveyed were not included in the analysis.

2 The average building characteristics were drawn from the 2003 Statewide RNC Baseline Study.

3 The baseline results were taken from the averages of the sites surveyed in the 2003 Statewide RNC Baseline Study.

4 The compliance margin of each climate zone by story.

Table E-2: Single Family Detached Prototypes (base case)

	CEC CZ 1	**CEC CZ 2**	**CEC CZ 3**	**CEC CZ 4**	**CEC CZ 5**	**CEC CZ 6**	**CEC CZ 7**	**CEC CZ 8**	**CEC CZ 9**	**CEC CZ 10**	**CEC CZ 11**	**CEC CZ 12**	**CEC CZ 13**	**CEC CZ 14**	**CEC CZ 15**	**CEC CZ 16**
1-Story Sq Ft	2,400	2,400	2,400	2,400	2,400	2,450	2,450	2,150	2,150	2,150	1,800	1,800	1,800	2,000	2,000	2,000
Glazing % Area	17.1%	17.1%	17.1%	17.1%	17.1%	16.9%	16.9%	14.1%	14.1%	14.1%	14.3%	14.3%	14.3%	15.5%	15.5%	15.5%
Glazing Area	410	410	410	410	410	414	414	303	303	303	257	257	257	310	310	310
Type of Window	2VL	2VL	2VL	2VL	2VL	2VC	2VC	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL
Glazing U-factor	0.37	0.37	0.37	0.37	0.37	0.60	0.60	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Glazing SHGC	0.41	0.41	0.41	0.41	0.41	0.65	0.65	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Wall Area	2,560	2,560	2,560	2,560	2,560	2,214	2,214	2,580	2,580	2,580	2,080	2,080	2,080	1,989	1,989	1,989
Wall	19	13	13	13	19	13	13	13	13	13	19	13	13	13	19	19
Roof Area	2,400	2,400	2,400	2,400	2,400	2,450	2,450	2,150	2,150	2,150	1,800	1,800	1,800	2,000	2,000	2,000
Roof	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Radiant Barrier	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TXV	No	No	No	No	No	No	No	No	Yes	No	Yes	No	No	No	No	Yes
Tight Ducts	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Infiltration Testing	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct Design	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct R-value	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
SEER	10.0	10.5	10.5	10.0	10.5	10.0	10.0	10.5	10.5	10.5	12.0	11.0	10.5	11.0	11.0	12.0
AFUE	92%	92%	86%	80%	86%	80%	80%	80%	80%	80%	86%	80%	80%	80%	80%	86%
EF	0.62	0.62	0.62	0.62	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.62
Standard	29.59	36.46	22.95	28.62	24.49	17.96	16.28	22.69	26.89	32.69	41.03	38.47	42.60	44.52	51.18	51.55
Margin	2.28	3.49	3.53	3.33	4.46	3.90	2.10	2.50	3.70	1.64	4.85	0.24	-3.44	-0.92	-5.16	0.54
% Compliance Margin	**7.7%**	**9.6%**	**15.4%**	**11.6%**	**18.2%**	**21.7%**	**12.9%**	**11.0%**	**13.8%**	**5.0%**	**11.8%**	**0.6%**	**-8.1%**	**-2.1%**	**-10.1%**	**1.0%**
2-Story Sq Ft	2,450	2,450	2,450	2,450	2,450	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,800	2,800	2,800
Glazing % Area	18.3%	18.3%	18.3%	18.3%	18.3%	16.2%	16.2%	15.9%	15.9%	15.9%	16.2%	16.2%	16.2%	14.6%	14.6%	14.6%
Glazing Area	447	447	447	447	447	470	470	461	461	461	470	470	470	409	409	409
Type of Window	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL
Glazing U-factor	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Glazing SHGC	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Wall Area	3,313	3,313	3,313	3,313	3,313	3,114	3,114	3,834	3,834	3,834	3,456	3,456	3,456	4,060	4,060	4,060
Wall	19	13	13	13	19	13	13	13	13	13	19	13	13	13	19	19
Roof Area	1,558	1,558	1,558	1,558	1,558	1,500	1,500	2,010	2,010	2,010	1,720	1,720	1,720	2,086	2,086	2,086
Roof	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Radiant Barrier	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TXV	No	No	No	No	No	No	No	No	Yes	No	Yes	Yes	Yes	No	No	Yes
Tight Ducts	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Infiltration Testing	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct Design	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct R-value	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
SEER	10.0	10.5	10.5	10.0	10.5	10.0	10.0	10.5	10.5	10.5	12.0	11.0	10.5	11.0	11.0	12.0
AFUE	92%	92%	86%	80%	86%	82%	80%	80%	80%	80%	86%	80%	80%	80%	80%	86%
EF	0.62	0.62	0.62	0.62	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.62
Standard	32.38	41.05	26.08	32.11	28.46	16.25	14.84	21.17	25.41	31.18	36.29	34.05	37.08	44.43	49.29	54.53
Margin	2.52	4.96	4.33	4.46	5.71	2.14	2.80	2.85	3.80	2.28	2.80	-1.16	-2.58	-1.82	-6.21	-0.19
% Compliance Margin	**7.8%**	**12.1%**	**16.6%**	**13.9%**	**20.1%**	**13.2%**	**18.9%**	**13.5%**	**15.0%**	**7.3%**	**7.7%**	**-3.4%**	**-7.0%**	**-4.1%**	**-12.6%**	**-0.3%**

Incremental Costs

Table E-3 presents the incremental cost for each high efficiency measure included in the analysis. These costs were originally taken from the incremental costs study conducted by Itron in 2003. However, due to changes in the window industry, the incremental costs of high efficiency windows were decreased. In addition, a few measures were added because the previous list of measures did not enable all of the prototypes to reach the desired targets. In June 2005, after a re-examination of the market, the costs of roof insulation and radiant barriers were decreased to better reflect current pricing.

For the 2008 Study, the incremental costs for the high efficiency central air conditioners were decreased starting in 2006. Note that there are two costs given for each of the central air conditioning units due to the change in the federal minimum efficiencies beginning in 2006. (For example, from 2003 to 2006 the incremental cost for moving from a 10 SEER unit to a 14 SEER unit is $900; however, beginning in 2006, the incremental cost to move from a 13 SEER to a 14 SEER is $200.)

Table E-3: Summary of Proposed Incremental Measure Costs

Measure	Efficiency	Total Cost	
Central Air Conditioner	12 SEER	$400/N/A	Per Unit
	14 SEER	$900/**$200**	Per Unit
	15 SEER	$1,200/**$450**	Per Unit
Furnace	92% AFUE	$700	Per Unit
Water Heater	0.63 EF	$50	Per Unit
Radiant Barrier	Yes	$0.12	Per Sq. Ft. (Roof)
Roof Insulation	R-38	$0.08	Per Sq. Ft. (Roof)
	R-49	$0.20	Per Sq. Ft. (Roof)
Wall Insulation	R-19	$0.06	Per Sq. Ft. (Wall)
Insulation Credit	Yes	$50	Per House
House Wrap	Yes	$0.25	Per Sq. Ft. (Wall)
Windows	2-Pane Vinyl Low-E	$0.50	Per Sq. Ft. (Glazing)
	2-Pane Vinyl Spectral Low-E	$0.75	Per Sq. Ft. (Glazing)
Duct Insulation	R-8.0	$350	Per House
HERS Certified Sealed Ducts	Yes	$163	Per House
ACCA Duct Design	Yes	$131	Per House
Infiltration Testing	Yes	$150 + cost of House Wrap	Per House
TXV	Yes	$0	Per Unit

Developing the Packages

After the prototypes were finalized, the prototype homes were used as the base cases to which the high efficiency packages were added. The packages were designed according to common builder practices found in the 2003 Statewide RNC Baseline Study. From these commonly found efficiency measures, 70 combinations of measures were constructed. These 70 packages were then added to each base case home and simulated using MICROPAS. The least-cost packages that reached a compliance margin of at least 15% and 25% above the 2001 Standards and 10% and 15% above the 2005 Standards were used to calculate energy savings per year for each prototype.

Least-Cost Package Results

Lastly, the savings in therms and watts per year were calculated for the least-cost package of each CEC climate zone. Energy savings per year were derived by subtracting the proposed energy usage of the upgraded home per year from the base case proposed energy usage per year (for space heating, cooling, and water heating). The following presents the cost and savings for reaching the targets under the 2001 Standards and the 2005 Standards separately.

2001 Standards

Table E-4 and Table E-5 present the measures included in the least-cost package that upgraded each prototype to 15% and 25% above the 2001 Standards, respectively. The tables also present the incremental cost of each package (*Cost*), the compliance margin of the base case prototype (*Base Compliance*), and the compliance margin reached by adding the package to the base case prototype (*Package Compliance*). For convenience, the measures that were upgraded for each prototype to reach its target are highlighted.

As shown in Table E-4, six of the base case prototypes were already at least 15% better than the 2001 Standards. (Note that these six prototypes have a $0 cost and their baseline and package compliance margins are equal.) Each of these six base case prototypes is along the coast of California, which has a mild climate and is relatively unaffected by the changes to the 2001 Standards. On the other hand, the 2003 RNC Baseline Study shows that homes in the inland regions of California are, on average, noncompliant. This is reflected in the small or negative base compliance margins of the base case prototypes in CEC Climate Zones 12-16. As shown, the one-story base case prototype in CEC Climate Zone 13 had a -8.1% compliance margin and would have to install several high efficiency measures including spectral low-E windows, a 12 SEER air conditioner with a TXV, and a 0.63 EF 50-gallon gas water heater. Additionally, a HERS rater would verify that they installed 8.0 duct insulation and tight ducts. To reach 15% above the 2001 Standards would cost approximately $1,000 more than building the typical home in this climate zone.

Table E-5 provides the same results for the base case homes to reach 25% above the 2001 Standards. The base case prototype in CEC Climate Zone 1 could not be upgraded to 25% above the 2001 Standards with the high efficiency measures currently included the packages. CEC Climate Zone 1 has no cooling in the Title 24 model and therefore has to achieve 25% using just water heating and space heating. This is difficult since most high efficiency measures are designed to reduce the peak cooling load.

Table E-4: Least-Cost Package by CEC Climate Zone – 15% Above 2001 Standards – Single Family Detached Homes

CEC_CZ	Story	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
01	1	2,400	7.7%	16.2%	$513	2VL	19	30	Yes	No	Yes	No	No	10	92%	0.63	No	Yes
02	1	2,400	10.4%	16.5%	$592	2VL	13	38	No	Yes	No	No	No	12	92%	0.63	No	No
03	1	2,400	15.4%	15.4%	$0	2VL	13	30	No	No	No	No	No	10.5	86%	0.62	No	No
04	1	2,400	11.6%	16.0%	$400	2VL	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
05	1	2,400	16.8%	16.8%	$0	2VL	19	30	No	No	No	No	No	10.5	86%	0.60	No	No
06	1	2,450	21.7%	21.7%	$0	2VC	13	30	No	No	No	No	No	10	80%	0.60	No	No
07	1	2,450	12.9%	21.0%	$207	2VL	13	30	No	No	No	No	No	10	80%	0.60	No	No
08	1	2,150	11.9%	19.9%	$450	2VL	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
09	1	2,150	13.8%	16.8%	$76	2VS	13	30	No	Yes	No	No	No	10.5	80%	0.60	No	No
10	1	2,150	6.9%	17.8%	$450	2VL	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
11	1	1,800	11.8%	15.8%	$194	2VL	19	38	No	Yes	No	No	No	12	86%	0.63	No	No
12	1	1,800	0.6%	15.2%	$827	2VS	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
13	1	1,800	-8.1%	15.9%	$1,027	2VS	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
14	1	2,000	-2.1%	17.1%	$763	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
15	1	2,000	-10.1%	18.9%	$763	2VL	19	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
16	1	2,000	1.0%	15.1%	$513	2VL	19	30	No	Yes	Yes	No	No	12	86%	0.63	No	Yes
01	2	2,450	7.8%	15.7%	$513	2VL	19	30	Yes	No	Yes	No	No	10	92%	0.63	No	Yes
02	2	2,450	12.1%	17.4%	$600	2VL	13	30	No	Yes	No	No	No	12	92%	0.63	No	No
03	2	2,450	16.6%	16.6%	$0	2VL	13	30	No	No	No	No	No	10.5	86%	0.62	No	No
04	2	2,450	13.9%	15.4%	$112	2VS	13	30	No	No	No	No	No	10	80%	0.62	No	No
05	2	2,450	19.2%	19.2%	$0	2VL	19	30	No	No	No	No	No	10.5	86%	0.60	No	No
06	2	2,900	13.2%	15.9%	$650	2VL	13	30	No	Yes	No	No	No	12	82%	0.63	No	No
07	2	2,900	18.9%	18.9%	$0	2VL	13	30	No	No	No	No	No	10	80%	0.60	No	No
08	2	2,900	13.5%	19.5%	$650	2VL	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
09	2	2,900	15.0%	15.6%	$115	2VS	13	30	No	Yes	No	No	No	10.5	80%	0.60	No	No
10	2	2,900	7.3%	16.0%	$650	2VL	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
11	2	2,900	7.7%	18.6%	$563	2VL	19	30	No	Yes	Yes	No	No	12	86%	0.63	No	Yes
12	2	2,900	-3.4%	17.0%	$1,812	2VS	13	30	No	Yes	Yes	No	No	12	92%	0.63	Yes	Yes
13	2	2,900	-9.4%	15.9%	$1,831	2VS	13	49	Yes	Yes	Yes	No	No	12	80%	0.63	No	Yes
14	2	2,800	-4.1%	15.9%	$965	2VS	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
15	2	2,800	-12.6%	16.4%	$863	2VL	19	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
16	2	2,800	-0.3%	15.0%	$930	2VL	19	38	Yes	Yes	Yes	No	No	12	86%	0.63	No	Yes

Table E-5: Least-Cost Package by CEC Climate Zone – 25% Above 2001 Standards – Single Family Detached Homes

CEC_CZ	Story	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
01	1	2,400	7.7%	19.8%	$2,067	2VS	19	49	Yes	No	Yes	Yes	Yes	10	92%	0.63	Yes	Yes
02	1	2,400	10.4%	25.2%	$1,208	2VS	13	38	No	Yes	Yes	No	No	12	92%	0.63	No	Yes
03	1	2,400	15.4%	25.3%	$1,703	2VL	13	30	No	Yes	Yes	Yes	Yes	12	86%	0.63	No	Yes
04	1	2,400	11.6%	25.5%	$1,393	2VL	13	38	Yes	Yes	Yes	No	No	12	80%	0.63	No	Yes
05	1	2,400	16.8%	25.8%	$1,155	2VL	19	38	No	Yes	Yes	No	No	12	86%	0.63	No	Yes
06	1	2,450	21.7%	26.0%	$450	2VC	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
07	1	2,450	12.9%	25.4%	$657	2VL	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
08	1	2,150	11.9%	25.3%	$1,135	2VL	13	38	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
09	1	2,150	13.8%	25.9%	$963	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
10	1	2,150	6.9%	25.1%	$963	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
11	1	1,800	11.8%	25.4%	$771	2VS	19	38	No	Yes	Yes	No	No	12	86%	0.63	No	Yes
12	1	1,800	0.6%	25.6%	$2,170	2VL	13	49	Yes	Yes	Yes	No	No	12	92%	0.63	Yes	Yes
13	1	1,800	-8.1%	25.2%	$2,370	2VL	13	49	Yes	Yes	Yes	No	No	12	92%	0.63	Yes	Yes
14	1	2,000	-2.1%	25.3%	$1,832	2VS	13	38	No	Yes	Yes	No	No	12	92%	0.63	Yes	Yes
15	1	2,000	-10.1%	25.2%	$1,163	2VL	19	38	Yes	Yes	Yes	No	No	12	80%	0.63	No	Yes
16	1	2,000	1.0%	26.6%	$2,401	2VL	19	49	Yes	Yes	Yes	Yes	Yes	12	92%	0.63	Yes	Yes
01	2	2,450	7.8%	22.4%	$1,934	2VL	19	49	Yes	No	Yes	Yes	Yes	10	92%	0.63	Yes	Yes
02	2	2,450	12.1%	25.1%	$1,349	2VS	13	38	No	Yes	Yes	No	No	12	92%	0.63	No	Yes
03	2	2,450	16.6%	25.9%	$1,838	2VL	13	38	No	Yes	Yes	No	No	12	92%	0.63	Yes	Yes
04	2	2,450	13.9%	25.0%	$1,238	2VL	13	38	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
05	2	2,450	19.2%	26.8%	$1,163	2VL	19	30	No	Yes	Yes	No	No	12	86%	0.63	No	Yes
06	2	2,900	13.2%	23.5%	$2,092	2VL	13	30	No	Yes	Yes	Yes	Yes	12	82%	0.63	No	Yes
07	2	2,900	18.9%	25.1%	$1,163	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
08	2	2,900	13.5%	25.0%	$1,278	2VS	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
09	2	2,900	15.0%	25.2%	$1,163	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
10	2	2,900	7.3%	25.4%	$1,278	2VS	13	30	No	Yes	Yes	No	No	12	80%	0.63	No	Yes
11	2	2,900	7.7%	26.2%	$1,625	2VS	19	38	Yes	Yes	Yes	No	No	12	92%	0.63	Yes	Yes
12	2	2,900	-3.4%	27.6%	$3,366	2VL	19	49	Yes	Yes	Yes	No	Yes	12	92%	0.63	Yes	Yes
13	2	2,900	-9.4%	26.9%	$3,666	2VL	19	49	Yes	Yes	Yes	No	Yes	12	92%	0.63	Yes	Yes
14	2	2,800	-4.1%	25.4%	$2,214	2VS	13	38	Yes	Yes	Yes	No	No	12	92%	0.63	Yes	Yes
15	2	2,800	-12.6%	26.4%	$2,214	2VS	19	38	Yes	Yes	Yes	No	No	12	92%	0.63	Yes	Yes
16	2	2,800	-0.3%	25.8%	$2,946	2VL	19	49	Yes	Yes	Yes	Yes	Yes	12	92%	0.63	Yes	Yes

Table E-6 and Table E-7 summarize the cost and savings results arising from upgrades to the base case home with the least-cost package for each to reach 15% and 25% above the 2001 Standards. As shown, it would cost approximately $763 to upgrade the base case prototype in CEC Climate Zone 14 from -2.1% to 17.1% and would result in a savings of 67 therms and 1,015kWh per year.

Table E-6: Energy Savings and Costs by CEC Climate Zone – 15% Above 2001 Standards – Single Family Detached Homes

CEC_CZ	Story	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	1	2,400	7.7%	16.2%	$513	57	0	4
02	1	2,400	10.4%	16.5%	$592	11	382	4
03	1	2,400	15.4%	15.4%	$0	0	0	0
04	1	2,400	11.6%	16.0%	$400	0	256	4
05	1	2,400	16.8%	16.8%	$0	0	0	0
06	1	2,450	21.7%	21.7%	$0	0	0	0
07	1	2,450	12.9%	21.0%	$207	-12	433	0
08	1	2,150	11.9%	19.9%	$450	7	206	11
09	1	2,150	13.8%	16.8%	$76	1	164	0
10	1	2,150	6.9%	17.8%	$450	10	549	11
11	1	1,800	11.8%	15.8%	$194	7	113	11
12	1	1,800	0.6%	15.2%	$827	37	521	11
13	1	1,800	-8.1%	15.9%	$1,027	23	1,462	11
14	1	2,000	-2.1%	17.1%	$763	56	1,015	11
15	1	2,000	-10.1%	18.9%	$763	5	2,747	11
16	1	2,000	1.0%	15.1%	$513	140	12	3
01	2	2,450	7.8%	15.7%	$513	59	0	4
02	2	2,450	12.1%	17.4%	$600	-10	589	4
03	2	2,450	16.6%	16.6%	$0	0	0	0
04	2	2,450	13.9%	15.4%	$112	-14	256	0
05	2	2,450	19.2%	19.2%	$0	0	0	0
06	2	2,900	13.2%	15.9%	$650	0	14	11
07	2	2,900	18.9%	18.9%	$0	0	0	0
08	2	2,900	13.5%	19.5%	$650	0	252	11
09	2	2,900	15.0%	15.6%	$115	-10	150	0
10	2	2,900	7.3%	16.0%	$650	0	661	11
11	2	2,900	7.7%	18.6%	$563	51	513	11
12	2	2,900	-3.4%	17.0%	$1,812	107	819	11
13	2	2,900	-9.4%	15.9%	$1,831	43	2,129	11
14	2	2,800	-4.1%	15.9%	$965	71	1,623	11
15	2	2,800	-12.6%	16.4%	$863	-11	3,917	11
16	2	2,800	-0.3%	15.0%	$930	220	104	4

Table E-7: Energy Savings and Costs by CEC Climate Zone – 25% Above 2001 Standards – Single Family Detached Homes

CEC_CZ	Story	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	1	2,400	7.7%	19.8%	$2,067	82	0	4
02	1	2,400	10.4%	25.2%	$1,208	54	706	4
03	1	2,400	15.4%	25.3%	$1,703	49	14	4
04	1	2,400	11.6%	25.5%	$1,393	43	479	4
05	1	2,400	16.8%	25.8%	$1,155	40	16	11
06	1	2,450	21.7%	26.0%	$450	0	72	12
07	1	2,450	12.9%	25.4%	$657	-12	493	12
08	1	2,150	11.9%	25.3%	$1,135	21	328	11
09	1	2,150	13.8%	25.9%	$963	23	351	11
10	1	2,150	6.9%	25.1%	$963	29	857	11
11	1	1,800	11.8%	25.4%	$771	34	545	11
12	1	1,800	0.6%	25.6%	$2,170	94	669	11
13	1	1,800	-8.1%	25.2%	$2,370	66	1,745	11
14	1	2,000	-2.1%	25.3%	$1,832	87	1,425	11
15	1	2,000	-10.1%	25.2%	$1,163	3	3,402	11
16	1	2,000	1.0%	26.6%	$2,401	255	51	3
01	2	2,450	7.8%	22.4%	$1,934	112	0	4
02	2	2,450	12.1%	25.1%	$1,349	54	716	4
03	2	2,450	16.6%	25.9%	$1,838	50	50	4
04	2	2,450	13.9%	25.0%	$1,238	42	410	4
05	2	2,450	19.2%	26.8%	$1,163	39	19	12
06	2	2,900	13.2%	23.5%	$2,092	35	23	11
07	2	2,900	18.9%	25.1%	$1,163	7	79	11
08	2	2,900	13.5%	25.0%	$1,278	10	490	11
09	2	2,900	15.0%	25.2%	$1,163	21	417	11
10	2	2,900	7.3%	25.4%	$1,278	18	1,315	11
11	2	2,900	7.7%	26.2%	$1,625	67	1,137	11
12	2	2,900	-3.4%	27.6%	$3,366	190	1,026	11
13	2	2,900	-9.4%	26.9%	$3,666	141	2,330	11
14	2	2,800	-4.1%	25.4%	$2,214	143	2,080	11
15	2	2,800	-12.6%	26.4%	$2,214	-4	5,192	11
16	2	2,800	-0.3%	25.8%	$2,946	382	134	4

Figure E-2 to Figure E-5 illustrate the data presented in the tables above by end use, number of stories, and CEC climate zone. The solid bars illustrate the therms/kWh savings and the thinner striped bars illustrate the total cost of the package. Since many measures lead to both space heating and cooling savings, it is impossible to separate the costs associated with the energy savings by end-use. The text above the bars is the % compliance margin of the base case prototype.

For example, Figure E-2 shows that the one-story prototype in CEC Climate Zone 14 had a base compliance of -2.1%. To reach at least 15% above the 2001 Standards would cost approximately $750 and result in a savings of just over 50 therms. However, upgrading the prototype to 25% above the 2001 Standards would cost an additional $1,100 and only result in an additional savings of 30 therms. Please note that this does not reflect the cooling savings associated with the cost.

Figure E-2: Gas Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – One-Story Single Family Detached Homes

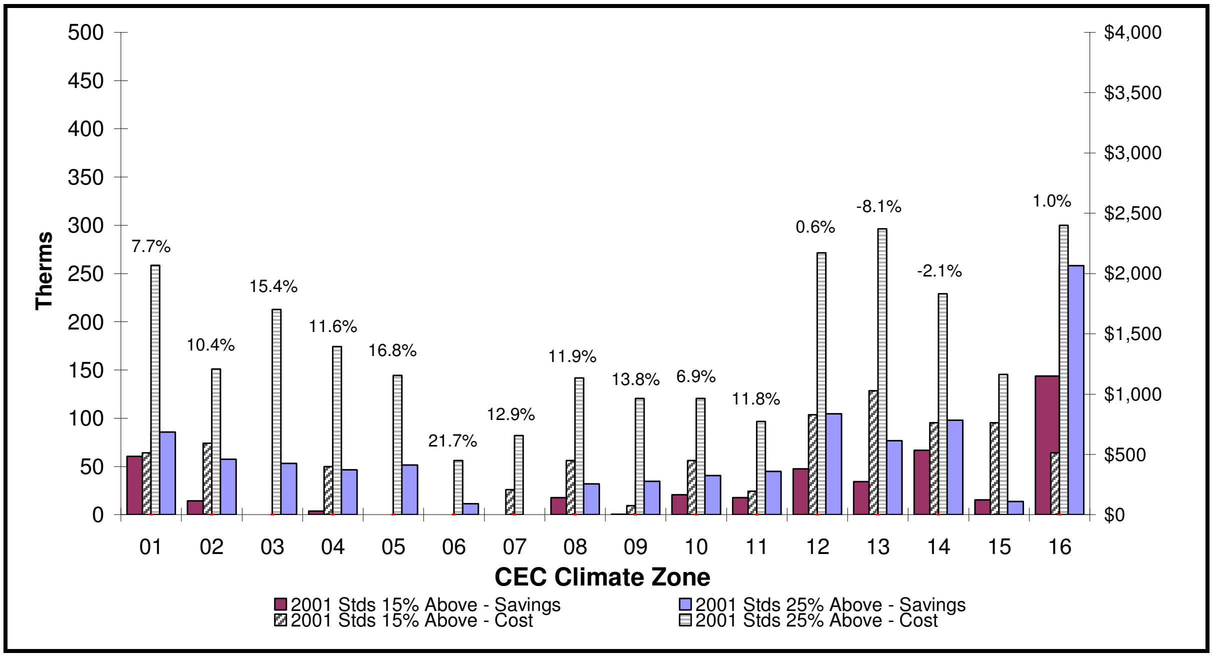


Figure E-3: Electric Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – One-Story Single Family Detached Homes

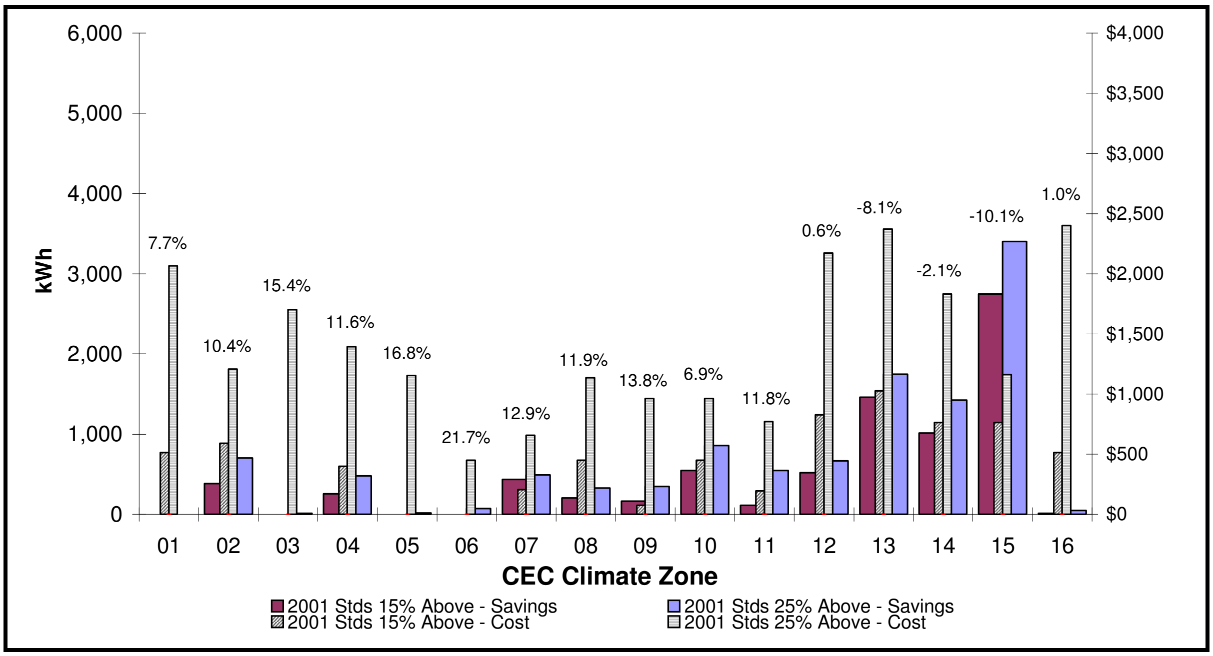


Figure E-4: Gas Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – Two-Story Single Family Detached Homes

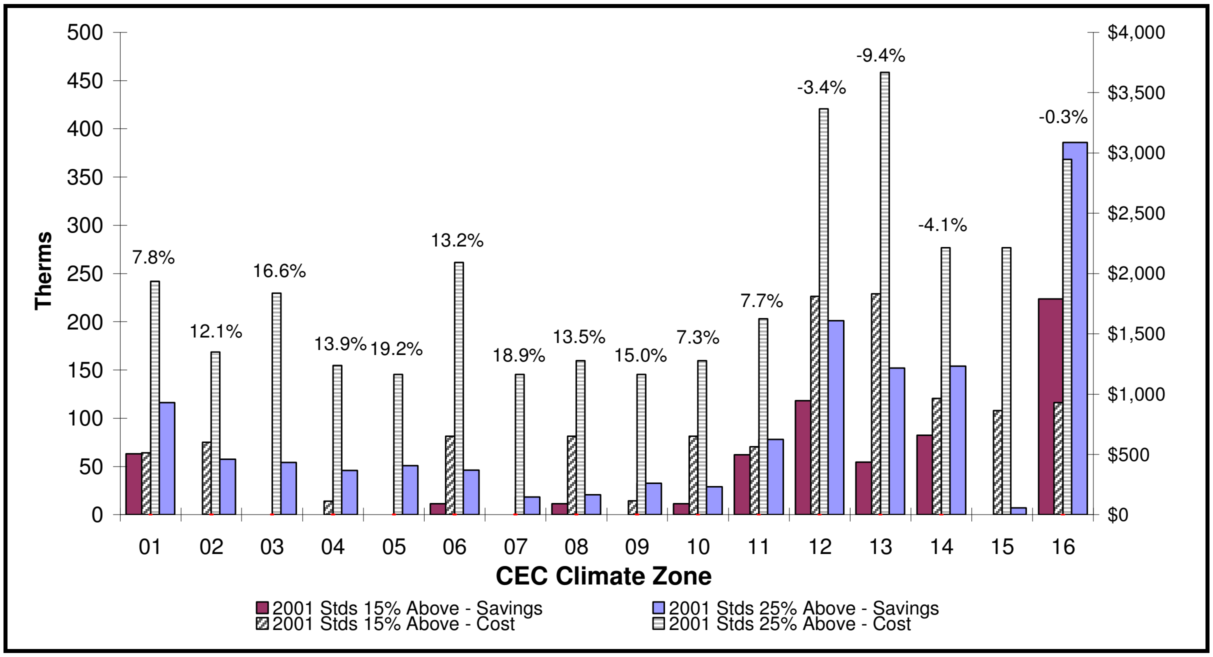
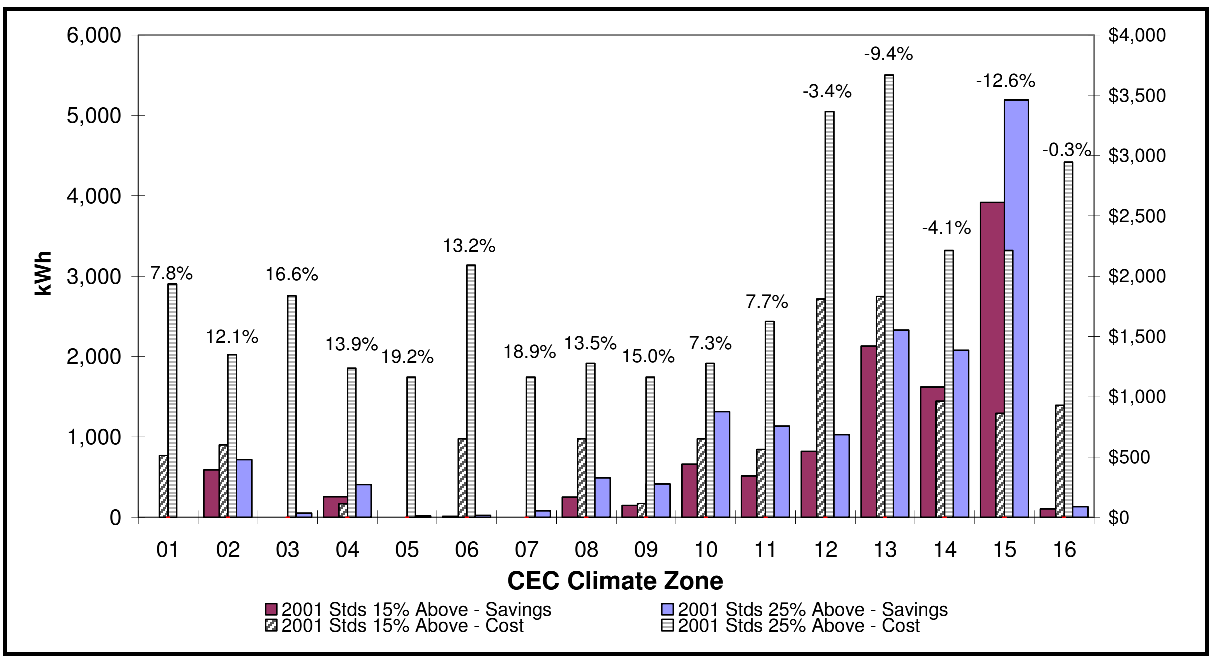


Figure E-5: Electric Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – Two-Story Single Family Detached Homes



2005 Standards

The 2001 base case prototypes were developed using the average building characteristics of newly constructed single family detached homes. However, because the 2005 Standards have not taken affect, it is impossible to know how builders will reach the new Standards. Therefore, each of the packages was added to the prototypes and run under the 2005 Standards.[5] The least-cost package that caused each prototype to just comply with the 2005 Standards was chosen as the 2005 base case prototype. Table E-8 presents the % compliance margin, the measures installed, and the cost of the package relative to the 2001 base case prototypes. Of the 32 single family detached prototypes, nine have the same 2005 base case as the 2001 base case. Each of these nine is along the coast, which is not surprising given that the 2005 Standards, like the 2001 Standards, were developed to be more stringent in the inland regions.

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[5] Beginning in 2006, the federal appliance standards will require the minimum efficiency of all air conditioners manufactured to be 13 SEER. Therefore, each of the 70 packages were modified when used to upgrade the homes when analyzed under 2005 to include at least a 13 SEER A/C. The packages that included a 14 or 15 SEER A/C were not changed.

Table E-8: 2005 Standards Base Case Prototypes – Single Family Detached Homes

RER _CZ	CEC_ CZ	Story	FlArea	Package	Base Compliance	Cost Above 01 Baseline	Window Type	Wall	Roof	Insulation Cert	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
1	01	1	2,400	0	2.8%	$0	2VL	19	30	No	Yes	No	No	No	No	13	92%	0.62	No	No
1	02	1	2,400	7	2.6%	$343	2VS	13	38	No	No	Yes	No	No	No	13	92%	0.63	No	No
1	03	1	2,400	1	3.7%	$0	2VL	13	30	No	No	Yes	No	No	No	13	86%	0.62	No	No
1	04	1	2,400	6	0.1%	$240	2VL	13	38	No	No	Yes	No	No	No	13	80%	0.63	No	No
1	05	1	2,400	1	10.9%	$0	2VL	19	30	No	No	Yes	No	No	No	13	86%	0.60	No	No
2	06	1	2,450	1	13.5%	$0	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
2	07	1	2,450	3	4.1%	$50	2VC	13	30	No	No	Yes	No	No	No	13	80%	0.63	No	No
3	08	1	2,150	2	0.1%	$76	2VS	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
3	09	1	2,150	7	2.3%	$341	2VS	13	38	No	No	Yes	No	No	No	13	80%	0.63	No	No
3	10	1	2,150	43	2.3%	$563	2VL	13	30	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
4	11	1	1,800	43	4.9%	$563	2VL	19	30	No	No	Yes	Yes	No	No	13	86%	0.63	No	Yes
4	12	1	1,800	47	0.9%	$1,031	2VL	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
4	13	1	1,800	48	2.4%	$1,095	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
5	14	1	2,000	46	1.5%	$841	2VS	13	38	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
5	15	1	2,000	44	1.5%	$641	2VS	19	30	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
5	16	1	2,000	9	-1.5%	$469	2VL	19	30	No	No	Yes	No	No	No	13	92%	0.63	No	No
1	01	2	2,450	19	-1.8%	$317	2VL	19	49	No	Yes	Yes	No	No	No	14	92%	0.63	No	No
1	02	2	2,450	1	1.5%	$0	2VL	13	30	No	No	Yes	No	No	No	13	92%	0.62	No	No
1	03	2	2,450	1	8.7%	$0	2VL	13	30	No	No	Yes	No	No	No	13	86%	0.62	No	No
1	04	2	2,450	1	2.5%	$0	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.62	No	No
1	05	2	2,450	1	21.0%	$0	2VL	19	30	No	No	Yes	No	No	No	13	86%	0.60	No	No
2	06	2	2,900	1	4.3%	$0	2VL	13	30	No	No	Yes	No	No	No	13	82%	0.60	No	No
2	07	2	2,900	1	7.4%	$0	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
3	08	2	2,900	2	2.5%	$115	2VS	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
3	09	2	2,900	5	0.1%	$165	2VS	13	30	No	No	Yes	No	No	No	13	80%	0.63	No	No
3	10	2	2,900	43	3.6%	$563	2VL	13	30	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
4	11	2	2,900	43	3.2%	$563	2VL	19	30	No	No	Yes	Yes	No	No	13	86%	0.63	No	Yes
4	12	2	2,900	26	0.4%	$1,684	2VS	13	38	No	No	Yes	Yes	No	No	13	92%	0.63	Yes	Yes
4	13	2	2,900	28	0.9%	$1,959	2VS	13	38	No	Yes	Yes	Yes	No	No	13	92%	0.63	Yes	Yes
5	14	2	2,800	46	2.4%	$874	2VS	13	38	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
5	15	2	2,800	46	1.6%	$874	2VS	19	38	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
5	16	2	2,800	9	-4.3%	$469	2VL	19	30	No	No	Yes	No	No	No	13	92%	0.63	No	No

Table E-9 and Table E-10 present the measures included in the least-cost package that upgraded each prototype to 10% and 15% above the 2005 Standards, respectively. The tables also present the incremental cost of each package (*Cost*), the compliance margin of the base case prototype (*Base Compliance*), and the compliance margin reached by adding the package to the base case prototype (*Package Compliance*). For convenience, the measures that were upgraded for each prototype to reach its target are highlighted in yellow meaning the measure was added, and green meaning that the base case prototype actually had a higher efficiency version of the measure installed (therefore decreasing the cost).

As shown in Table E-9, two of the base case prototypes were already at least 10% better than the 2005 Standards. Table E-10 provides the same results for the base case homes to reach 15% above the 2005 Standards. While it is possible for each of the prototypes to reach 15% better than the 2005 Standards, the number of high efficiency measures and the cost of those measures varies dramatically between the coast and inland regions. The prototypes in the inland regions need nearly every high efficiency measure in the list while some coastal prototypes need to install just one or two high efficiency measures.

Table E-9: Least-Cost Package by CEC Climate Zone – 10% Above 2005 Standards – Single Family Detached Homes

CEC_CZ	Story	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Insulation Certification	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
01	1	2,400	2.8%	6.2%	$993	2VL	19	49	No	Yes	Yes	Yes	No	No	13	92%	0.63	No	Yes
02	1	2,400	2.6%	11.4%	$273	2VS	13	30	No	No	Yes	Yes	No	No	13	92%	0.63	No	Yes
03	1	2,400	3.7%	14.0%	$513	2VL	13	30	No	No	Yes	Yes	No	No	13	86%	0.63	No	Yes
04	1	2,400	0.1%	10.3%	$465	2VL	13	38	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
05	1	2,400	10.9%	10.9%	$0	2VL	19	30	No	No	Yes	No	No	No	13	86%	0.60	No	No
06	1	2,450	13.5%	13.5%	$0	2VC	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
07	1	2,450	4.1%	15.1%	$157	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
08	1	2,150	0.1%	12.5%	$735	2VS	13	38	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
09	1	2,150	2.3%	11.5%	$470	2VS	13	38	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
10	1	2,150	2.3%	13.2%	$506	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
11	1	1,800	4.9%	11.2%	$208	2VS	19	38	No	No	Yes	Yes	No	No	13	86%	0.63	No	Yes
12	1	1,800	0.9%	10.4%	$1,004	2VS	13	49	No	Yes	Yes	Yes	No	No	13	92%	0.63	Yes	Yes
13	1	1,800	2.4%	10.2%	$1,445	2VL	13	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
14	1	2,000	1.5%	11.3%	$1,271	2VS	13	49	No	Yes	Yes	Yes	No	No	13	92%	0.63	Yes	Yes
15	1	2,000	1.5%	10.9%	$400	2VS	19	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
16	1	2,000	-1.5%	11.3%	$44	2VL	19	30	No	No	Yes	Yes	No	No	13	86%	0.63	No	Yes
01	2	2,450	-1.8%	16.1%	$389	2VL	19	49	Yes	Yes	Yes	Yes	No	No	15	92%	0.63	Yes	Yes
02	2	2,450	1.5%	13.9%	$513	2VL	13	30	No	No	Yes	Yes	No	No	13	92%	0.63	No	Yes
03	2	2,450	8.7%	10.4%	$125	2VL	13	38	No	No	Yes	No	No	No	13	86%	0.63	No	No
04	2	2,450	2.5%	13.1%	$513	2VL	13	30	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
05	2	2,450	21.0%	21.0%	$0	2VL	19	30	No	No	Yes	No	No	No	13	86%	0.60	No	No
06	2	2,900	4.3%	13.9%	$563	2VL	13	30	No	No	Yes	Yes	No	No	13	82%	0.63	No	Yes
07	2	2,900	7.4%	10.0%	$167	2VS	13	30	No	No	Yes	No	No	No	13	80%	0.63	No	No
08	2	2,900	2.5%	11.5%	$563	2VS	13	30	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
09	2	2,900	0.1%	10.4%	$513	2VS	13	30	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
10	2	2,900	3.6%	13.1%	$517	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
11	2	2,900	3.2%	11.9%	$461	2VS	19	38	No	Yes	Yes	Yes	No	No	13	86%	0.63	No	Yes
12	2	2,900	0.4%	18.9%	$1,382	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
13	2	2,900	0.9%	13.4%	$1,107	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
14	2	2,800	2.4%	11.2%	$1,290	2VS	13	49	No	Yes	Yes	Yes	No	No	13	92%	0.63	Yes	Yes
15	2	2,800	1.6%	10.2%	$2,830	2VS	19	49	No	Yes	Yes	Yes	Yes	Yes	14	92%	0.63	Yes	Yes
16	2	2,800	-4.3%	10.2%	$211	2VL	19	38	No	No	Yes	Yes	No	No	13	86%	0.63	No	Yes

Note: Yellow highlighting indicates a more efficient measure is needed compared to the baseline home and green highlighting indicates a less efficient measure is needed.

Table E-10: Least-Cost Package by CEC Climate Zone – 15% Above 2005 Standards – Single Family Detached Homes

CEC_CZ	Story	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Insulation Certification	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
01	1	2,400	2.8%	13.4%	$1,174	2VL	19	49	Yes	Yes	Yes	Yes	No	No	13	92%	0.63	Yes	Yes
02	1	2,400	2.6%	17.2%	$753	2VS	13	38	No	Yes	Yes	Yes	No	No	13	92%	0.63	No	Yes
03	1	2,400	3.7%	15.5%	$705	2VL	13	38	No	No	Yes	Yes	No	No	13	86%	0.63	No	Yes
04	1	2,400	0.1%	15.7%	$1,144	2VS	13	49	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
05	1	2,400	10.9%	15.7%	$519	2VL	19	30	No	No	Yes	No	No	No	13	92%	0.63	No	No
06	1	2,450	13.5%	16.4%	$207	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
07	1	2,450	4.1%	15.1%	$157	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
08	1	2,150	0.1%	15.7%	$993	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
09	1	2,150	2.3%	15.4%	$728	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
10	1	2,150	2.3%	15.8%	$964	2VS	13	49	No	Yes	Yes	Yes	No	No	14	80%	0.63	No	Yes
11	1	1,800	4.9%	16.8%	$640	2VS	19	49	No	Yes	Yes	Yes	No	No	13	86%	0.63	No	Yes
12	1	1,800	0.9%	15.6%	$1,509	2VL	13	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
13	1	1,800	2.4%	17.7%	$1,570	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
14	1	2,000	1.5%	20.6%	$1,861	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
15	1	2,000	1.5%	17.7%	$2,619	2VS	19	49	Yes	Yes	Yes	Yes	Yes	Yes	15	92%	0.63	Yes	Yes
16	1	2,000	-1.5%	15.4%	$684	2VL	19	49	No	Yes	Yes	Yes	No	No	13	86%	0.63	No	Yes
01	2	2,450	-1.8%	16.1%	$539	2VL	19	49	Yes	Yes	Yes	Yes	No	No	15	92%	0.63	Yes	Yes
02	2	2,450	1.5%	16.2%	$625	2VS	13	30	No	No	Yes	Yes	No	No	13	92%	0.63	No	Yes
03	2	2,450	8.7%	18.8%	$513	2VL	13	30	No	No	Yes	Yes	No	No	13	86%	0.63	No	Yes
04	2	2,450	2.5%	16.6%	$749	2VS	13	38	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
05	2	2,450	21.0%	21.0%	$0	2VL	19	30	No	No	Yes	No	No	No	13	86%	0.60	No	No
06	2	2,900	4.3%	15.3%	$1,043	2VL	13	49	No	Yes	Yes	Yes	No	No	13	82%	0.63	No	Yes
07	2	2,900	7.4%	16.7%	$683	2VL	13	38	No	No	Yes	Yes	No	No	13	80%	0.63	No	Yes
08	2	2,900	2.5%	16.7%	$965	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
09	2	2,900	0.1%	16.1%	$915	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	No	Yes
10	2	2,900	3.6%	15.5%	$1,349	2VS	13	38	No	Yes	Yes	Yes	No	No	13	92%	0.63	Yes	Yes
11	2	2,900	3.2%	15.4%	$1,682	2VS	19	49	No	Yes	Yes	Yes	Yes	Yes	13	86%	0.63	No	Yes
12	2	2,900	0.4%	18.9%	$1,382	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
13	2	2,900	0.9%	19.1%	$2,125	2VS	19	49	Yes	Yes	Yes	Yes	Yes	Yes	15	92%	0.63	Yes	Yes
14	2	2,800	2.4%	15.3%	$2,253	2VL	13	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
15	2	2,800	1.6%	14.4%	$3,255	2VS	19	49	Yes	Yes	Yes	Yes	Yes	Yes	15	92%	0.63	Yes	Yes
16	2	2,800	-4.3%	15.5%	$1,062	2VL	19	38	No	Yes	Yes	Yes	No	No	13	92%	0.63	Yes	Yes

Note: Yellow highlighting indicates a more efficient measure is needed compared to the baseline home and green highlighting indicates a less efficient measure is needed.

Table E-11 and Table E-12 summarize the cost and savings[6] that result from upgrading the base case home with the least-cost package for each to reach 10% and 15% above the 2005 Standards. As shown, it would cost just $157 to upgrade the one-story base case prototype in CEC Climate Zone 7 from 4.1% to 15.1% and would result in a savings of 273 kWh per year; however, installing this package of measures results in the prototype using more therms for both water heating and space heating. While installing a different package could result in positive gas savings, this was the least-cost package that brings this prototype to the goal.

Table E-11: Energy Savings and Costs by CEC Climate Zone – 10% Above 2005 Standards – Single Family Detached Homes

CEC_CZ	Story	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	1	2,400	2.8%	6.2%	$993	25	0	0
02	1	2,400	2.6%	11.4%	$273	70	47	0
03	1	2,400	3.7%	14.0%	$513	60	0	4
04	1	2,400	0.1%	10.3%	$465	61	42	0
05	1	2,400	10.9%	10.9%	$0	0	0	0
06	1	2,450	13.5%	13.5%	$0	0	0	0
07	1	2,450	4.1%	15.1%	$157	-6	273	-12
08	1	2,150	0.1%	12.5%	$735	26	111	12
09	1	2,150	2.3%	11.5%	$470	25	137	0
10	1	2,150	2.3%	13.2%	$506	0	427	0
11	1	1,800	4.9%	11.2%	$208	0	257	0
12	1	1,800	0.9%	10.4%	$1,004	33	158	0
13	1	1,800	2.4%	10.2%	$1,445	73	0	0
14	1	2,000	1.5%	11.3%	$1,271	50	260	0
15	1	2,000	1.5%	10.9%	$400	3	743	0
16	1	2,000	-1.5%	11.3%	$44	140	2	0
01	2	2,450	-1.8%	16.1%	$389	149	0	0
02	2	2,450	1.5%	13.9%	$513	97	189	4
03	2	2,450	8.7%	10.4%	$125	7	10	4
04	2	2,450	2.5%	13.1%	$513	75	50	4
05	2	2,450	21.0%	21.0%	$0	0	0	0
06	2	2,900	4.3%	13.9%	$563	33	3	12
07	2	2,900	7.4%	10.0%	$167	-13	51	12
08	2	2,900	2.5%	11.5%	$563	36	68	12
09	2	2,900	0.1%	10.4%	$513	39	218	0
10	2	2,900	3.6%	13.1%	$517	-2	573	0
11	2	2,900	3.2%	11.9%	$461	-2	621	0
12	2	2,900	0.4%	18.9%	$1,382	147	315	0
13	2	2,900	0.9%	13.4%	$1,107	117	366	0
14	2	2,800	2.4%	11.2%	$1,290	81	296	0
15	2	2,800	1.6%	10.2%	$2,830	20	944	0
16	2	2,800	-4.3%	10.2%	$211	231	57	0

[6] The method of estimating the compliance and energy savings from exceeding the 2005 Standards was calculated differently than it was under the 2001 Standards. The 2005 Standards use TDV for calculating compliance. However, since the TDV calculations weight the energy used across hours differently, it is not correct to use the TDV budgets to calculate energy savings. Therefore, the TDV budgets are used to determine the percent compliance margins but the source energy budgets are used to calculate energy savings. Under the 2001 Standards, the source energy budgets are used to estimate both compliance and savings.

Table E-12: Energy Savings and Costs by CEC Climate Zone – 15% Above 2005 Standards – Single Family Detached Homes

CEC_CZ	Story	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	1	2,400	2.8%	13.4%	$1,174	78	0	0
02	1	2,400	2.6%	17.2%	$753	85	206	0
03	1	2,400	3.7%	15.5%	$705	68	2	4
04	1	2,400	0.1%	15.7%	$1,144	58	242	0
05	1	2,400	10.9%	15.7%	$519	17	0	12
06	1	2,450	13.5%	16.4%	$207	-9	137	-12
07	1	2,450	4.1%	15.1%	$157	-6	273	-12
08	1	2,150	0.1%	15.7%	$993	28	172	12
09	1	2,150	2.3%	15.4%	$728	26	231	0
10	1	2,150	2.3%	15.8%	$964	3	523	0
11	1	1,800	4.9%	16.8%	$640	8	443	0
12	1	1,800	0.9%	15.6%	$1,509	84	107	0
13	1	1,800	2.4%	17.7%	$1,570	100	216	0
14	1	2,000	1.5%	20.6%	$1,861	144	299	0
15	1	2,000	1.5%	17.7%	$2,619	14	1,251	0
16	1	2,000	-1.5%	15.4%	$684	178	31	0
01	2	2,450	-1.8%	16.1%	$539	149	0	0
02	2	2,450	1.5%	16.2%	$625	83	369	4
03	2	2,450	8.7%	18.8%	$513	72	7	4
04	2	2,450	2.5%	16.6%	$749	68	220	4
05	2	2,450	21.0%	21.0%	$0	0	0	0
06	2	2,900	4.3%	15.3%	$1,043	38	9	12
07	2	2,900	7.4%	16.7%	$683	26	23	12
08	2	2,900	2.5%	16.7%	$965	41	198	12
09	2	2,900	0.1%	16.1%	$915	37	454	0
10	2	2,900	3.6%	15.5%	$1,349	30	573	0
11	2	2,900	3.2%	15.4%	$1,682	32	706	0
12	2	2,900	0.4%	18.9%	$1,382	147	315	0
13	2	2,900	0.9%	19.1%	$2,125	109	907	0
14	2	2,800	2.4%	15.3%	$2,253	167	216	0
15	2	2,800	1.6%	14.4%	$3,255	33	1,390	0
16	2	2,800	-4.3%	15.5%	$1,062	313	93	0

Figure E-6 to Figure E-9 illustrate the data presented in the tables above by end use, number of stories, and CEC climate zone. The solid bars illustrate the therms/kWh savings and the thinner striped bars illustrate the total cost of the package. Since many measures lead to both space heating and cooling savings, it is impossible to separate the costs associated with the energy savings by end use. The text above the bars is the percent compliance margin of the base case prototype.

Figure E-6: Gas Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – One-Story Single Family Detached Homes

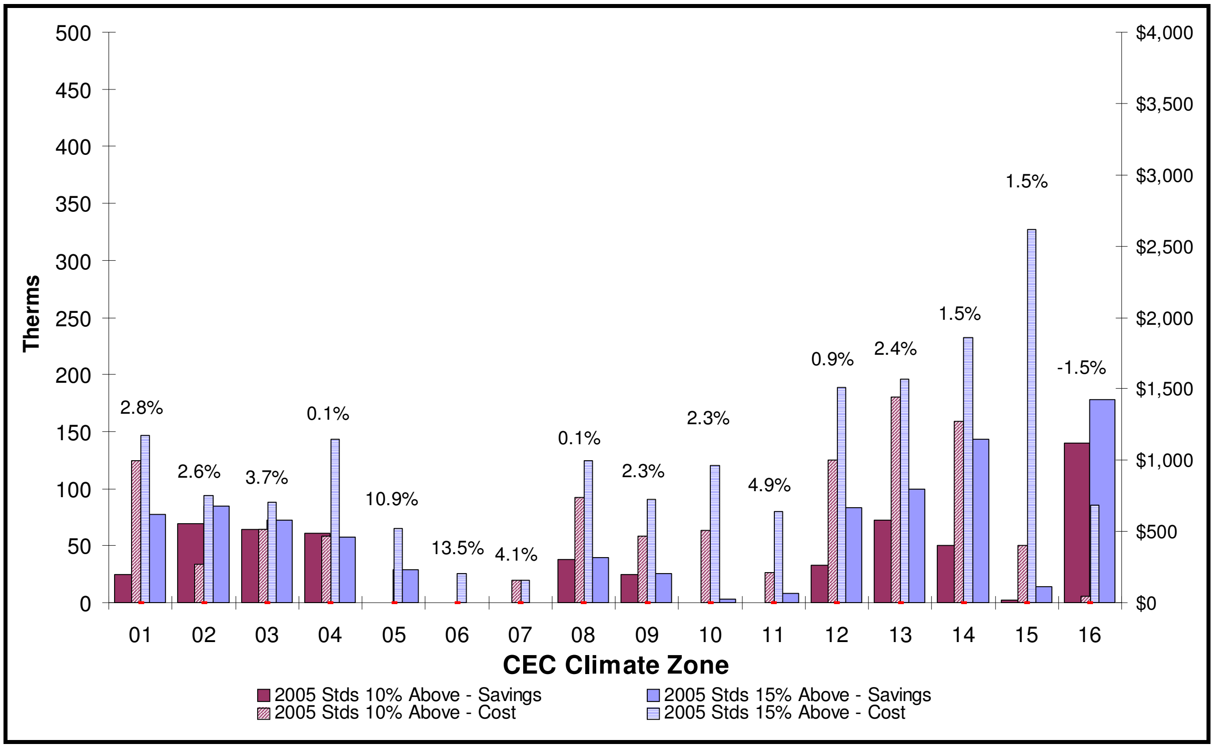


Figure E-7: Electric Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – One-Story Single Family Detached Homes

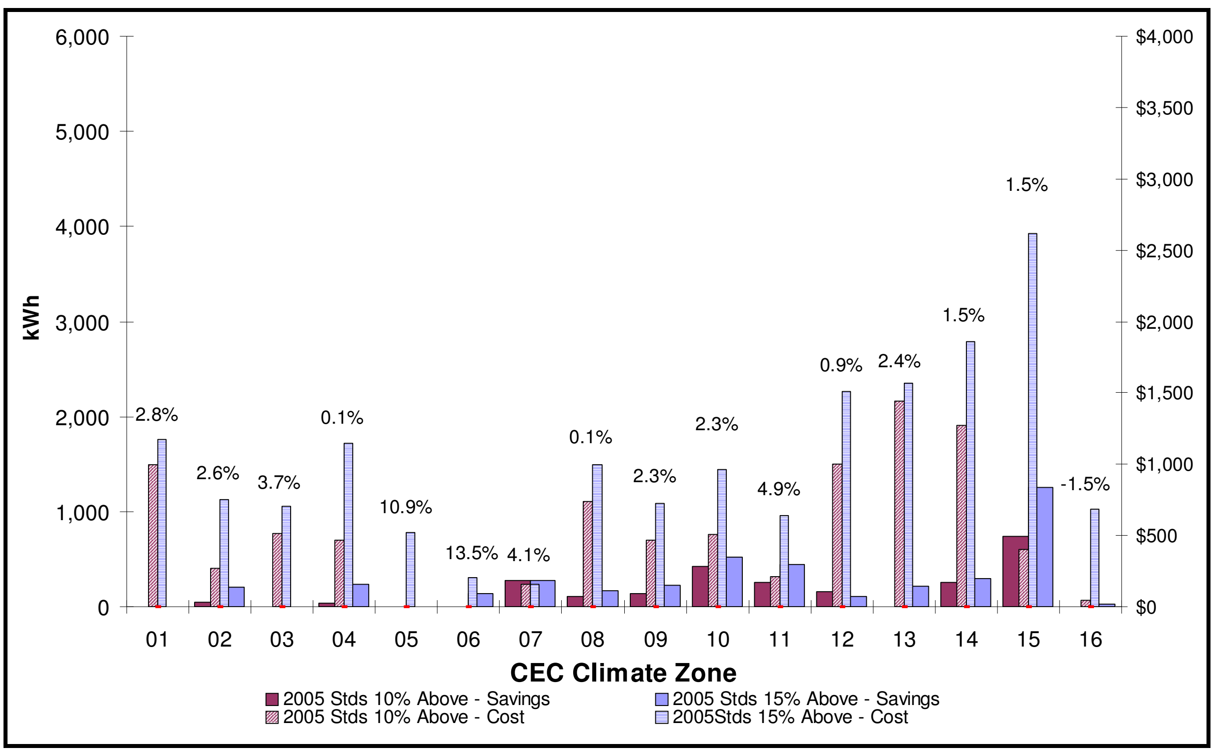


Figure E-8: Gas Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – Two-Story Single Family Detached Homes

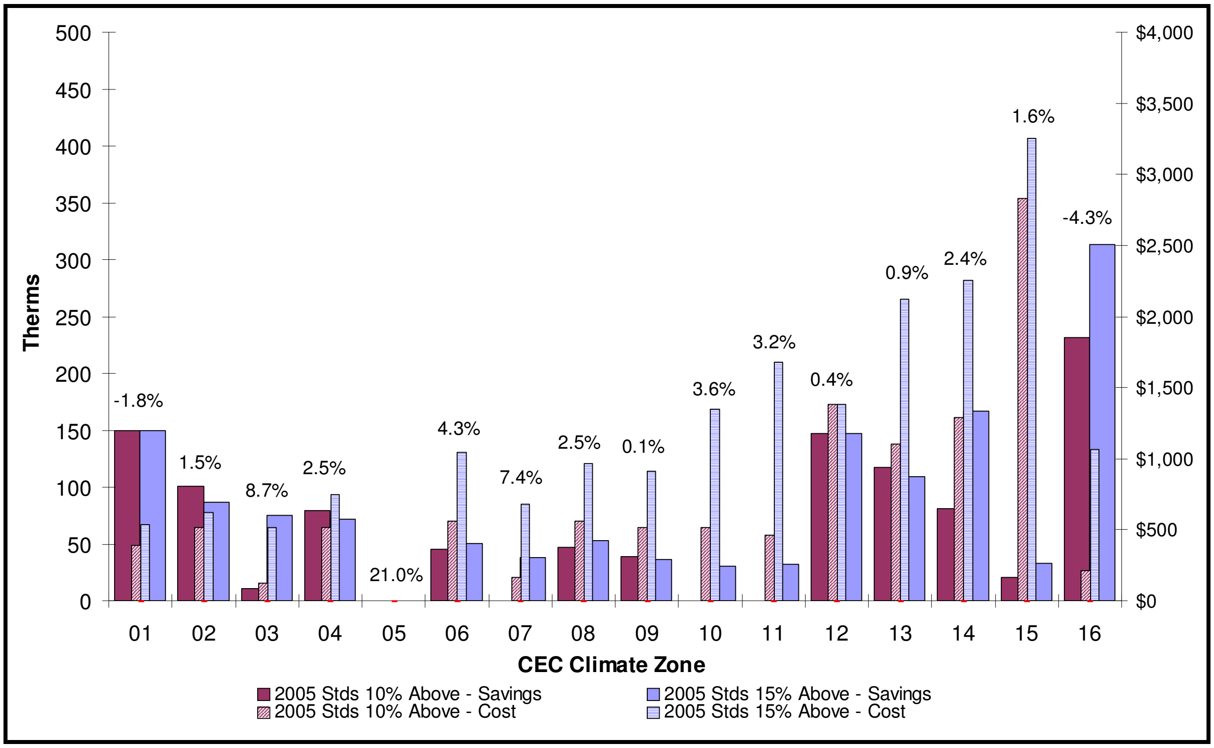
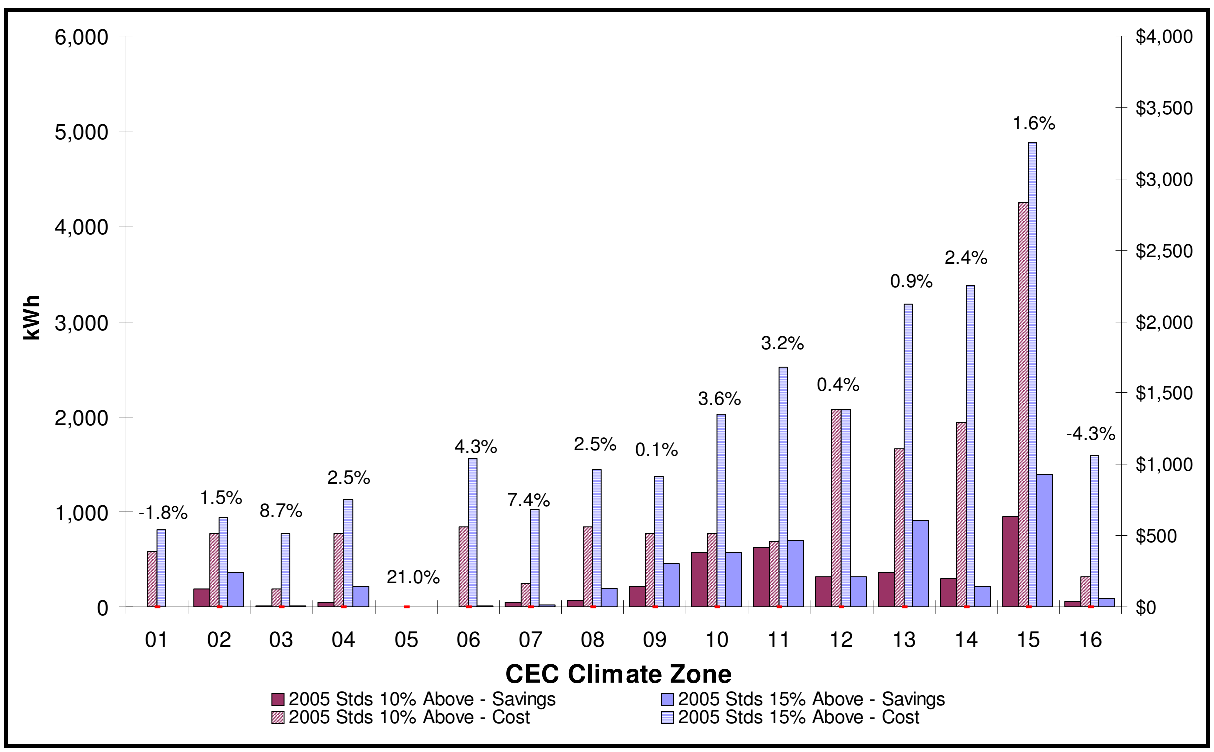


Figure E-9: Electric Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – Two-Story Single Family Detached Homes



E.3 Single Family Attached Buildings

A single family attached building is defined as a building with dwelling units that do not have floors or ceilings adjoining with any other dwelling units but share adjoining walls.

Base Case Prototypes

The first step was to develop a base case building for each RMST climate zone. These base case (prototype) buildings were developed by first finding buildings that matched closely the baseline average building shell characteristics (such as floor area and glazing area) of each CEC climate zone found during the RNC Baseline Study conducted in 2001. The adjustments were then made to the equipment efficiencies based on the expertise of the advisory group and using the 2001 RNC Baseline Study and the ENERGY STAR New Homes Evaluation conducted in 2004 by RLW.

Table E-13 presents the building characteristics and the compliance margins of the 16 single family attached prototypes used in the analysis and approved by the New Construction Residential Advisory Group on September 16, 2004.

Table E-13: Single Family Attached Prototypes (Base Case)

	CEC CZ 1	CEC CZ 2	CEC CZ 3	CEC CZ 4	CEC CZ 5	CEC CZ 6	CEC CZ 7	CEC CZ 8	CEC CZ 9	CEC CZ 10	CEC CZ 11	CEC CZ 12	CEC CZ 13	CEC CZ 14	CEC CZ 15	CEC CZ 16
Sq Ft	8,400	8,400	8,400	8,400	8,400	10,400	10,400	12,936	12,936	12,936	4,551	4,551	4,551	4,200	4,200	4,200
# Stories	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
# of Units	6	6	6	6	6	6	6	7	7	7	3	3	3	4	4	4
Glazing % Area	13.5%	13.5%	13.5%	13.5%	13.5%	13.5%	13.5%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%
Glazing Area	1134	1134	1134	1134	1134	1404	1404	1552	1552	1552	546	546	546	504	504	504
Type of Window	2VL	2VL	2VL	2VL	2VL	2VC	2VC	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL	2VL
Glazing U-factor	0.37	0.37	0.37	0.37	0.37	0.60	0.60	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Glazing SHGC	0.41	0.41	0.41	0.41	0.41	0.65	0.65	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Wall Area	8,060	8,060	8,060	8,060	8,060	7,480	7,480	9,168	9,168	9,168	3,520	3,520	3,520	3,740	3,740	3,740
Wall	19	19	19	19	19	13	13	13	13	13	13	13	13	19	19	19
Roof Area	4,200	4,200	4,200	4,200	4,200	5,200	5,200	6,468	6,468	6,468	4,551	4,551	4,551	4,200	4,200	4,200
Roof	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Radiant Barrier	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TXV	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Tight Ducts	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Infiltration Testing	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct Design	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct R-value	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
SEER	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	11.0	11.0	11.0	11.0	11.0	11.0
AFUE	0.92	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
EF	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Standard	30.7	38.3	27.3	32.3	28.8	18.9	18.0	21.1	23.8	28.1	37.1	34.6	38.9	48.6	58.8	53.5
Margin	-0.12	-0.31	4.08	3.27	3.11	3.26	1.77	3.53	3.48	3.49	1.77	2.35	-0.15	-1.63	-7.04	0.75
% Compliance Margin	-0.4%	-0.8%	14.9%	10.1%	10.8%	17.2%	9.8%	16.8%	14.6%	12.4%	4.8%	6.8%	-0.4%	-3.4%	-12.0%	1.4%

Incremental Costs

Table E-14 presents the incremental cost for each measure included in the analysis. These costs were developed in the same manner as the incremental costs for the high efficiency measures installed in single detached homes. The New Construction Residential Advisory Group approved the final incremental costs on October 8, 2004. As with the single family detached residences, the incremental cost of the central air conditioning units changed due to the change in the federal minimum efficiency standards in 2006. The first cost given applied to the years from 2003 to 2005, and the second cost given applies to all years after 2005.

Table E-14: Summary of Proposed Incremental Measure Costs – Single Family Attached Buildings

Measure	Efficiency	Total Cost	
Central Air Conditioner	12 SEER	$200/N/A	Per Unit
	14 SEER	$400/$200	Per Unit
	15 SEER	$1,000/$400	Per Unit
Furnace	92% AFUE	$600	Per Unit
Water Heater	0.63 EF	$50	Per Unit
Radiant Barrier	Yes	$0.12	Per Sq. Ft. (Roof)
Roof Insulation	R-38	$0.08	Per Sq. Ft. (Roof)
	R-49	$0.20	Per Sq. Ft. (Roof)
Wall Insulation	R-19	$0.06	Per Sq. Ft. (Wall)
Insulation Credit	Yes	$25	Per House
House Wrap	Yes	$0.25	Per Sq. Ft. (Wall)
Windows	2-Pane Vinyl Low-E	$0.50	Per Sq. Ft. (Glazing)
	2-Pane Vinyl Spectral Low-E	$0.75	Per Sq. Ft. (Glazing)
Duct Insulation	R-8.0	$200	Per House
HERS Certified Sealed Ducts	Yes	$163	Per House
ACCA Duct Design	Yes	$131	Per House
Infiltration Testing	Yes	$150 + cost of House Wrap	Per House
TXV	Yes	$0	Per Unit

Developing the Packages

After the prototypes were finalized, the prototype buildings were used as the base cases to which the 70 high efficiency packages were added. The least-cost packages that reached a compliance margin of at least 15% and 25% above the 2001 Standards and 10% and 15% above the 2005 Standards were used to calculate energy savings per year for each prototype.

Least-Cost Package Results

Lastly, the savings in therms and watts per year were calculated for the least-cost package of each CEC climate zone. Energy savings per year were derived by subtracting the proposed energy usage of the upgraded unit per year from the base case proposed energy usage per year (for space heating, cooling, and water heating). The following presents the cost and savings for reaching the targets under the 2001 Standards and the 2005 Standards separately. All savings and costs presented are per unit.

2001 Standards

Table E-15 and Table E-16 present the measures included in the least-cost package that upgraded each prototype to 15% and 25% above the 2001 Standards, respectively. The tables also present the incremental cost of each package (*Cost*), the compliance margin of the base case prototype (*Base Compliance*), and the compliance margin reached by adding the package to the base case prototype (*Package Compliance*). For convenience, the measures that were upgraded for each prototype to reach its target are highlighted.

As shown in Table E-15, two of the base case prototypes already were at least 15% better than the 2001 Standards. (Note that these two prototypes have a $0 cost and their baseline and package compliance margins are equal.) Both of these base case prototypes are along the Southern coast of California, which has a mild climate and was not affected much by the changes to the 2001 Standards. Also shown is that the base case prototype in CEC Climate Zone 2 had a -0.8% compliance margin and would have to install several high efficiency measures, including a 12 SEER air conditioner with a TXV, roof insulation with a 38 R-value, a radiant barrier, and a 0.62 50-gallon gas water heater. Additional a HERS rater would have to verify that they installed 8.0 duct insulation and tight ducts. To reach 15% above the 2001 Standards would cost approximately $700 more than building the typical home in this climate zone.

Table E-16 provides the same results for the base case homes to reach 25% above the 2001 Standards. The base case prototype in CEC Climate Zone 1 could not be upgraded to 25% above the 2001 Standards given the current high efficiency measures in the packages. CEC Climate Zone 1 has no cooling in the Title 24 model and therefore has to achieve 25% using just the water heating and space heating budgets. This is difficult since most high efficiency measures are designed to reduce the peak cooling load.

Table E-15: Least-Cost Package by CEC Climate Zone – 15% Above 2001 Standards – Single Family Attached Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
01	6	8,400	-0.4%	15.1%	$1,080	2VL	19	49	Yes	No	Yes	Yes	Yes	10	92%	0.62	No	Yes
02	6	8,400	-0.8%	15.2%	$710	2VL	19	38	Yes	Yes	Yes	No	No	12	80%	0.62	No	Yes
03	6	8,400	14.9%	18.2%	$250	2VL	19	30	No	Yes	No	No	No	12	80%	0.62	No	No
04	6	8,400	10.1%	16.2%	$250	2VL	19	30	No	Yes	No	No	No	12	80%	0.62	No	No
05	6	8,400	10.8%	18.9%	$570	2VL	19	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
06	6	10,400	17.2%	17.2%	$0	2VC	13	30	No	No	No	No	No	10	80%	0.60	No	No
07	6	10,400	9.8%	17.5%	$117	2VL	13	30	No	No	No	No	No	10	80%	0.60	No	No
08	7	12,936	16.8%	16.8%	$0	2VL	13	30	No	No	No	No	No	10	80%	0.60	No	No
09	7	12,936	14.6%	17.6%	$55	2VS	13	30	No	No	No	No	No	10	80%	0.60	No	No
10	7	12,936	12.4%	21.4%	$250	2VL	13	30	No	Yes	No	No	No	12	80%	0.62	No	No
11	3	4,551	4.8%	19.2%	$470	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
12	3	4,551	6.8%	18.6%	$470	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
13	3	4,551	-0.4%	17.0%	$470	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
14	4	4,200	-3.4%	15.9%	$470	2VL	19	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
15	4	4,200	-12.0%	15.9%	$470	2VL	19	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
16	4	4,200	1.4%	15.3%	$470	2VL	19	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes

Table E-16: Least-Cost Package by CEC Climate Zone – 25% Above 2001 Standards – Single Family Attached Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
01	6	8,400	-0.4%	15.1%	$1,080	2VL	19	49	Yes	No	Yes	Yes	No	10	92%	0.62	No	Yes
02	6	8,400	-0.8%	25.2%	$2,059	2VS	19	49	Yes	Yes	Yes	Yes	Yes	12	92%	0.62	Yes	Yes
03	6	8,400	14.9%	26.1%	$1,056	2VL	19	30	No	Yes	Yes	Yes	Yes	12	80%	0.63	No	Yes
04	6	8,400	10.1%	26.1%	$1,280	2VL	19	49	Yes	Yes	Yes	Yes	Yes	12	80%	0.62	No	Yes
05	6	8,400	10.8%	25.6%	$1,686	2VL	19	49	Yes	Yes	Yes	No	Yes	10	92%	0.63	Yes	Yes
06	6	10,400	17.2%	25.1%	$756	2VL	13	38	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
07	6	10,400	9.8%	25.0%	$1,119	2VS	13	38	Yes	Yes	Yes	No	No	14	80%	0.62	No	Yes
08	7	12,936	16.8%	25.4%	$570	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
09	7	12,936	14.6%	25.7%	$379	2VS	13	38	No	Yes	No	No	No	12	80%	0.62	No	No
10	7	12,936	12.4%	26.5%	$570	2VL	13	30	No	Yes	Yes	No	No	12	80%	0.62	No	Yes
11	3	4,551	4.8%	25.5%	$1,001	2VS	13	49	Yes	Yes	Yes	No	No	12	80%	0.62	No	Yes
12	3	4,551	6.8%	25.2%	$1,255	2VL	13	49	Yes	Yes	Yes	No	No	14	80%	0.62	No	Yes
13	3	4,551	-0.4%	25.7%	$1,301	2VS	13	49	Yes	Yes	Yes	No	No	14	80%	0.62	No	Yes
14	4	4,200	-3.4%	25.7%	$1,221	2VS	19	49	Yes	Yes	Yes	Yes	Yes	12	80%	0.62	No	Yes
15	4	4,200	-12.0%	25.5%	$1,138	2VS	19	49	Yes	Yes	Yes	No	No	14	80%	0.62	No	Yes
16	4	4,200	1.4%	25.8%	$1,537	2VL	19	49	Yes	Yes	Yes	No	No	12	92%	0.62	Yes	Yes

Table E-17 and Table E-18 summarize the cost and savings results caused by upgrading the base case home with the least-cost package for each to reach 15% and 25% above the 2001 Standards. As shown, it would cost approximately $470 to upgrade the base case prototype in CEC Climate Zone 14 from -3.4% to 15.9%, and would result in a savings of 30 therms and 662 kWh per year.

Table E-17: Energy Savings and Costs by CEC Climate Zone – 15% Above 2001 Standards – Single Family Attached Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	6	8,400	-0.4%	15.1%	$1,080	56	0	10
02	6	8,400	-0.8%	15.2%	$710	35	396	10
03	6	8,400	14.9%	18.2%	$250	0	22	10
04	6	8,400	10.1%	16.2%	$250	0	170	10
05	6	8,400	10.8%	18.9%	$570	19	36	10
06	6	10,400	17.2%	17.2%	$0	0	0	0
07	6	10,400	9.8%	17.5%	$117	0	239	0
08	7	12,936	16.8%	16.8%	$0	0	0	0
09	7	12,936	14.6%	17.6%	$55	-4	166	0
10	7	12,936	12.4%	21.4%	$250	0	352	11
11	3	4,551	4.8%	19.2%	$470	26	433	10
12	3	4,551	6.8%	18.6%	$470	28	230	10
13	3	4,551	-0.4%	17.0%	$470	18	721	10
14	4	4,200	-3.4%	15.9%	$470	20	662	10
15	4	4,200	-12.0%	15.9%	$470	2	1,571	10
16	4	4,200	1.4%	15.3%	$470	60	79	10

Table E-18: Energy Savings and Costs by CEC Climate Zone – 25% Above 2001 Standards – Single Family Attached Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	6	8,400	-0.4%	15.1%	$1,080	56	0	10
02	6	8,400	-0.8%	25.2%	$2,059	76	521	10
03	6	8,400	14.9%	26.1%	$1,056	30	29	10
04	6	8,400	10.1%	26.1%	$1,280	33	278	10
05	6	8,400	10.8%	25.6%	$1,686	45	42	10
06	6	10,400	17.2%	25.1%	$756	-2	164	11
07	6	10,400	9.8%	25.0%	$1,119	1	354	11
08	7	12,936	16.8%	25.4%	$570	5	173	11
09	7	12,936	14.6%	25.7%	$379	-3	397	11
10	7	12,936	12.4%	26.5%	$570	9	522	11
11	3	4,551	4.8%	25.5%	$1,001	32	724	10
12	3	4,551	6.8%	25.2%	$1,255	40	451	10
13	3	4,551	-0.4%	25.7%	$1,301	21	1,194	10
14	4	4,200	-3.4%	25.7%	$1,221	34	1,017	10
15	4	4,200	-12.0%	25.5%	$1,138	2	2,143	10
16	4	4,200	1.4%	25.8%	$1,537	111	156	10

Figure E-10 and Figure E-11 illustrate the data presented in the tables above by end use and CEC climate zone. The solid bars illustrate the therms/kWh savings and the thinner striped bars illustrate the total cost of the package. Since many measures lead to both space heating and cooling savings, it is impossible to separate the costs associated with the energy savings by end use. The text above the bars is the % compliance margin of the base case prototype.

For example, Figure E-10 shows that the prototype in CEC Climate Zone 15 had a base compliance of -12.0%. To reach at least 15% above the 2001 Standards would cost $638 and result in a savings of just 12 therms. However, upgrading the prototype to 25% above the 2001 Standards would cost an additional $1,500 and only result in an additional savings of 3 therms. Note that this does not reflect the cooling savings associated with the cost.

Figure E-10: Gas Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – Single Family Attached Buildings

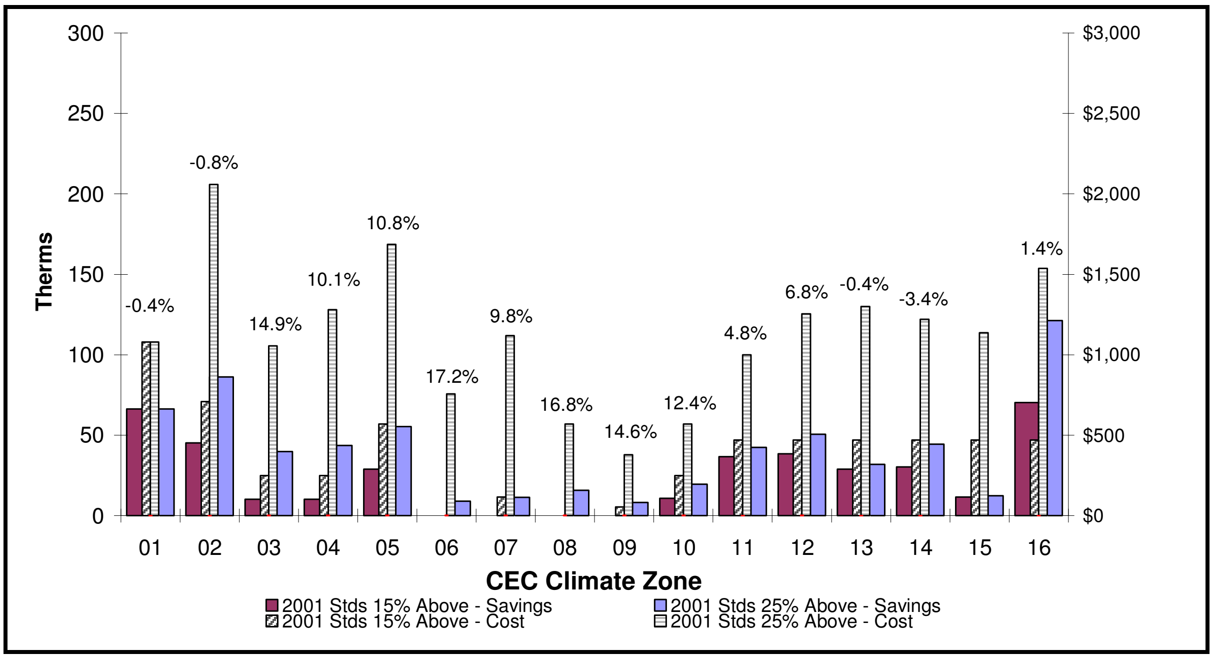
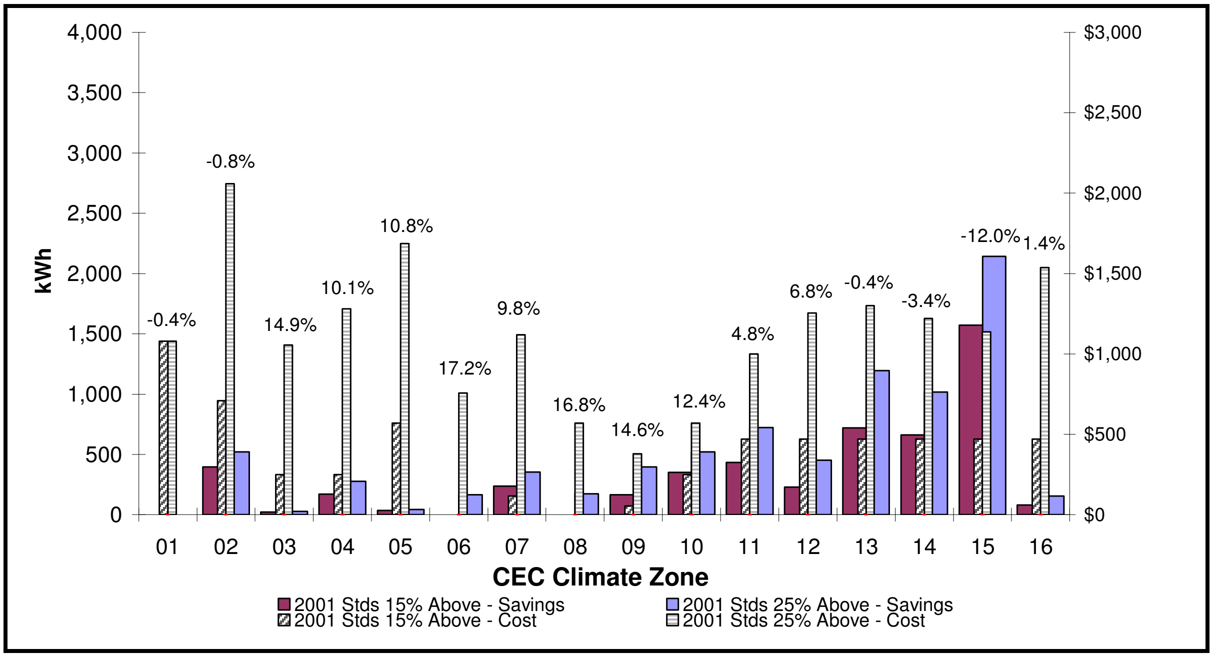


Figure E-11: Electric Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – Single Family Attached Buildings



2005 Standards

The 2005 base buildings were developed in the same way that the single family detached homes were—the least-cost package that caused each prototype to just comply with the 2005 Standards was chosen as the 2005 base case prototype. Table E-19 presents the % compliance margin, the measures installed, and the cost of the package relative to the 2001 base case prototypes. Of the 16 single family attached prototypes, two have the same 2005 base case as the 2001 base case. Both are along the coast, which is not surprising given that the 2005 Standards, like the 2001 Standards, were developed to be more stringent in the inland regions.

Table E-19: 2005 Standards Base Case Prototypes – Single Family Attached Buildings

RER _CZ	CEC_ CZ	Story	FlArea	Package	Base Compliance	Cost Above 01 Baseline	Window Type	Wall	Roof	Insulation Cert	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
1	01	2	8,400	49	-1.3%	$692	2VL	19	49	No	Yes	No	Yes	No	No	13	92%	0.62	No	Yes
1	02	2	8,400	44	2.3%	$417	2VS	19	30	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
1	03	2	8,400	1	1.6%	$0	2VL	19	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
1	04	2	8,400	43	4.4%	$370	2VL	19	30	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
1	05	2	8,400	1	4.1%	$0	2VL	19	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
2	06	2	10,400	3	1.6%	$50	2VC	13	30	No	No	Yes	No	No	No	13	80%	0.62	No	No
2	07	2	10,400	1	4.5%	$117	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.60	No	No
3	08	2	12,936	7	0.9%	$198	2VS	13	38	No	No	Yes	No	No	No	13	80%	0.62	No	No
3	09	2	12,936	44	3.6%	$425	2VS	13	30	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
3	10	2	12,936	55	1.9%	$562	2VL	13	38	No	No	Yes	Yes	No	No	14	80%	0.62	No	Yes
4	11	2	4,551	46	0.1%	$567	2VS	13	38	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
4	12	2	4,551	46	1.4%	$567	2VS	13	38	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
4	13	2	4,551	48	2.6%	$810	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.62	No	Yes
5	14	2	4,200	47	0.5%	$643	2VL	19	38	No	Yes	Yes	Yes	No	No	13	80%	0.62	No	Yes
5	15	2	4,200	47	0.4%	$643	2VL	19	38	No	Yes	Yes	Yes	No	Yes	13	80%	0.62	No	Yes
5	16	2	4,200	43	6.2%	$370	2VL	19	30	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes

Table E-20 and Table E-21 present the measures included in the least-cost package that upgraded each prototype to 10% and 15% above the 2005 Standards, respectively. The tables also present the incremental cost of each package (*Cost*), the compliance margin of the base case prototype (*Base Compliance*), and the compliance margin reached by adding the package to the base case prototype (*Package Compliance*). For convenience, the measures that were upgraded for each prototype to reach its target are highlighted in yellow meaning the measure was added, and green meaning that the base case prototype actually had a higher efficiency version of the measure installed (therefore decreasing the cost).

As shown in Table E-20, three of the base case prototypes were already at least 10% better than the 2005 Standards. Table E-21 provides the same results for the base case homes to reach 15% above the 2005 Standards. While it is possible for each of the prototypes to reach 15% better than the 2005 Standards, the number of high efficiency measures and the cost of those measures varies dramatically between the coast and inland regions. The prototypes in the inland regions need nearly every high efficiency measure in list while some of the coastal prototypes need to install only one or two high efficiency measures.

Table E-20: Least-Cost Package by CEC Climate Zone – 10% Above 2005 Standards – Single Family Attached Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Insulation Certification	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
01	6	8,400	-1.3%	5.6%	$58	2VL	19	49	No	Yes	No	Yes	No	No	13	92%	0.63	Yes	Yes
02	6	8,400	2.3%	10.4%	$871	2VS	19	38	No	Yes	Yes	Yes	No	No	13	92%	0.62	Yes	Yes
03	6	8,400	1.6%	12.5%	$370	2VL	19	30	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
04	6	8,400	4.4%	10.3%	$271	2VS	19	49	No	Yes	Yes	Yes	No	No	13	80%	0.62	No	Yes
05	6	8,400	4.1%	15.1%	$370	2VL	19	30	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
06	6	10,400	1.6%	11.9%	$117	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.62	No	No
07	6	10,400	4.5%	10.2%	$109	2VS	13	30	No	No	Yes	No	No	No	13	80%	0.62	No	No
08	7	12,936	0.9%	10.0%	$512	2VS	13	38	No	Yes	Yes	Yes	No	No	14	80%	0.62	No	Yes
09	7	12,936	3.6%	10.0%	$285	2VS	13	38	No	Yes	Yes	Yes	No	No	14	80%	0.62	No	Yes
10	7	12,936	1.9%	10.9%	$736	2VS	13	49	No	Yes	Yes	Yes	Yes	Yes	14	80%	0.62	No	Yes
11	3	4,551	0.1%	10.4%	$1,165	2VS	13	49	No	Yes	Yes	Yes	No	No	14	92%	0.62	Yes	Yes
12	3	4,551	1.4%	10.3%	$877	2VS	13	49	No	Yes	Yes	Yes	Yes	Yes	14	80%	0.62	No	Yes
13	3	4,551	2.6%	9.0%	$1,095	2VL	13	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
14	4	4,200	0.5%	9.5%	$1,053	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
15	4	4,200	0.4%	7.0%	$578	2VS	19	49	No	Yes	Yes	Yes	Yes	Yes	14	80%	0.62	No	Yes
16	4	4,200	6.2%	10.6%	$210	2VL	19	38	No	Yes	Yes	Yes	No	No	13	80%	0.62	No	Yes

Note: Yellow highlighting indicates a more efficient measure is needed compared to the baseline home and green highlighting indicates a less efficient measure is needed.

Table E-21: Least-Cost Package by CEC Climate Zone – 15% Above 2005 Standards – Single Family Attached Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Insulation Cert	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	SEER	AFUE	EF	Duct Design	Duct Insulation
01	6	8,400	-1.3%	8.4%	$394	2VL	19	49	Yes	Yes	No	Yes	No	Yes	13	92%	0.63	Yes	Yes
02	6	8,400	2.3%	16.3%	$1,269	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
03	6	8,400	1.6%	15.1%	$694	2VL	19	49	No	Yes	Yes	Yes	No	No	14	80%	0.62	No	Yes
04	6	8,400	4.4%	15.4%	$1,103	2VS	19	49	No	Yes	Yes	Yes	No	No	14	92%	0.62	Yes	Yes
05	6	8,400	4.1%	15.1%	$370	2VL	19	30	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
06	6	10,400	1.6%	15.7%	$437	2VL	13	30	No	No	Yes	Yes	No	No	13	80%	0.62	No	Yes
07	6	10,400	4.5%	15.7%	$602	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.62	No	Yes
08	7	12,936	0.9%	18.9%	$1,911	2VS	19	49	No	Yes	Yes	Yes	Yes	Yes	14	92%	0.63	Yes	Yes
09	7	12,936	3.6%	16.6%	$1,403	2VL	19	49	No	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
10	7	12,936	1.9%	15.5%	$1,066	2VL	19	49	No	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
11	3	4,551	0.1%	19.7%	$1,408	2VL	19	49	No	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
12	3	4,551	1.4%	15.7%	$1,338	2VL	13	49	Yes	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
13	3	4,551	2.6%	15.2%	$1,166	2VL	19	49	No	Yes	Yes	Yes	No	Yes	13	92%	0.63	Yes	Yes
14	4	4,200	0.5%	14.2%	$1,635	2VS	19	49	Yes	Yes	Yes	Yes	Yes	Yes	15	92%	0.63	Yes	Yes
15	4	4,200	0.4%	10.4%	$1,635	2VS	19	49	Yes	Yes	Yes	Yes	Yes	Yes	15	92%	0.63	Yes	Yes
16	4	4,200	6.2%	15.6%	$815	2VL	19	38	No	No	Yes	Yes	No	No	13	92%	0.62	Yes	Yes

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Table E-22 and Table E-23 summarize the cost and savings[7] results caused by upgrading the base case home with the least-cost package for each to reach 10% and 15% above the 2005 Standards. As shown, it would cost just $117 to upgrade the base case prototype in CEC Climate Zone 6 from 1.6% to 11.9% and would result in a savings of 132 kWh per year.

Table E-22: Energy Savings and Costs by CEC Climate Zone – 10% Above 2005 Standards – Single Family Attached Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	6	8,400	-1.3%	5.6%	$58	29	0	0
02	6	8,400	2.3%	10.4%	$871	34	60	0
03	6	8,400	1.6%	12.5%	$370	31	7	11
04	6	8,400	4.4%	10.3%	$271	0	114	0
05	6	8,400	4.1%	15.1%	$370	31	3	11
06	6	10,400	1.6%	11.9%	$117	-2	132	0
07	6	10,400	4.5%	10.2%	$109	-5	41	11
08	7	12,936	0.9%	10.0%	$512	13	92	0
09	7	12,936	3.6%	10.0%	$285	2	121	0
10	7	12,936	1.9%	10.9%	$736	13	191	0
11	3	4,551	0.1%	10.4%	$1,165	31	188	0
12	3	4,551	1.4%	10.3%	$877	17	132	0
13	3	4,551	2.6%	9.0%	$1,095	47	-10	0
14	4	4,200	0.5%	9.5%	$1,053	38	87	0
15	4	4,200	0.4%	7.0%	$578	1	318	0
16	4	4,200	6.2%	10.6%	$210	15	42	0

7 The method of estimating the compliance and energy savings from exceeding the 2005 Standards was calculated differently than it was under the 2001 Standards. The 2005 Standards use TDV for calculating compliance. However, since the TDV calculations weight the energy used across hours differently, it is not correct to use the TDV budgets to calculate energy savings. Therefore, the TDV budgets are used to determine the percent compliance margins but the source energy budgets are used to calculate energy savings. Under the 2001 Standards, the source energy budgets are used to estimate both compliance and energy savings.

Table E-23: Energy Savings and Costs by CEC Climate Zone – 15% Above 2005 Standards – Single Family Attached Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	6	8,400	-1.3%	8.4%	$394	40	0	0
02	6	8,400	2.3%	16.3%	$1,269	73	31	0
03	6	8,400	1.6%	15.1%	$694	36	23	11
04	6	8,400	4.4%	15.4%	$1,103	19	133	0
05	6	8,400	4.1%	15.1%	$370	31	3	11
06	6	10,400	1.6%	15.7%	$437	9	136	0
07	6	10,400	4.5%	15.7%	$602	6	66	11
08	7	12,936	0.9%	18.9%	$1,911	32	154	0
09	7	12,936	3.6%	16.6%	$1,403	31	108	0
10	7	12,936	1.9%	15.5%	$1,066	43	164	0
11	3	4,551	0.1%	19.7%	$1,408	87	214	0
12	3	4,551	1.4%	15.7%	$1,338	73	28	0
13	3	4,551	2.6%	15.2%	$1,166	62	144	0
14	4	4,200	0.5%	14.2%	$1,635	34	258	0
15	4	4,200	0.4%	10.4%	$1,635	4	466	0
16	4	4,200	6.2%	15.6%	$815	51	21	0

Figure E-12 and Figure E-13 illustrate the data presented in the tables above by end use, number of stories, and CEC climate zone. The solid bars illustrate the therms/kWh savings and the thinner striped bars illustrate the total cost of the package. Since many measures lead to both space heating and cooling savings, it is impossible to separate the costs associated with the energy savings by end use. The text above the bars is the % compliance margin of the base case prototype.

Figure E-12: Gas Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – Single Family Attached Buildings

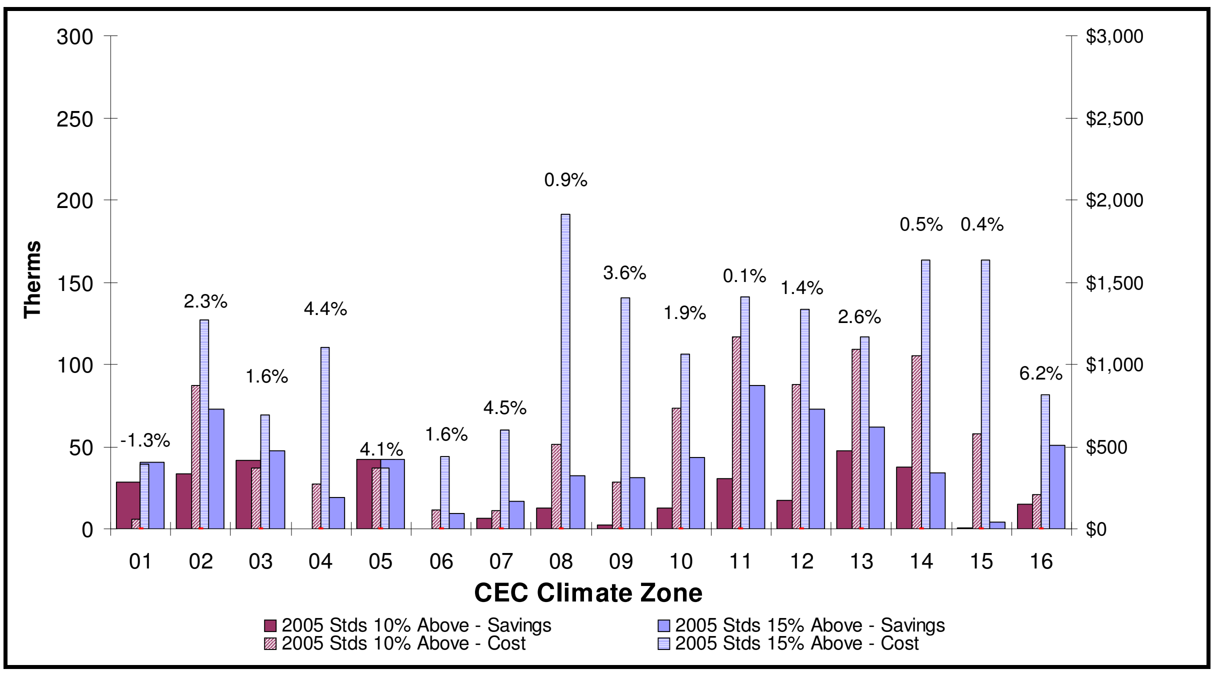
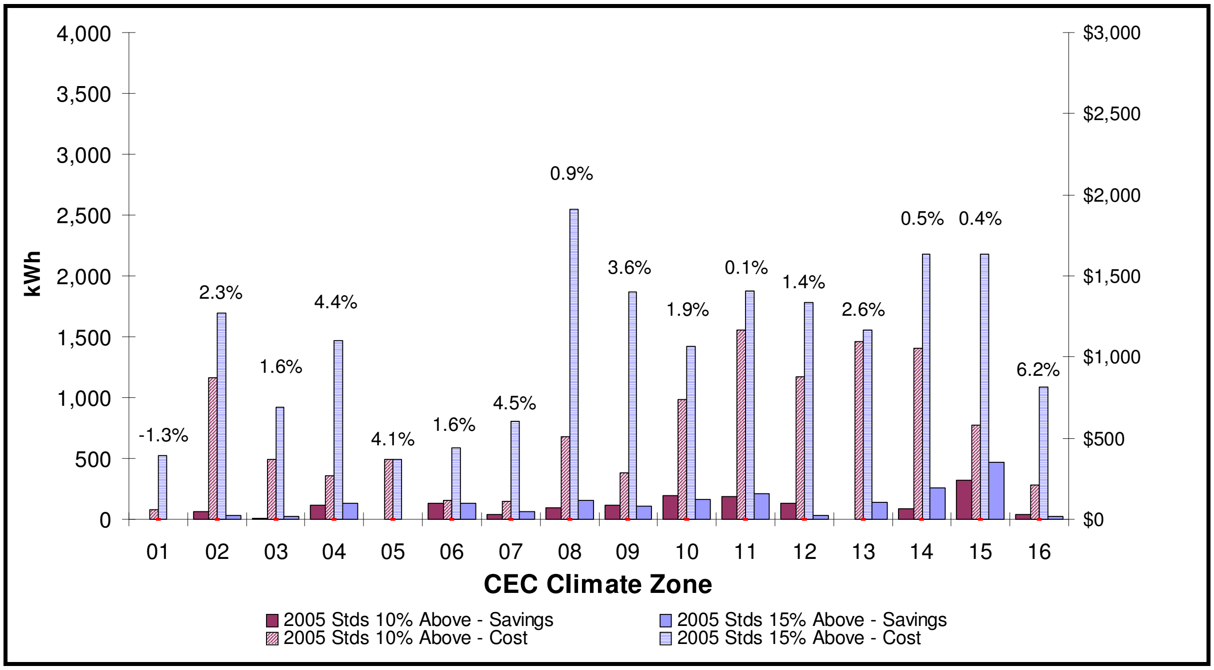


Figure E-13: Electric Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – Single Family Attached Buildings



E.4 Low-Rise Multifamily Buildings

A multifamily building is defined as a building with dwelling units that have adjoining floors and/or ceilings and possibly adjoining walls.

Base Case Prototypes

The first step was to develop a base case two-story and three-story building for each RMST climate zone. These Base case (prototype) buildings were developed by first finding buildings that matched closely the baseline average building shell characteristics (such as floor area and glazing area) of each CEC climate zone found during the 2001 RNC Baseline Study. Heating systems differ in multifamily units. Adjustments were then made to the equipment efficiencies based on the project team's expertise, and using the 2001 RNC Baseline Study and the ENERGY STAR New Homes Evaluation conducted in 2004 by RLW.

Table E-24 presents the building characterizes and the compliance margins of the 32 low-rise multifamily prototypes used in the analysis, which were approved by the New Construction Residential Advisory Group on December 3, 2004.

Table E-24: Low-Rise Multifamily Prototypes (base case)

2-Story	CEC CZ 1	CEC CZ 2	CEC CZ 3	CEC CZ 4	CEC CZ 5	CEC CZ 6	CEC CZ 7	CEC CZ 8	CEC CZ 9	CEC CZ 10	CEC CZ 11	CEC CZ 12	CEC CZ 13	CEC CZ 14	CEC CZ 15	CEC CZ 16
Sq Ft	10,800	10,800	10,800	10,800	10,800	12,000	12,000	8,400	8,400	8,400	13,936	13,936	13,936	13,936	13,936	13,936
# Stories	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
# of Units	12	12	12	12	12	8	8	8	8	8	12	12	12	12	12	12
Glazing % Area	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Glazing Area	1,080	1,080	1,080	1,080	1,080	1,200	1,200	840	840	840	1,394	1,394	1,394	1,394	1,394	1,394
Type of Window	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC
Glazing U-factor	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Glazing SHGC	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Wall Area	9,240	9,240	9,240	9,240	9,240	7,480	7,480	5,720	5,720	5,720	8,184	8,184	8,184	8,184	8,184	8,184
Wall	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Roof Area	5,400	5,400	5,400	5,400	5,400	6,000	6,000	4,200	4,200	4,200	6,968	6,968	6,968	6,968	6,968	6,968
Roof	30	30	30	30	30	19	19	19	19	19	19	19	19	30	30	30
Radiant Barrier	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TXV	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Tight Ducts	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Infiltration Testing	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct Design	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct R-value	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
EER/SEER	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	12.0	12.0	12.0
Heating Type	Hydro	Hydro	Hydro	Hydro	Hydro	Heat Pump	Heat Pump	Hydro	Hydro	Hydro	Hydro	Hydro	Hydro	Hydro	Hydro	Hydro
Heating Efficiency	0.75	0.75	0.75	0.75	0.75	7.0	7.0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
WH Type	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Storage	Indiv Storage	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Combo	Indiv Combo
Distrib Type	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std
WH Efficiency	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.62	0.62	0.62	0.62	0.62	0.62
Standard	33.05	41.01	30.78	35.82	31.69	20.31	19.40	27.65	30.44	35.14	36.90	34.45	38.05	41.49	50.50	46.63
Margin	1.40	2.42	6.18	5.12	4.96	3.68	2.05	3.60	3.09	1.69	-2.46	-1.31	-4.16	-1.40	-5.74	-0.37
% Compliance Margin	4.2%	5.9%	20.1%	14.3%	15.7%	18.1%	10.6%	13.0%	10.2%	4.8%	-6.7%	-3.8%	-10.9%	-3.4%	-11.4%	-0.8%

Table E-24 (cont'd): Low-Rise Multifamily Prototypes (base case)

3-Story	**CEC CZ 1**	**CEC CZ 2**	**CEC CZ 3**	**CEC CZ 4**	**CEC CZ 5**	**CEC CZ 6**	**CEC CZ 7**	**CEC CZ 8**	**CEC CZ 9**	**CEC CZ 10**	**CEC CZ 11**	**CEC CZ 12**	**CEC CZ 13**	**CEC CZ 14**	**CEC CZ 15**	**CEC CZ 16**
Sq Ft	21,000	21,000	21,000	21,000	21,000	21,528	21,528	75,000	75,000	75,000	22,800	22,800	22,800	22,800	22,800	22,800
# Stories	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
# of Units	20	20	20	20	20	17	17	62	62	62	24	24	24	24	24	24
Glazing % Area	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%
Glazing Area	1,890	1,890	1,890	1,890	1,890	1,938	1,938	6,750	6,750	6,750	2,052	2,052	2,052	2,052	2,052	2,052
Type of Window	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC	2VC
Glazing U-factor	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Glazing SHGC	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Wall Area	11,220	11,220	11,220	11,220	11,220	13,680	13,680	39,744	39,744	39,744	14,700	14,700	14,700	14,700	14,700	14,700
Wall	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Roof Area	7,000	7,000	7,000	7,000	7,000	7,176	7,176	24,000	24,000	24,000	7,600	7,600	7,600	7,600	7,600	7,600
Roof	19	19	19	19	19	19	19	19	19	19	19	19	19	30	30	30
Radiant Barrier	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TXV	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Tight Ducts	N/A	N/A	N/A	N/A	N/A	No	No	N/A	N/A	N/A	No	No	No	No	No	No
Infiltration Testing	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Duct Design	N/A	N/A	N/A	N/A	N/A	No	No	N/A	N/A	N/A	No	No	No	No	No	No
Duct R-value	N/A	N/A	N/A	N/A	N/A	4.2	4.2	N/A	N/A	N/A	4.2	4.2	4.2	4.2	4.2	4.2
EER/SEER	8.8	8.8	8.8	8.8	8.8	10.0	10.0	8.5	8.5	8.5	10.0	10.0	10.0	10.0	12.0	10.0
Heating Type	Electric	Electric	Electric	Electric	Electric	Hydro	Hydro	Room Heat	Room Heat	Room Heat	Heat Pump	Heat Pump	Heat Pump	Heat Pump	Heat Pump	Heat Pump
Heating Efficiency	3.4	3.4	3.4	3.4	3.4	0.75	0.75	6.8	6.8	6.8	7.0	7.0	7.0	7.0	7.0	7.0
WH Type	Central Storage	Central Storage	Central Storage	Central Storage	Central Storage	Indiv Combo	Indiv Combo	Central Storage	Central Storage	Central Storage	Central Storage	Central Storage	Central Storage	Central Storage	Central Storage	Central Storage
Distrib Type	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Std	Std	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp	Recirc/ Temp
WH Efficiency	0.76	0.76	0.76	0.76	0.76	0.60	0.60	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Standard	31.31	38.01	28.08	32.97	29.05	22.21	21.10	26.67	29.38	33.89	42.17	39.44	42.78	46.99	55.44	54.75
Margin	3.83	6.56	10.00	10.24	8.70	4.77	3.17	8.43	8.90	10.36	3.32	4.33	1.45	1.24	0.62	5.70
% Compliance Margin	12.2%	17.3%	35.6%	31.1%	29.9%	21.5%	15.0%	31.6%	30.3%	30.6%	7.9%	11.0%	3.4%	2.6%	1.1%	10.4%

Incremental Costs

Table E-25 presents the incremental cost for each measure included in the analysis. These costs were developed in the same manner as the incremental costs for the high efficiency measures installed in single family homes. The final incremental costs below were approved by the New Construction Residential Advisory Group on October 8, 2004. As with the single family buildings, the costs of the air conditioning units changed in 2006 to accommodate the changes in the federal standards.

Table E-25: Summary of Proposed Incremental Measure Costs – Low-Rise Multifamily Buildings

Measure	Efficiency	Total Cost	
Air Conditioner	12 SEER	$200/N/A	per AC Unit
	14 SEER	$400/$200	per AC Unit
Room Air Conditioner	9.8	$50/N/A	per AC Unit
	10.8	$200/$100	per AC Unit
Central Heat Pump Cooling	12 SEER	$300/N/A	per HP Units
	14 SEER	$500/$150	per HP Units
Room Heat Pump Cooling	9.5	$50/N/A	per HP Units
	10.5	$200/$100	per HP Units
Storage Water Heater	0.63 EF	$50	per Unit
Central Water Heater	95% AFUE	$1,261	per WH
Radiant Barrier	Yes	$0.12	Per Sq. Ft.
Roof Insulation	R-38	$0.08	Per Sq. Ft.
	R-49	$0.20	Per Sq. Ft.
Wall Insulation	R-19	$0.06	Per Sq. Ft.
Windows	2-Pane Vinyl Low-E	$0.50	Per Sq. Ft.
	2-Pane Vinyl Spectral Low-E	$0.25	Per Sq. Ft.
Duct Insulation	R-8.0	$150	per House
HERS Certified Sealed Ducts	Yes	$75	per House
ACCA Duct Design	Yes	$75	per House
Infiltration Testing	Yes	$1000	per House
TXV	Yes	$0	per AC Unit

Developing the Packages

After the prototypes were finalized, the prototype buildings were used as the base cases to which the 70 high efficiency packages were added. The least-cost packages that reached a compliance margin of at least 15% and 25% above the 2001 Standards and 10% and 15% above the 2005 Standards were used to calculate energy savings per year for each prototype.

Least-Cost Package Results

Lastly, the savings in therms and watts per year were calculated for the least-cost package of each CEC climate zone. Energy savings per year were derived by subtracting the proposed energy usage of the upgraded unit per year from the base case proposed energy usage per year (for space heating, cooling, and water heating). The following presents the cost and savings for reaching the targets under the 2001 Standards and the 2005 Standards separately. All savings and costs presented are per unit.

2001 Standards

Table E-26 and Table E-27 present the measures included in the least-cost package that upgraded each prototype to 15% and 25% above the 2001 Standards, respectively. The tables also present the incremental cost of each package (*Cost*), the compliance margin of the base case prototype (*Base Compliance*), and the compliance margin reached by adding the package to the base case prototype (*Package Compliance*). For convenience, the measures that were upgraded for each prototype to reach its target are highlighted.

As shown in Table E-26, 12 of the base case prototypes already were at least 15% better than the 2001 Standards. (Note that these prototypes have a $0 cost and their baseline and package compliance margins are equal.) Also shown is that the two-story Base case prototype in CEC Climate Zone 12 had a -3.8% base compliance margin and would have to install several high efficiency measures including dual paned, vinyl, spectral low-E windows, R-30 roof insulation, a 12 SEER hydronic heating system, and a .63 EF water heater. To reach 15% above the 2001 Standards would cost approximately $337 more than building the typical home in this climate zone.

Table E-27 provides the same results for the base case homes to reach 25% above the 2001 Standards. Six of the prototypes, all of them three-story buildings, were at least 25% better than the 2001 Standards. The two-story prototype in CEC Climate Zone 12 would need, in addition to the measures needed to reach 15% above the standard, a radiant barrier, HERS-certified tight ducts, and duct insulation. These measures would cost $1,000 above the prototypical home.

Table E-26: Least Costs Package by CEC Climate Zone – 15% Above 2001 Standards – Low-Rise Multifamily Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	Cooling Eff	Heating Eff	Wh Eff	Duct Design	Duct Insulation
01	12	10,800	4.2%	15.0%	$356	2VL	13	38	No	No	Yes	No	No	10	75%	0.63	No	Yes
02	12	10,800	5.9%	15.2%	$68	2VS	13	30	No	No	No	No	No	10	75%	0.60	No	No
03	12	10,800	20.1%	20.1%	$0	2VC	13	30	No	No	No	No	No	10	75%	0.60	No	No
04	12	10,800	14.3%	21.5%	$45	2VL	13	30	No	No	No	No	No	10	75%	0.60	No	No
05	12	10,800	15.7%	15.7%	$0	2VC	13	30	No	No	No	No	No	10	75%	0.60	No	No
06	8	12,000	18.1%	18.1%	$0	2VC	13	19	No	No	No	No	No	10	7.0	0.60	No	No
07	8	12,000	10.6%	18.1%	$75	2VL	13	19	No	No	No	No	No	10	7.0	0.60	No	No
08	8	8,400	13.0%	19.2%	$53	2VL	13	19	No	No	No	No	No	10	75%	0.60	No	No
09	8	8,400	10.2%	19.5%	$53	2VL	13	19	No	No	No	No	No	10	75%	0.60	No	No
10	8	8,400	4.8%	15.9%	$53	2VL	13	19	No	No	No	No	No	10	75%	0.60	No	No
11	12	13,936	-6.7%	15.1%	$337	2VS	13	19	No	Yes	No	No	No	12	80%	0.63	No	No
12	12	13,936	-3.8%	15.7%	$337	2VS	13	19	No	Yes	No	No	No	12	80%	0.63	No	No
13	12	13,936	-10.9%	17.8%	$355	2VL	13	38	No	Yes	No	No	No	12	80%	0.63	No	No
14	12	13,936	-3.4%	16.1%	$184	2VS	13	38	No	Yes	No	No	No	12	80%	0.63	No	No
15	12	13,936	-11.4%	21.1%	$333	2VL	13	30	No	Yes	Yes	No	No	12	75%	0.63	No	Yes
16	12	13,936	-0.8%	15.1%	$333	2VL	13	30	No	Yes	Yes	No	No	12	75%	0.63	No	Yes
01	20	21,000	12.2%	18.1%	$47	2VL	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
02	20	21,000	17.3%	17.3%	$0	2VC	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
03	20	21,000	35.6%	35.6%	$0	2VC	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
04	20	21,000	31.1%	31.1%	$0	2VC	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
05	20	21,000	29.9%	29.9%	$0	2VC	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
06	17	21,528	21.5%	21.5%	$0	2VC	13	19	No	No	No	No	No	10	75%	0.60	No	No
07	17	21,528	15.0%	15.0%	$0	2VC	13	19	No	No	No	No	No	10	75%	0.60	No	No
08	62	75,000	31.6%	31.6%	$0	2VC	13	19	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
09	62	75,000	30.3%	30.3%	$0	2VC	13	19	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
10	62	75,000	30.6%	30.6%	$0	2VC	13	19	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
11	24	22,800	7.9%	18.2%	$43	2VL	13	19	No	No	No	No	No	10	7.0	0.76	No	No
12	24	22,800	11.0%	20.8%	$43	2VL	13	19	No	No	No	No	No	10	7.0	0.76	No	No
13	24	22,800	3.4%	15.7%	$64	2VS	13	19	No	No	No	No	No	10	7.0	0.76	No	No
14	24	22,800	2.6%	15.0%	$615	2VC	13	30	No	Yes	No	No	No	12	7.5	0.80	No	No
15	24	22,800	1.1%	19.1%	$358	2VL	13	30	No	Yes	No	No	No	12	7.5	0.80	No	No
16	24	22,800	10.4%	16.8%	$615	2VC	13	30	No	Yes	No	No	No	12	7.5	0.80	No	No

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 , are three-story buildings.

Table E-27: Least-Cost Package by CEC Climate Zone – 25% above 2001 Standards – Low-Rise Multifamily Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	Cooling Eff	Heating Eff	Wh Eff	Duct Design	Duct Insulation
01	12	10,800	4.2%	26.4%	$1,608	2VS	19	49	Yes	No	Yes	Yes	No	10	80%	0.63	Yes	Yes
02	12	10,800	5.9%	25.3%	$556	2VL	13	38	No	Yes	Yes	No	No	12	75%	0.63	No	Yes
03	12	10,800	20.1%	26.8%	$295	2VL	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
04	12	10,800	14.3%	27.4%	$295	2VL	13	30	No	Yes	No	No	No	12	80%	0.63	No	No
05	12	10,800	15.7%	25.2%	$520	2VL	13	30	No	Yes	Yes	No	No	12	75%	0.63	No	Yes
06	8	12,000	18.1%	25.4%	$425	2VL	13	19	No	Yes	No	No	No	12	7.5	0.63	No	No
07	8	12,000	10.6%	25.2%	$485	2VL	13	38	No	Yes	No	No	No	12	7.5	0.63	No	No
08	8	8,400	13.0%	25.5%	$303	2VL	13	19	No	Yes	No	No	No	12	80%	0.63	No	No
09	8	8,400	10.2%	26.8%	$303	2VL	13	19	No	Yes	No	No	No	12	80%	0.63	No	No
10	8	8,400	4.8%	25.8%	$329	2VS	13	19	No	Yes	No	No	No	12	80%	0.63	No	No
11	12	13,936	-6.7%	25.3%	$655	2VL	13	38	No	Yes	Yes	No	No	12	80%	0.63	Yes	Yes
12	12	13,936	-3.8%	25.2%	$678	2VS	13	38	Yes	Yes	Yes	No	No	12	75%	0.63	No	Yes
13	12	13,936	-10.9%	25.7%	$678	2VS	13	38	Yes	Yes	Yes	No	No	12	75%	0.63	No	Yes
14	12	13,936	-3.4%	25.1%	$524	2VL	13	38	Yes	Yes	Yes	No	No	12	80%	0.63	Yes	Yes
15	12	13,936	-11.4%	26.3%	$478	2VS	13	38	Yes	Yes	Yes	No	No	12	75%	0.63	No	Yes
16	12	13,936	-0.8%	25.4%	$1,519	2VL	13	49	Yes	Yes	Yes	Yes	Yes	12	75%	0.63	No	Yes
01	20	21,000	12.2%	28.3%	$1,500	2VL	13	49	Yes	No	N/A	No	Yes	8.8	3.4	0.80	N/A	N/A
02	20	21,000	17.3%	27.2%	$47	2VL	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
03	20	21,000	35.6%	35.6%	$0	2VC	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
04	20	21,000	31.1%	31.1%	$0	2VC	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
05	20	21,000	29.9%	29.9%	$0	2VC	13	19	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
06	17	21,528	21.5%	26.3%	$250	2VC	13	19	No	Yes	No	No	No	12	80%	0.63	No	No
07	17	21,528	15.0%	25.1%	$541	2VL	13	38	No	Yes	No	No	No	14	80%	0.63	No	No
08	62	75,000	31.6%	31.6%	$0	2VC	13	19	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
09	62	75,000	30.3%	30.3%	$0	2VC	13	19	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
10	62	75,000	30.6%	30.6%	$0	2VC	13	19	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
11	24	22,800	7.9%	27.0%	$658	2VL	13	19	No	Yes	No	No	No	12	7.5	0.80	No	No
12	24	22,800	11.0%	28.2%	$658	2VL	13	19	No	Yes	No	No	No	12	7.5	0.80	No	No
13	24	22,800	3.4%	25.1%	$658	2VL	13	19	No	Yes	No	No	No	12	7.5	0.80	No	No
14	24	22,800	2.6%	25.5%	$705	2VS	13	38	No	Yes	No	No	No	12	7.5	0.80	No	No
15	24	22,800	1.1%	29.9%	$583	2VL	13	30	No	Yes	Yes	No	No	12	7.0	0.80	No	Yes
16	24	22,800	10.4%	25.9%	$883	2VL	13	30	No	Yes	Yes	No	No	12	7.0	0.80	No	Yes

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 prototypes are three-story buildings.

Table E-28 and Table E-29 summarize the cost and savings resulting from upgrading the base case homes with the least-cost package to reach 15% and 25% above the 2001 standards. As shown, it would cost approximately $903 to upgrade the two-story base case prototype in CEC Climate Zone 14 from -3.4% to 16.1%, resulting in a savings of 11 therms and 806 kWh per unit per year.

Table E-28: Energy Savings and Costs by CEC Climate Zone – 15% above 2001 Standards – Low-Rise Multifamily Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms or *kWh*)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	12	10,800	4.2%	15.0%	$356	22	0	10
02	12	10,800	5.9%	15.2%	$68	3	304	0
03	12	10,800	20.1%	20.1%	$0	0	0	0
04	12	10,800	14.3%	21.5%	$45	3	194	0
05	12	10,800	15.7%	15.7%	$0	0	0	0
06	8	12,000	18.1%	18.1%	$0	*0*	0	0
07	8	12,000	10.6%	18.1%	$75	*-1*	216	0
08	8	8,400	13.0%	19.2%	$53	0	179	0
09	8	8,400	10.2%	19.5%	$53	1	282	0
10	8	8,400	4.8%	15.9%	$53	1	389	0
11	12	13,936	-6.7%	15.1%	$337	5	829	3
12	12	13,936	-3.8%	15.7%	$337	7	668	3
13	12	13,936	-10.9%	17.8%	$355	12	1,090	3
14	12	13,936	-3.4%	16.1%	$184	8	806	3
15	12	13,936	-11.4%	21.1%	$333	1	1,821	3
16	12	13,936	-0.8%	15.1%	$333	66	161	3
01	20	21,000	12.2%	18.1%	$47	*190*	0	0
02	20	21,000	17.3%	17.3%	$0	*0*	0	0
03	20	21,000	35.6%	35.6%	$0	*0*	0	0
04	20	21,000	31.1%	31.1%	$0	*0*	0	0
05	20	21,000	29.9%	29.9%	$0	*0*	0	0
06	17	21,528	21.5%	21.5%	$0	0	0	0
07	17	21,528	15.0%	15.0%	$0	0	0	0
08	62	75,000	31.6%	31.6%	$0	*0*	0	0
09	62	75,000	30.3%	30.3%	$0	*0*	0	0
10	62	75,000	30.6%	30.6%	$0	*0*	0	0
11	24	22,800	7.9%	18.2%	$43	*29*	376	0
12	24	22,800	11.0%	20.8%	$43	*30*	330	0
13	24	22,800	3.4%	15.7%	$64	*-3*	491	0
14	24	22,800	2.6%	15.0%	$615	*66*	408	7
15	24	22,800	1.1%	19.1%	$358	*22*	836	7
16	24	22,800	10.4%	16.8%	$615	*59*	199	7

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 prototypes are three-story buildings.

Table E-29: Energy Savings and Costs by CEC Climate Zone – 25% above 2001 Standards – Low-Rise Multifamily Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms or *kWh*)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	12	10,800	4.2%	26.4%	$1,608	56	0	10
02	12	10,800	5.9%	25.3%	$556	21	398	10
03	12	10,800	20.1%	26.8%	$295	3	57	10
04	12	10,800	14.3%	27.4%	$295	6	261	10
05	12	10,800	15.7%	25.2%	$520	10	72	10
06	8	12,000	18.1%	25.4%	$425	*-53*	167	10
07	8	12,000	10.6%	25.2%	$485	*31*	284	10
08	8	8,400	13.0%	25.5%	$303	1	250	10
09	8	8,400	10.2%	26.8%	$303	2	403	10
10	8	8,400	4.8%	25.8%	$329	1	655	10
11	12	13,936	-6.7%	25.3%	$655	29	1,019	3
12	12	13,936	-3.8%	25.2%	$678	24	866	3
13	12	13,936	-10.9%	25.7%	$678	14	1,410	3
14	12	13,936	-3.4%	25.1%	$524	28	1,035	3
15	12	13,936	-11.4%	26.3%	$478	0	2,124	3
16	12	13,936	-0.8%	25.4%	$1,519	119	190	3
01	20	21,000	12.2%	28.3%	$1,500	*448*	0	7
02	20	21,000	17.3%	27.2%	$47	*165*	223	0
03	20	21,000	35.6%	35.6%	$0	*0*	0	0
04	20	21,000	31.1%	31.1%	$0	*0*	0	0
05	20	21,000	29.9%	29.9%	$0	*0*	0	0
06	17	21,528	21.5%	26.3%	$250	1	25	10
07	17	21,528	15.0%	25.1%	$541	-1	170	10
08	62	75,000	31.6%	31.6%	$0	*0*	0	0
09	62	75,000	30.3%	30.3%	$0	*0*	0	0
10	62	75,000	30.6%	30.6%	$0	*0*	0	0
11	24	22,800	7.9%	27.0%	$658	*85*	598	7
12	24	22,800	11.0%	28.2%	$658	*90*	474	7
13	24	22,800	3.4%	25.1%	$658	*60*	736	7
14	24	22,800	2.6%	25.5%	$705	*76*	855	7
15	24	22,800	1.1%	29.9%	$583	*14*	1,399	7
16	24	22,800	10.4%	25.9%	$883	*467*	252	7

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 prototypes are three-story buildings.

Figure E-14 and Figure E-15 illustrate the data presented in the previous tables by CEC climate zone and end use. The solid bars represent the therms/kWh savings and the thinner striped bars illustrate the total cost of the package. Since many measures lead to both space heating and cooling savings, it is impossible to separate the costs associated with the energy savings by end-use. The text above the bars is the % compliance margin of the base case prototype.

Figure E-14: Gas Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – Two-Story Low-Rise Multifamily Buildings

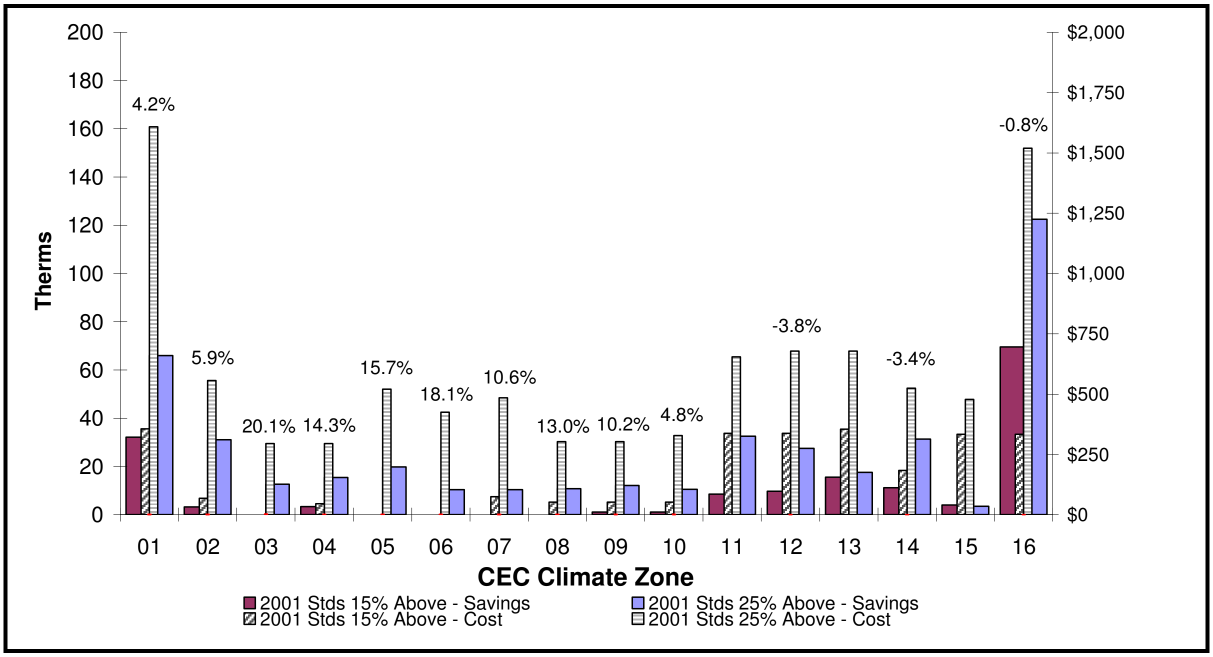


Figure E-15: Electric Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – Two-Story Low-Rise Multifamily Buildings

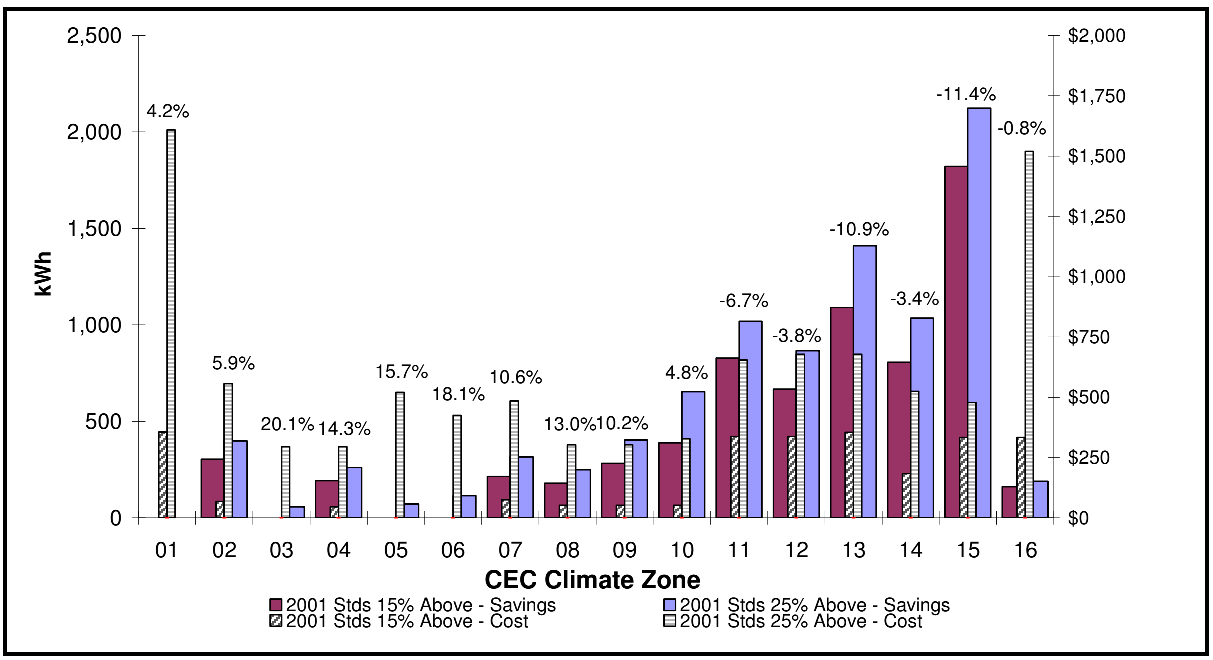


Figure E-16: Gas Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – Three-Story Low-Rise Multifamily Buildings

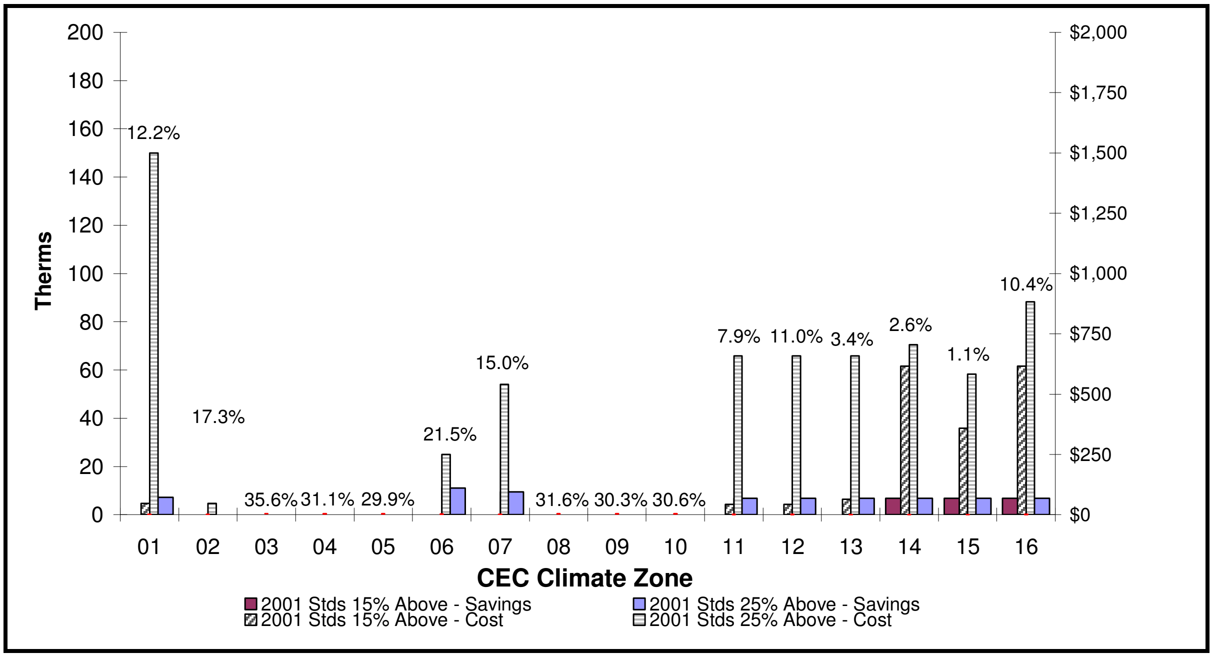
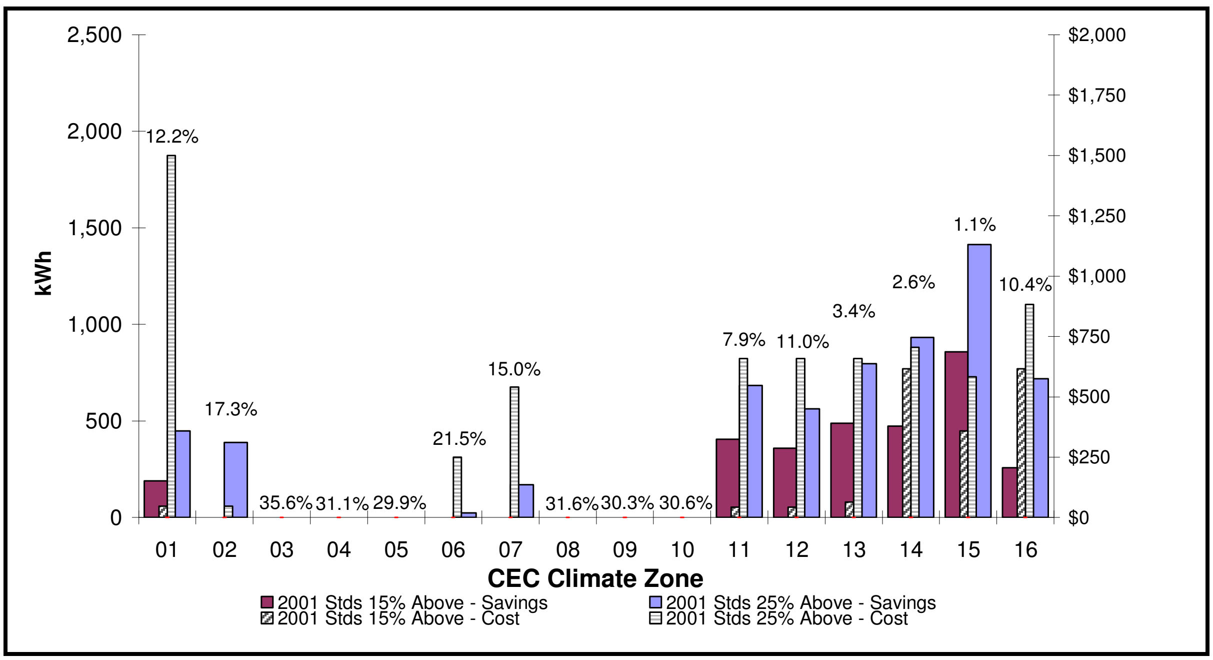


Figure E-17: Electric Savings of Least-Cost Package by CEC Climate Zone – 2001 Standards – Three-Story Low-Rise Multifamily Buildings



2005 Standards

The 2005 base multifamily buildings were developed in the same way that the single family homes were. The least-cost package that caused each prototype to just comply with the 2005

Standards was chosen as the 2005 base case prototype. Table E-30 presents the percent compliance margin, the measures installed, and the cost of the package relative to the 2001 base case prototypes. Several of the coastal prototypes were able to comply with 2005 Standards with only one additional measure, such as low-E or spectral low-E windows, resulting in low costs above the 2001 baseline.

Table E-30: 2005 Standards Base Case Prototypes – Low-Rise Multifamily Building

CEC_ CZ	Story	FlArea	Base Compliance	Cost Above 01 Baseline	Window Type	Wall	Roof	Insulation Cert	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	Cooling Eff	Heating Eff	Wh Eff	Duct Design	Duct Insulation
01	2	10,800	0.1%	$302	2VL	13	49	No	Yes	No	No	No	No	13	80%	0.63	No	No
02	2	10,800	1.0%	$118	2VS	13	30	No	No	Yes	No	No	No	13	80%	0.63	No	No
03	2	10,800	7.2%	$45	2VL	13	30	No	No	Yes	No	No	No	13	75%	0.60	No	No
04	2	10,800	1.3%	$68	2VS	13	30	No	No	Yes	No	No	No	13	75%	0.60	No	No
05	2	10,800	8.3%	$45	2VL	13	30	No	No	Yes	No	No	No	13	75%	0.60	No	No
06	2	12,000	0.1%	$125	2VL	13	19	No	No	Yes	No	No	No	13	7.0	0.63	No	No
07	2	12,000	0.4%	$113	2VS	13	19	No	No	Yes	No	No	No	13	7.0	0.60	No	No
08	2	8,400	1.1%	$129	2VS	13	19	No	No	Yes	No	No	No	13	75%	0.63	No	No
09	2	8,400	0.3%	$155	2VL	13	38	No	No	Yes	No	No	No	13	75%	0.63	No	No
10	2	8,400	0.2%	$155	2VL	13	38	No	No	Yes	No	No	No	13	80%	0.63	No	No
11	2	13,936	1.0%	$391	2VL	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
12	2	13,936	1.2%	$420	2VS	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
13	2	13,936	2.2%	$391	2VL	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
14	2	13,936	1.7%	$420	2VS	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
15	2	13,936	3.4%	$437	2VS	13	30	No	No	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
16	2	13,936	2.1%	$333	2VL	13	30	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
01	3	21,000	-17.1%	$0	2VC	13	19	No	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
02	3	21,000	-0.5%	$386	2VS	13	19	No	No	No	N/A	No	No	9.7	3.4	0.80	N/A	N/A
03	3	21,000	6.8%	$47	2VL	13	19	No	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
04	3	21,000	2.5%	$47	2VL	13	19	No	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
05	3	21,000	-0.5%	$47	2VL	13	19	No	No	No	N/A	No	No	8.8	3.4	0.76	N/A	N/A
06	3	21,528	0.5%	$50	2VC	13	19	No	No	Yes	No	No	No	13	75%	0.63	No	No
07	3	21,528	3.1%	$57	2VL	13	19	No	No	Yes	No	No	No	13	75%	0.60	No	No
08	3	75,000	3.8%	$54	2VL	13	19	No	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
09	3	75,000	5.9%	$54	2VL	13	19	No	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
10	3	75,000	11.4%	$54	2VL	13	19	No	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
11	3	22,800	-0.8%	$711	2VS	13	38	No	No	Yes	Yes	No	No	13	7.5	0.80	Yes	Yes
12	3	22,800	-1.1%	$804	2VL	13	49	Yes	Yes	Yes	Yes	No	No	15	7.5	0.80	Yes	Yes
13	3	22,800	-0.5%	$687	2VS	13	38	No	Yes	Yes	Yes	No	No	13	7.0	0.80	No	Yes
14	3	22,800	0.0%	$762	2VS	13	38	No	Yes	Yes	Yes	No	No	13	7.5	0.80	Yes	Yes
15	3	22,800	0.4%	$711	2VS	13	38	No	No	Yes	Yes	No	No	13	7.5	0.80	Yes	Yes
16	3	22,800	4.7%	$804	2VL	13	49	Yes	Yes	Yes	Yes	No	No	15	7.5	0.80	Yes	Yes

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 prototypes are three-story buildings.

Table E-31 and Table E-32 present the measures included in the least-cost package that upgraded each prototype to 10% and 15% above the 2005 Standards, respectively. The tables also present the incremental cost of each package (*Cost*), the compliance margin of the base case prototype (*Base Compliance*), and the compliance margin reached by adding the package to the base case prototype (*Package Compliance*). For convenience, the measures that were upgraded for each prototype to reach its target are highlighted in yellow meaning the measure was added, and green meaning that the base case prototype actually had a higher efficiency version of the measure installed (therefore decreasing the cost).

As shown in Table E-31, one of the base case prototypes was already at least 10% better than the 2005 Standards. The three-story unit for Climate Zone 1 was not able to reach 10% above compliance given the current packages. The package included in the table is for the second most compliant package. Table E-32 provides the same results for the base case homes to reach 15% above the 2005 Standards. Three of the three-story units were unable to reach 15% above compliance. Each of these has information on the most compliant package.

Table E-31: Least-Cost Package by CEC Climate Zone – 10% Above 2005 Standards – Low-Rise Multifamily Building

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Insulation Cert	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	Cooling Eff	Heating Eff	Wh Eff	Duct Design	Duct Insulation
01	12	10,800	0.1%	12.3%	$325	2VL	13	49	Yes	Yes	No	Yes	No	No	13	80%	0.63	Yes	Yes
02	12	10,800	1.0%	10.4%	$300	2VS	13	30	No	No	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
03	12	10,800	7.2%	12.4%	$50	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.63	No	No
04	12	10,800	1.3%	11.3%	$311	2VS	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
05	12	10,800	8.3%	13.4%	$50	2VL	13	30	No	No	Yes	No	No	No	13	80%	0.63	No	No
06	8	12,000	0.1%	10.7%	$285	2VL	13	38	No	No	Yes	Yes	No	No	13	7.0	0.63	No	Yes
07	8	12,000	0.4%	11.2%	$110	2VS	13	38	No	No	Yes	No	No	No	13	7.5	0.63	No	No
08	8	8,400	1.1%	10.9%	$267	2VS	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
09	8	8,400	0.3%	11.7%	$314	2VS	13	38	No	Yes	Yes	Yes	No	No	13	75%	0.63	No	Yes
10	8	8,400	0.2%	10.8%	$251	2VS	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
11	12	13,936	1.0%	10.1%	$174	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
12	12	13,936	1.2%	12.3%	$510	2VL	13	49	Yes	Yes	Yes	Yes	No	No	15	80%	0.63	Yes	Yes
13	12	13,936	2.2%	12.0%	$174	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
14	12	13,936	1.7%	10.1%	$214	2VS	13	49	No	Yes	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
15	12	13,936	3.4%	10.2%	$386	2VS	13	49	No	Yes	Yes	Yes	No	No	14	80%	0.63	Yes	Yes
16	12	13,936	2.1%	8.9%	$261	2VL	13	49	No	Yes	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
01	20	21,000	-17.1%	-10.6%	$1,000	2VL	13	49	Yes	Yes	No	N/A	No	Yes	8.8	3.4	0.80	N/A	N/A
02	20	21,000	-0.5%	12.3%	$1,077	2VL	19	49	Yes	Yes	Yes	N/A	No	Yes	9.7	3.4	0.80	N/A	N/A
03	20	21,000	6.8%	10.3%	$339	2VS	13	19	No	No	Yes	N/A	No	No	9.7	3.4	0.80	N/A	N/A
04	20	21,000	2.5%	10.7%	$343	2VS	13	38	No	No	Yes	N/A	No	No	9.7	3.4	0.80	N/A	N/A
05	20	21,000	-0.5%	10.5%	$1,137	2VL	13	49	Yes	Yes	Yes	N/A	No	Yes	9.7	3.4	0.80	N/A	N/A
06	17	21,528	0.5%	11.1%	$57	2VL	13	19	No	No	Yes	No	No	No	13	80%	0.63	No	No
07	17	21,528	3.1%	10.3%	$78	2VS	13	19	No	No	Yes	No	No	No	13	80%	0.63	No	No
08	62	75,000	3.8%	14.1%	$342	2VS	13	19	No	No	Yes	N/A	No	No	9.7	7.5	0.80	N/A	N/A
09	62	75,000	5.9%	10.5%	$27	2VS	13	19	No	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
10	62	75,000	11.4%	14.8%	$27	2VS	13	19	No	No	No	N/A	No	No	8.5	6.8	0.76	N/A	N/A
11	24	22,800	-0.8%	11.7%	$1,001	2VS	13	49	No	Yes	Yes	Yes	Yes	Yes	13	7.0	0.80	No	Yes
12	24	22,800	-1.1%	11.3%	$750	2VS	13	49	No	Yes	Yes	Yes	Yes	Yes	13	7.5	0.80	Yes	Yes
13	24	22,800	-0.5%	10.7%	$467	2VL	13	49	Yes	Yes	Yes	Yes	No	No	15	7.5	0.80	Yes	Yes
14	24	22,800	0.0%	11.1%	$1,017	2VL	13	49	No	Yes	Yes	Yes	Yes	Yes	13	7.5	0.80	Yes	Yes
15	24	22,800	0.4%	11.1%	$1,076	2VS	13	49	No	Yes	Yes	Yes	Yes	Yes	13	7.5	0.80	Yes	Yes
16	24	22,800	4.7%	11.8%	$550	2VL	13	49	No	Yes	Yes	Yes	Yes	Yes	13	7.0	0.80	No	Yes

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 prototypes are three-story buildings. Yellow highlighting indicates a more efficient measure is needed compared to the baseline home and green highlighting indicates a less efficient measure is needed.

Table E-32: Least-Cost Package by CEC Climate Zone – 15% Above 2005 Standards – Low-Rise Multifamily Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Window Type	Wall	Roof	Insulation Cert	Radiant Barrier	TXV	Tight Ducts	Infiltration Testing	House Wrap	Cooling Eff	Heating Eff	Wh Eff	Duct Design	Duct Insulation
01	12	10,800	0.1%	15.1%	$1,325	2VL	13	49	Yes	Yes	No	Yes	No	Yes	13	80%	0.63	Yes	Yes
02	12	10,800	1.0%	19.8%	$747	2VL	13	49	Yes	Yes	Yes	Yes	No	No	15	80%	0.63	Yes	Yes
03	12	10,800	7.2%	15.6%	$311	2VL	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
04	12	10,800	1.3%	15.7%	$494	2VS	13	49	No	Yes	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
05	12	10,800	8.3%	15.6%	$275	2VL	13	30	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
06	8	12,000	0.1%	20.6%	$915	2VL	13	49	Yes	Yes	Yes	Yes	No	No	15	7.5	0.63	Yes	Yes
07	8	12,000	0.4%	15.5%	$425	2VS	13	38	No	Yes	Yes	Yes	No	No	13	7.0	0.63	No	Yes
08	8	8,400	1.1%	15.5%	$468	2VS	13	49	No	Yes	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
09	8	8,400	0.3%	15.4%	$452	2VS	13	49	No	Yes	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
10	8	8,400	0.2%	16.6%	$389	2VS	13	38	No	Yes	Yes	Yes	No	No	13	80%	0.63	Yes	Yes
11	12	13,936	1.0%	16.1%	$1,239	2VL	13	49	Yes	Yes	Yes	Yes	No	Yes	13	80%	0.63	Yes	Yes
12	12	13,936	1.2%	18.9%	$1,251	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	80%	0.63	Yes	Yes
13	12	13,936	2.2%	16.0%	$539	2VL	13	49	Yes	Yes	Yes	Yes	No	No	15	80%	0.63	Yes	Yes
14	12	13,936	1.7%	15.2%	$1,214	2VS	13	49	No	Yes	Yes	Yes	Yes	Yes	13	80%	0.63	Yes	Yes
15	12	13,936	3.4%	15.6%	$1,223	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	80%	0.63	Yes	Yes
16	12	13,936	2.1%	16.1%	$586	2VL	13	49	Yes	Yes	Yes	Yes	No	No	15	80%	0.63	Yes	Yes
01	20	21,000	-17.1%	-6.9%	$1,034	2VL	19	49	Yes	Yes	No	N/A	No	Yes	8.8	3.4	0.80	N/A	N/A
02	20	21,000	-0.5%	14.1%	$1,301	2VS	19	49	Yes	Yes	Yes	N/A	Yes	Yes	11.2	3.4	0.80	N/A	N/A
03	20	21,000	6.8%	17.4%	$652	2VL	13	49	Yes	Yes	Yes	N/A	No	No	11.2	3.4	0.80	N/A	N/A
04	20	21,000	2.5%	16.6%	$629	2VL	13	49	Yes	Yes	Yes	N/A	No	No	11.2	3.4	0.80	N/A	N/A
05	20	21,000	-0.5%	12.6%	$1,171	2VL	19	49	Yes	Yes	Yes	N/A	No	Yes	9.7	3.4	0.80	N/A	N/A
06	17	21,528	0.5%	15.0%	$316	2VL	13	38	No	No	Yes	Yes	No	No	13	75%	0.63	No	Yes
07	17	21,528	3.1%	15.2%	$388	2VS	13	38	No	Yes	Yes	Yes	No	No	13	75%	0.63	No	Yes
08	62	75,000	3.8%	15.8%	$346	2VL	13	38	No	No	Yes	N/A	No	No	9.7	7.5	0.80	N/A	N/A
09	62	75,000	5.9%	16.5%	$342	2VS	13	19	No	No	Yes	N/A	No	No	9.7	7.5	0.80	N/A	N/A
10	62	75,000	11.4%	17.5%	$315	2VL	13	19	No	No	Yes	N/A	No	No	9.7	7.5	0.80	N/A	N/A
11	24	22,800	-0.8%	21.0%	$1,116	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	7.5	0.80	Yes	Yes
12	24	22,800	-1.1%	19.0%	$790	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	7.5	0.80	Yes	Yes
13	24	22,800	-0.5%	19.5%	$1,153	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	7.5	0.80	Yes	Yes
14	24	22,800	0.0%	18.8%	$1,078	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	7.5	0.80	Yes	Yes
15	24	22,800	0.4%	17.5%	$1,363	2VS	19	49	No	Yes	Yes	Yes	Yes	Yes	14	7.5	0.80	Yes	Yes
16	24	22,800	4.7%	20.1%	$687	2VL	19	49	Yes	Yes	Yes	Yes	No	Yes	13	7.5	0.80	Yes	Yes

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 prototypes are three-story buildings. Yellow highlighting indicates a more efficient measure is needed compared to the baseline home and green highlighting indicates a less efficient measure is needed.

Table E-33 and Table E-34 summarize the cost and savings[8] results caused by upgrading the base case home with the least-cost package for each to reach 10% and 15% above the 2005 Standards. As shown, it would cost just $57 to upgrade the three-story base case prototype in CEC Climate Zone 6 from 0.5% to 11.1% and would result in a savings of 99 kWh per year. However, installing this package of measures results in the prototype using an additional therm for space heating.

[8] The method of estimating the compliance and energy savings from exceeding the 2005 Standards was calculated differently than it was under the 2001 Standards. The 2005 Standards use TDV for calculating compliance. However, since the TDV calculations weight the energy used across hours differently, it is not correct to use the TDV budgets to calculate energy savings. Therefore, the TDV budgets are used to determine the percent compliance margins but the source energy budgets are used to calculate energy savings. Under the 2001 Standards, the source energy budgets are used to estimate both compliance and savings.

Table E-33: Energy Savings and Costs by CEC Climate Zone – 10% Above 2005 Standards – Low-Rise Multifamily Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms or *kWh*)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	12	10,800	0.1%	12.3%	$325	32	0	0
02	12	10,800	1.0%	10.4%	$300	14	69	0
03	12	10,800	7.2%	12.4%	$50	3	0	11
04	12	10,800	1.3%	11.3%	$311	10	26	10
05	12	10,800	8.3%	13.4%	$50	2	0	10
06	8	12,000	0.1%	10.7%	$285	*148*	40	0
07	8	12,000	0.4%	11.2%	$110	*66*	45	11
08	8	8,400	1.1%	10.9%	$267	5	80	0
09	8	8,400	0.3%	11.7%	$314	1	137	0
10	8	8,400	0.2%	10.8%	$251	1	173	0
11	12	13,936	1.0%	10.1%	$174	3	188	0
12	12	13,936	1.2%	12.3%	$510	25	69	0
13	12	13,936	2.2%	12.0%	$174	1	254	0
14	12	13,936	1.7%	10.1%	$214	8	173	0
15	12	13,936	3.4%	10.2%	$386	1	286	0
16	12	13,936	2.1%	8.9%	$261	25	40	0
01	20	21,000	-17.1%	-10.6%	$1,000	*76*	0	5
02	20	21,000	-0.5%	12.3%	$1,077	*260*	15	5
03	20	21,000	6.8%	10.3%	$339	*-22*	11	5
04	20	21,000	2.5%	10.7%	$343	*30*	36	5
05	20	21,000	-0.5%	10.5%	$1,137	*116*	5	5
06	17	21,528	0.5%	11.1%	$57	-1	99	0
07	17	21,528	3.1%	10.3%	$78	-1	30	11
08	62	75,000	3.8%	14.1%	$342	*-19*	117	5
09	62	75,000	5.9%	10.5%	$27	*-24*	91	0
10	62	75,000	11.4%	14.8%	$27	*-31*	103	0
11	24	22,800	-0.8%	11.7%	$1,001	*371*	20	5
12	24	22,800	-1.1%	11.3%	$750	*300*	4	5
13	24	22,800	-0.5%	10.7%	$467	*195*	104	5
14	24	22,800	0.0%	11.1%	$1,017	*436*	-15	5
15	24	22,800	0.4%	11.1%	$1,076	*85*	242	5
16	24	22,800	4.7%	11.8%	$550	*377*	-16	5

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 prototypes are three-story buildings.

Table E-34: Energy Savings and Costs by CEC Climate Zone – 15% Above 2005 Standards – Low-Rise Multifamily Buildings

CEC_CZ	# Units	FlArea	Base Compliance	Package Compliance	Cost	Space Heat Savings (Therms or *kWh*)	Space Cool Savings (kWh)	DHW Savings (Therms)
01	12	10,800	0.1%	15.1%	$1,325	39	0	0
02	12	10,800	1.0%	19.8%	$747	36	113	0
03	12	10,800	7.2%	15.6%	$311	8	7	11
04	12	10,800	1.3%	15.7%	$494	14	55	10
05	12	10,800	8.3%	15.6%	$275	6	4	10
06	8	12,000	0.1%	20.6%	$915	*311*	65	0
07	8	12,000	0.4%	15.5%	$425	*119*	63	11
08	8	8,400	1.1%	15.5%	$468	7	120	0
09	8	8,400	0.3%	15.4%	$452	3	176	0
10	8	8,400	0.2%	16.6%	$389	2	259	0
11	12	13,936	1.0%	16.1%	$1,239	32	177	0
12	12	13,936	1.2%	18.9%	$1,251	41	96	0
13	12	13,936	2.2%	16.0%	$539	17	278	0
14	12	13,936	1.7%	15.2%	$1,214	27	212	0
15	12	13,936	3.4%	15.6%	$1,223	9	433	0
16	12	13,936	2.1%	16.1%	$586	58	58	0
01	20	21,000	-17.1%	-6.9%	$1,034	*152*	-1	5
02	20	21,000	-0.5%	14.1%	$1,301	*177*	76	5
03	20	21,000	6.8%	17.4%	$652	*92*	15	5
04	20	21,000	2.5%	16.6%	$629	*123*	47	5
05	20	21,000	-0.5%	12.6%	$1,171	*150*	6	5
06	17	21,528	0.5%	15.0%	$316	3	120	0
07	17	21,528	3.1%	15.2%	$388	2	59	11
08	62	75,000	3.8%	15.8%	$346	*30*	106	5
09	62	75,000	5.9%	16.5%	$342	*-22*	153	5
10	62	75,000	11.4%	17.5%	$315	*0*	98	5
11	24	22,800	-0.8%	21.0%	$1,116	*589*	84	5
12	24	22,800	-1.1%	19.0%	$790	*499*	11	5
13	24	22,800	-0.5%	19.5%	$1,153	*419*	148	5
14	24	22,800	0.0%	18.8%	$1,078	*623*	69	5
15	24	22,800	0.4%	17.5%	$1,363	*125*	428	5
16	24	22,800	4.7%	20.1%	$687	*787*	6	5

Note: The first 16 prototypes listed are two-story buildings, while the lower 16 prototypes are three-story buildings.

Figure E-18 to Figure E-19 illustrate the data presented in the tables above by end use, number of stories, and CEC climate zone. The solid bars illustrate the therms/kWh savings and the thinner striped bars illustrate the total cost of the package. Since many measures lead to both space heating and cooling savings, it is impossible to separate the costs associated with the energy savings by end use. The text above the bars is the percent compliance margin of the base case prototype.

Figure E-18: Gas Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – Two-Story Low-Rise Multifamily Buildings

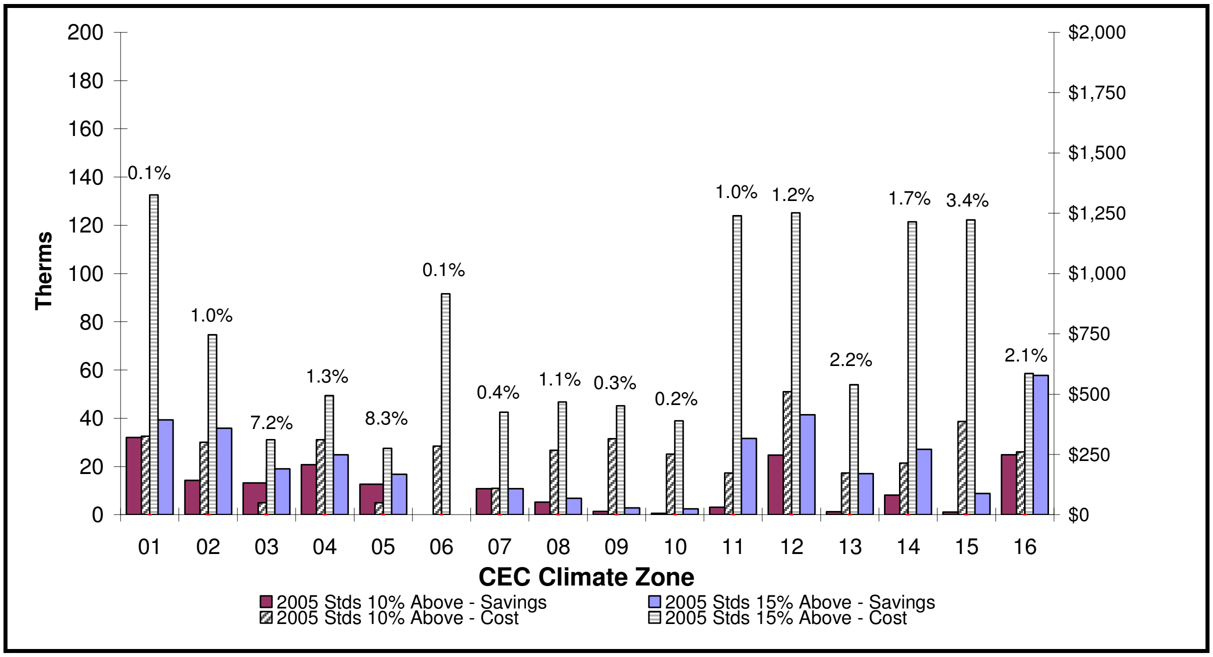


Figure E-19: Electric Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – Two-Story Low-Rise Multifamily Buildings

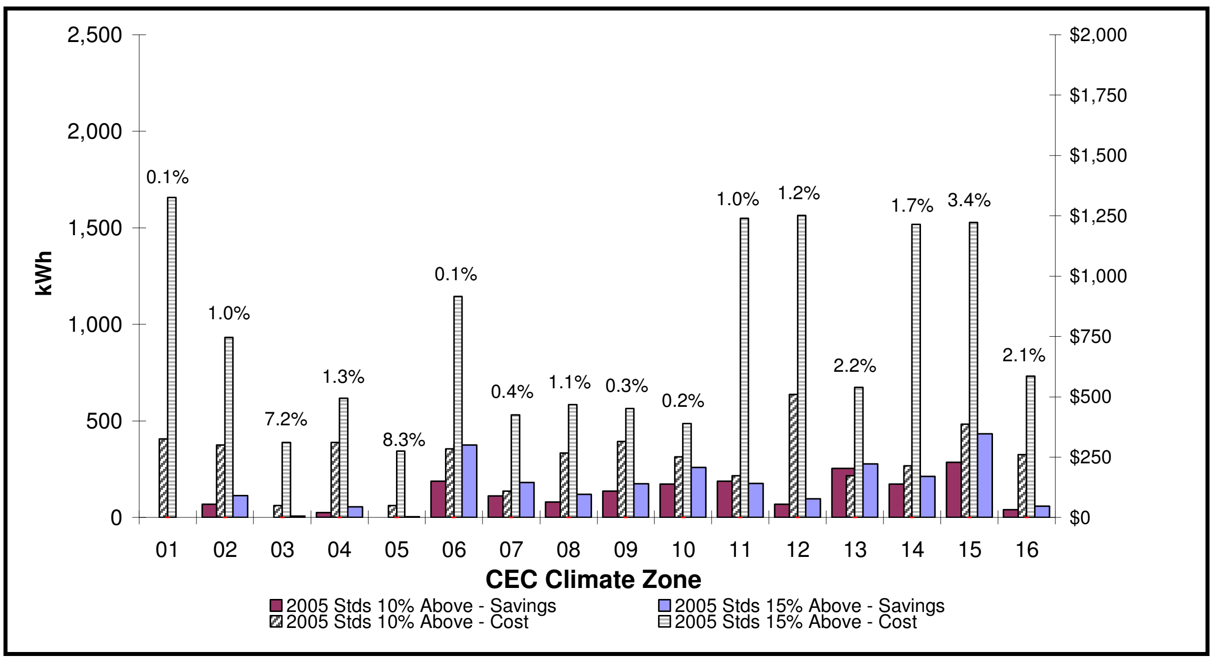


Figure E-20: Gas Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – Three-Story Low-Rise Multifamily Buildings

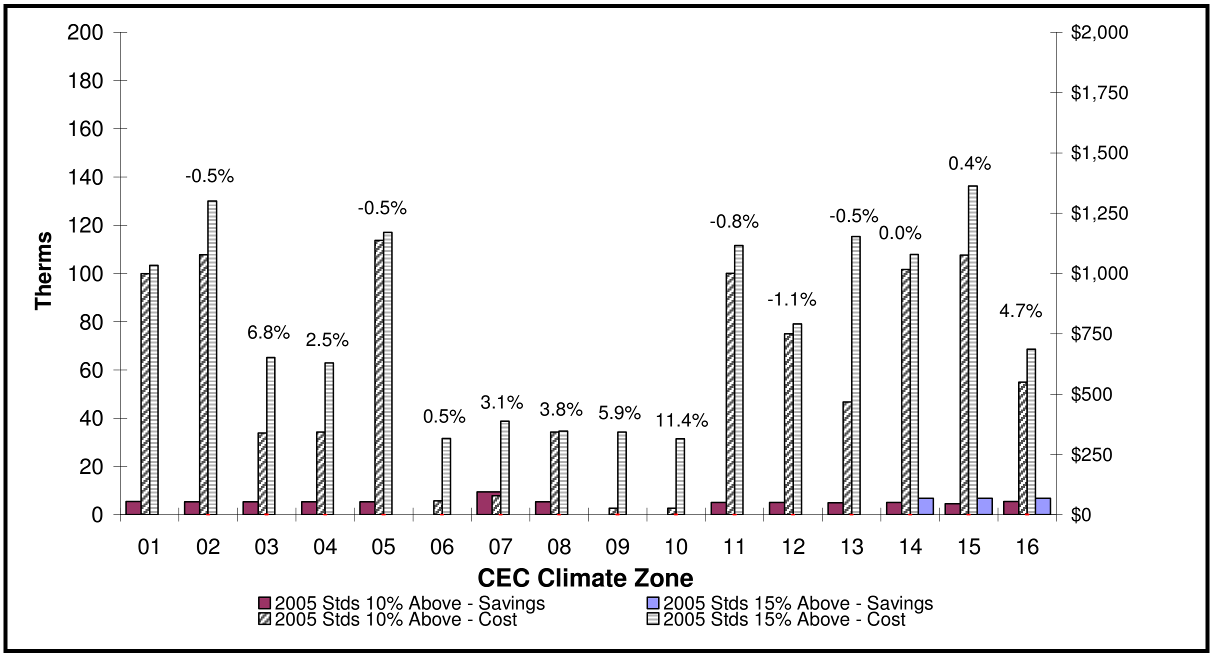
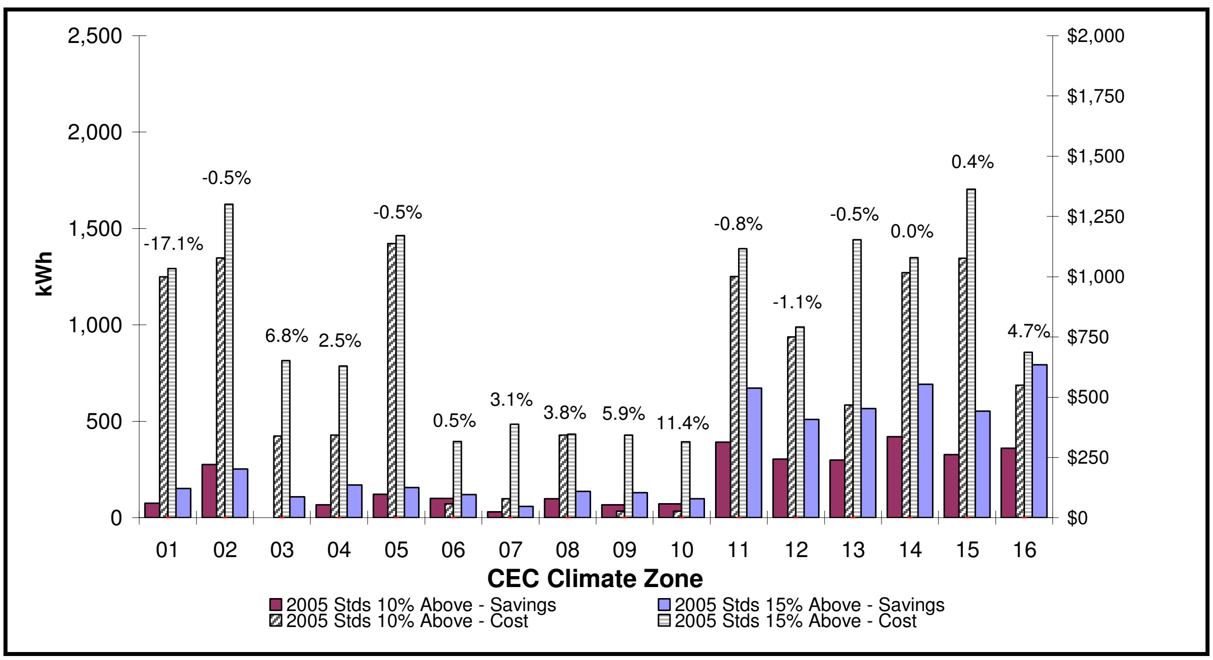


Figure E-21: Electric Savings of Least-Cost Package by CEC Climate Zone – 2005 Standards – Three-Story Low-Rise Multifamily Buildings



E.5 Development of ASSET Residential New Construction Model Inputs

Awareness

The residential new construction analysis used an awareness of 100% for all units built under the 2001 standards. Because of the change in Title 24 Standards in 2005, an awareness of 50% was used starting in 2006 for high efficiency units built under the 2005 standards, which was then increased each year.

Willingness, Feasibility, Technology Density, and Applicability

The willingness, feasibility, and applicability used in the residential new construction analysis are each 100%. These inputs are all 100% because anything is possible in residential new construction. The technology density used was also 1 since the analysis is done by residence.

New Construction Housing Starts

The housing stock by utility, climate zone, and building type is available in Appendix C. The housing stock forecast was provided courtesy of the CEC.

Energy Time-Of-Use Shares and Coincident Peak Factors

The following table lists the energy time-of-use shares associated with each segment for residential new construction units. The energy included in the data below includes the electricity used for central air conditioners, room air conditioners, electric water heaters, and electric space heaters, where applicable.[9] The energy time-of-use shares change by Title 24 climate zone.

[9] Each of the single family and attached single family time-of-use data include only central air conditioners. However, for multifamily dwellings, see Table E-24 for the type of equipment in each of the multifamily prototypes.

Table E-35: Energy Time-Of-Use Shares by Technology and Segment

Technology Name	Segment	Energy Time-Of-Use Share	Changes by
SF1_01_00	1 Story SF	SF1	T24 CZ
SF1_01_15	1 Story SF	SF1	T24 CZ
SF1_01_25	1 Story SF	SF1	T24 CZ
SF1_05_00	1 Story SF	SF1	T24 CZ
SF1_05_10	1 Story SF	SF1	T24 CZ
SF1_05_15	1 Story SF	SF1	T24 CZ
SF2_01_00	2 Story SF	SF2	T24 CZ
SF2_01_15	2 Story SF	SF2	T24 CZ
SF2_01_25	2 Story SF	SF2	T24 CZ
SF2_05_00	2 Story SF	SF2	T24 CZ
SF2_05_10	2 Story SF	SF2	T24 CZ
SF2_05_15	2 Story SF	SF2	T24 CZ
SFA_01_00	SFA	SF1	T24 CZ
SFA_01_15	SFA	SF1	T24 CZ
SFA_01_25	SFA	SF1	T24 CZ
SFA_05_00	SFA	SF1	T24 CZ
SFA_05_10	SFA	SF1	T24 CZ
SFA_05_15	SFA	SF1	T24 CZ
MFLR2_01_00	2 Story MF	MFLR2	T24 CZ
MFLR2_01_15	2 Story MF	MFLR2	T24 CZ
MFLR2_01_25	2 Story MF	MFLR2	T24 CZ
MFLR2_05_00	2 Story MF	MFLR2	T24 CZ
MFLR2_05_10	2 Story MF	MFLR2	T24 CZ
MFLR2_05_15	2 Story MF	MFLR2	T24 CZ
MFLR3_01_00	3 Story MF	MFLR3	T24 CZ
MFLR3_01_15	3 Story MF	MFLR3	T24 CZ
MFLR3_01_25	3 Story MF	MFLR3	T24 CZ
MFLR3_05_00	3 Story MF	MFLR3	T24 CZ
MFLR3_05_10	3 Story MF	MFLR3	T24 CZ
MFLR3_05_15	3 Story MF	MFLR3	T24 CZ

The following table lists the energy time-of-use shares for residential new construction end uses by Title 24 climate zone. The load shapes were determined using *SitePro*. The TOU periods are the same as those given in the previous section of the appendix. The summer peak coincidence factor is also included.

Table E-36: TOU Load Shapes and Summer Peak Factors

Energy Time-Of-Use Share	Region	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak	Summer Peak Factor
MFLR2	T24 CZ 1	0%	0%	0%	0%	0%	0.0
MFLR2	T24 CZ 2	33%	19%	34%	10%	5%	2.5
MFLR2	T24 CZ 3	42%	11%	35%	4%	7%	5.0
MFLR2	T24 CZ 4	41%	17%	33%	5%	4%	2.0
MFLR2	T24 CZ 5	35%	18%	32%	8%	7%	5.0
MFLR2	T24 CZ 6	15%	8%	20%	12%	45%	3.2
MFLR2	T24 CZ 7	21%	11%	20%	9%	39%	2.6
MFLR2	T24 CZ 8	34%	21%	31%	9%	5%	2.1
MFLR2	T24 CZ 9	33%	18%	32%	11%	6%	2.2
MFLR2	T24 CZ 10	27%	20%	35%	12%	6%	1.9
MFLR2	T24 CZ 11	35%	22%	35%	5%	3%	2.0
MFLR2	T24 CZ 12	39%	19%	32%	6%	5%	2.3
MFLR2	T24 CZ 13	29%	22%	37%	8%	3%	1.8
MFLR2	T24 CZ 14	30%	23%	38%	7%	3%	1.8
MFLR2	T24 CZ 15	22%	19%	40%	12%	7%	1.5
MFLR2	T24 CZ 16	44%	21%	32%	2%	1%	2.4
MFLR3	T24 CZ 1	2%	4%	20%	24%	50%	0.0
MFLR3	T24 CZ 2	12%	8%	21%	19%	40%	2.3
MFLR3	T24 CZ 3	4%	2%	16%	21%	57%	5.0
MFLR3	T24 CZ 4	13%	7%	18%	16%	47%	1.9
MFLR3	T24 CZ 5	6%	4%	20%	15%	56%	4.7
MFLR3	T24 CZ 6	37%	21%	33%	5%	4%	3.2
MFLR3	T24 CZ 7	40%	21%	29%	6%	4%	2.7
MFLR3	T24 CZ 8	21%	12%	22%	11%	34%	2.2
MFLR3	T24 CZ 9	21%	12%	25%	11%	31%	2.2
MFLR3	T24 CZ 10	21%	15%	29%	11%	23%	1.9
MFLR3	T24 CZ 11	13%	9%	20%	17%	42%	2.0
MFLR3	T24 CZ 12	14%	7%	17%	18%	44%	2.4
MFLR3	T24 CZ 13	16%	12%	24%	15%	33%	1.8
MFLR3	T24 CZ 14	16%	13%	25%	12%	34%	1.8
MFLR3	T24 CZ 15	18%	16%	35%	11%	19%	1.5
MFLR3	T24 CZ 16	7%	5%	19%	21%	48%	2.4

Table E-36 (cont'd.): TOU Load Shapes and Summer Peak Factors

Energy Time-Of-Use Share	Region	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak	Summer Peak Factor
SF1	T24 CZ 1	13%	11%	39%	8%	29%	0.0
SF1	T24 CZ 2	32%	21%	39%	4%	3%	2.8
SF1	T24 CZ 3	16%	3%	76%	2%	3%	5.0
SF1	T24 CZ 4	45%	17%	36%	0%	2%	2.6
SF1	T24 CZ 5	52%	22%	23%	1%	2%	5.0
SF1	T24 CZ 6	41%	22%	35%	1%	1%	2.8
SF1	T24 CZ 7	44%	24%	30%	0%	1%	2.5
SF1	T24 CZ 8	38%	23%	37%	1%	1%	2.5
SF1	T24 CZ 9	36%	21%	39%	1%	3%	2.6
SF1	T24 CZ 10	29%	22%	41%	5%	3%	2.0
SF1	T24 CZ 11	34%	25%	40%	1%	1%	2.2
SF1	T24 CZ 12	41%	22%	33%	1%	2%	2.8
SF1	T24 CZ 13	28%	24%	42%	4%	2%	1.9
SF1	T24 CZ 14	29%	24%	43%	2%	2%	2.0
SF1	T24 CZ 15	22%	20%	43%	9%	6%	1.4
SF1	T24 CZ 16	43%	22%	34%	0%	0%	4.0
SF2	T24 CZ 1	13%	11%	40%	8%	29%	0.0
SF2	T24 CZ 2	32%	21%	39%	4%	4%	2.8
SF2	T24 CZ 3	20%	2%	72%	1%	4%	5.0
SF2	T24 CZ 4	45%	17%	36%	0%	2%	2.5
SF2	T24 CZ 5	53%	23%	22%	1%	1%	5.0
SF2	T24 CZ 6	40%	20%	40%	0%	0%	4.8
SF2	T24 CZ 7	48%	22%	29%	0%	0%	3.4
SF2	T24 CZ 8	38%	22%	33%	4%	3%	2.3
SF2	T24 CZ 9	35%	19%	34%	7%	5%	2.3
SF2	T24 CZ 10	29%	21%	35%	10%	5%	1.9
SF2	T24 CZ 11	36%	23%	36%	3%	2%	2.2
SF2	T24 CZ 12	41%	20%	32%	4%	4%	2.7
SF2	T24 CZ 13	31%	23%	37%	6%	3%	1.8
SF2	T24 CZ 14	31%	24%	38%	5%	2%	1.9
SF2	T24 CZ 15	23%	20%	41%	11%	6%	1.5
SF2	T24 CZ 16	46%	21%	32%	0%	0%	3.0

Appendix F

Commercial New Construction Methodology and ASSET Inputs

As part of the 2006 New Construction Potential study, Architectural Energy Corporation (AEC) was charged with estimating the potential energy savings from constructing commercial buildings in California that are higher than code (i.e., Savings by Design). The first and most important part of the study was to find the costs and savings for commercial buildings to reach 15% and 25% above the 2001 Standards. This information was then used to create packages of high efficiency measures.

The remainder of this appendix summarizes the prototypes used as the baseline, the incremental measure cost of high efficiency measures, the bundles of measures included in the packages, and the proposed least-cost packages to reach the base and high activity levels presented in Table F-1.

F.1 Objectives

The objectives of the New Construction Potential Study included finding the savings potential for commercial buildings that would approximate the building of Savings by Design buildings under the new standards (reaching 10 and 15% above the 2005 codes), by Title 24 climate zone.[1] Further, unlike the residential new construction analysis, the commercial new construction analysis conducted an individual building analysis on a large sample of buildings rather than defining a set of prototype models from a large sample of buildings. The analysis was conducted for 11 building types: colleges, grocery stores, health care buildings, lodging, large office buildings, retail, restaurants, schools, small office buildings, warehouses, and miscellaneous. The measure bundles were focused primarily on electricity saving measures, and were expanded to include gas measures in building types where gas was a major end use (primarily restaurants). Also unlike the residential analysis, incremental

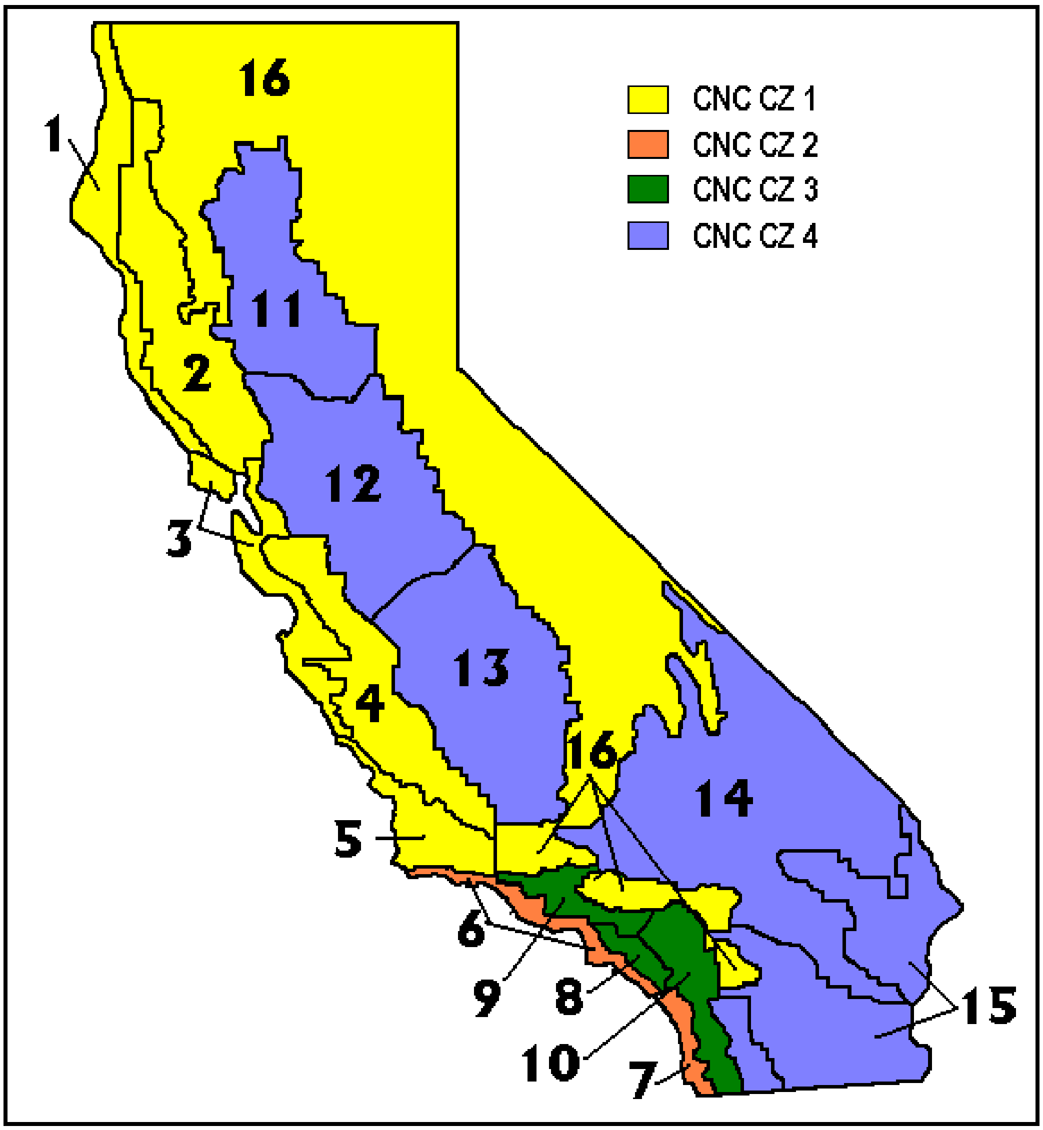
[1] While reviewing this section, please note that when developing the packages of measures, cost-effective measures were added first and then less cost-effective measures where added by building type and by region until each building reached the various levels above the Standards. Since the Standards are fuel neutral and, in general, electric measures are more cost-effective than gas measures, the packages assembled for many building types did not include many, if any, gas measures.

costs and savings were developed by region instead of by California Energy Commission (CEC) climate zones. Specifically, these inputs were developed by building type for each of the four climate regions shown in Figure F-1.

Table F-1: Measure Bundle Efficiency Levels

Scenario	Description	2004-2005 Level of Efficiency	2006-2013 Level of Efficiency
1	Code Level	2001 Code	2005 Code
2	Base Activity Level	2001 Code +15%	2005 Code + 10%
3	High Activity Level	2001 Code + 25%	2005 Code + 15%

Figure F-1: CEC Climate Zones



F.2 Commercial Buildings

Building Sample

The primary building characteristics dataset was the Nonresidential New Construction (NRNC) database. The California Statewide NRNC database is a collection of buildings statistically selected to represent the majority of statewide NRNC activity. The buildings in the database represent the building types considered by the CEC in their nonresidential sector forecasting models with the exception of refrigerated warehouses, which are not covered under Title 24. Most of the data come from on-site surveys conducted during impact evaluation studies of the PG&E, SCE, and SDG&E NRNC energy efficiency programs, starting with program year 1994 and continuing through program year (PY) 2003. The dataset contains nearly 1,900 buildings, including both program participants and nonparticipants. For this project, only nonparticipants were used, resulting in a final dataset of 996 buildings. Sample weights assigned to each building permit extrapolation of measure bundle impacts to the statewide level.

Load Impacts

The AEC ModelIT software was used to conduct the load impact analysis. ModelIT is a C++ application that reads data tables from the NRNC database and automatically creates a series of DOE-2 input files for each building in the database. ModelIT was programmed to create code-compliant versions of each building for each code scenario examined, and implemented the measure bundles defined in a series of parametric simulations. The simulations were run in a batch process and the resulting 8760 hourly end-use load profiles were combined into energy consumption and demand by costing period data, as required by ASSET.

Commercial Baseline

One issue of discussion during the development of the research plan was the manner in which the commercial baselines would be established. After further review and discussion with advisory committee members, it was decided to look at nonparticipant buildings studied under the BEA project (which looks at impacts of the PY2002 and PY2003 Savings by Design program) that were built under the AB 970 (2001) version of Title 24. This allowed the research team to gain an understanding of common practices relative to the code, especially in areas where the efficiency standards were tightened considerably. Due to limitations in the sample size and coverage across building types, only differences that are statistically significant from Title 24 are used; otherwise, the baseline is set at the minimum code compliant value.

Incremental Costs

Efficiency levels and incremental costs for building shell, lighting, mechanical equipment, refrigeration systems and food service equipment are described below. The Title 24 efficiency levels, Savings by Design incentive levels, and common practice baselines are shown in the tables. Common practices relative to 2001 code are designated “CP01.” Common practices extrapolated to the 2005 code are designated “CP05.” Resources for estimating incremental costs are primarily the 2005 Database for Energy Efficient Resources (DEER) measure cost study, supplemented by research conducted by AEC for measures not included in DEER.

Building Shell

Measure values for building envelope U-values are based on the *Advanced Buildings Guidelines* (ABG) taken from The New Buildings Institute’s *Energy Benchmark for High Performance Buildings* (E-Benchmark). For glazing, however, the ABG values are not as stringent as Title 24 in some instances. Therefore, measure values for glazing relative to solar heat gain are based on available high performance low-E glazing products. The shell measure efficiency and incremental costs are shown in Table F-2.

Lighting

Measure values for allowed lighting power densities (LPD) were primarily based on *Savings By Design* (SBD) values, *Advanced Buildings* guideline values, or common practice data adjusted for a change in source efficacy. In many space types, higher efficiency lighting sources or fixtures with improved optics were used to lower the LPD. For some spaces, the measure values were further reduced by the ratio of available higher efficacy light sources over common practice (e.g., using CFL high bays in place of metal halide lamps for commercial storage space). The lighting measure efficiency and incremental costs are shown in Table F-3.

Mechanical Equipment

Measure efficiency values for mechanical equipment typically was based on the most efficient of the values from several data sources, including SBD, ABG, common practice from BEA data, the Consortium for Energy Efficiency’s (CEE) Equipment Database Tier II criteria, and the U.S. DOE’s Federal Energy Management Program (FEMP) listings for “Best Available” efficiencies for various types of mechanical equipment. The mechanical equipment measure efficiency and incremental costs are shown in Table F-4.

Grocery Store Refrigeration

The grocery store refrigeration measures focused on display case measures and condenser measures. Since Title 24 does not address refrigeration, the characteristics of grocery stores in the BEA database were examined to determine common practice in grocery store refrigeration. Only measures not currently common practiced are included. These measures were applied to grocery stores only. The measures considered in the analysis and their incremental costs are shown in Table F-5.

Food Service

The food service measures focus on griddles, fryers, ovens, food warmers and range tops. As with grocery store refrigeration, Title 24 does not address food service equipment. High efficiency versions of the common food service equipment used in the restaurants within the database are substituted for standard efficiency units. The measures considered in the analysis and their incremental costs are shown in Table F-6.

Table F-2: Shell Measure Efficiency Levels and Incremental Costs

Measure	Climate Zone	HE Measures	Title 24 - 2001	Common Practice 2001	Incremental Cost per SqFt over CP01	Title 24 - 2005	Common Practice 2005	Incremental Cost per SqFt over CP05
Roof U-value								
	CZ 1,16	0.039	0.057	0.057	$0.27	0.051	0.051	$0.20
	CZ 3-5	0.048	0.057	0.057	$0.10	0.051	0.051	$0.03
	CZ 6-9	0.048	0.078	0.078	$0.26	0.076	0.076	$0.24
	CZ 2, 10-13	0.048	0.057	0.057	$0.10	0.051	0.051	$0.03
	CZ 14,15	0.048	0.057	0.057	$0.10	0.051	0.051	$0.03
Wall U-value								
Wood frame	CZ 1,16	0.063	0.084	0.063	$0.00	0.102	0.063	$0.00
Wood frame	CZ 3-5	0.063	0.092	0.069	$0.03	0.110	0.069	$0.03
Wood frame	CZ 6-9	0.063	0.092	0.069	$0.03	0.110	0.069	$0.03
Wood frame	CZ 2, 10-13	0.063	0.084	0.063	$0.00	0.102	0.063	$0.00
Wood frame	CZ 14,15	0.063	0.084	0.063	$0.00	0.102	0.063	$0.00
Metal frame	CZ 1,16	0.077	0.182	0.152	$0.21	0.217	0.152	$0.18
Metal frame	CZ 3-5	0.077	0.189	0.189	$0.30	0.224	0.224	$0.34
Metal frame	CZ 6-9	0.077	0.189	0.189	$0.30	0.224	0.224	$0.34
Metal frame	CZ 2, 10-13	0.077	0.182	0.152	$0.21	0.217	0.152	$0.18
Metal frame	CZ 14,15	0.077	0.182	0.152	$0.21	0.217	0.152	$0.18
Mass HC 7 - 15	CZ 1,16	0.110	0.340	0.340	$0.59	0.330	0.330	$0.59
Mass HC 7 - 15	CZ 3-5	0.110	0.430	0.241	$0.24	0.430	0.241	$0.24
Mass HC 7 - 15	CZ 6-9	0.110	0.430	0.241	$0.24	0.430	0.241	$0.24
Mass HC 7 - 15	CZ 2, 10-13	0.110	0.430	0.241	$0.24	0.430	0.241	$0.24
Mass HC 7 - 15	CZ 14,15	0.142	0.430	0.241	$0.18	0.430	0.241	$0.18
Mass HC > 15	CZ 1,16	0.110	0.360	0.360	$0.59	0.360	0.360	$0.59
Mass HC > 15	CZ 3-5	0.110	0.650	0.385	$0.30	0.650	0.385	$0.30
Mass HC > 15	CZ 6-9	0.110	0.690	0.459	$0.36	0.690	0.459	$0.36
Mass HC > 15	CZ 2, 10-13	0.110	0.650	0.385	$0.30	0.650	0.385	$0.30
Mass HC > 15	CZ 14,15	0.142	0.400	0.400	$0.51	0.410	0.410	$0.51

Table F-2 (cont'd): Shell Measure Efficiency Levels and Incremental Costs

Window to Wall Area Ratio	Direction	Climate Zone	HE Measures	Title 24 - 2001	Common Practice 2001	Incremental Cost per SqFt over CP01	Title 24 - 2005	Common Practice 2005	Incremental Cost per SqFt over CP05
Window RSHG									
0-10% WWR	Non-north	CZ 1,16	0.23	0.49	0.47	$1.85	0.49	0.47	$1.85
		CZ 3-5	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 6-9	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 2, 10-13	0.23	0.47	0.45	$1.84	0.47	0.45	$1.84
		CZ 14,15	0.23	0.46	0.44	$1.84	0.46	0.44	$1.84
0-10% WWR	North	CZ 1,16	0.23	0.72	0.69	$1.88	0.72	0.69	$1.88
		CZ 3-5	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 6-9	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 2, 10-13	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 14,15	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
11-20% WWR	Non-north	CZ 1,16	0.23	0.43	0.41	$1.83	0.43	0.41	$1.83
		CZ 3-5	0.23	0.55	0.53	$1.86	0.55	0.53	$1.86
		CZ 6-9	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 2, 10-13	0.23	0.36	0.35	$1.78	0.36	0.35	$1.78
		CZ 14,15	0.23	0.36	0.35	$1.78	0.36	0.35	$1.78
11-20% WWR	North	CZ 1,16	0.23	0.49	0.47	$1.85	0.49	0.47	$1.85
		CZ 3-5	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 6-9	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 2, 10-13	0.23	0.51	0.49	$1.85	0.51	0.49	$1.85
		CZ 14,15	0.23	0.51	0.49	$1.85	0.51	0.49	$1.85
21-30% WWR	Non-north	CZ 1,16	0.23	0.43	0.41	$1.83	0.43	0.41	$1.83
		CZ 3-5	0.23	0.41	0.39	$1.82	0.41	0.39	$1.82
		CZ 6-9	0.23	0.39	0.37	$1.81	0.39	0.37	$1.81
		CZ 2, 10-13	0.23	0.36	0.35	$1.78	0.36	0.35	$1.78
		CZ 14,15	0.23	0.36	0.35	$1.78	0.36	0.35	$1.78
21-30% WWR	North	CZ 1,16	0.23	0.47	0.45	$1.84	0.47	0.45	$1.84
		CZ 3-5	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 6-9	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 2, 10-13	0.23	0.47	0.45	$1.84	0.47	0.45	$1.84
		CZ 14,15	0.23	0.47	0.45	$1.84	0.47	0.45	$1.84
31-40% WWR	Non-north	CZ 1,16	0.23	0.43	0.41	$1.83	0.43	0.41	$1.83
		CZ 3-5	0.23	0.41	0.39	$1.82	0.41	0.39	$1.82
		CZ 6-9	0.23	0.34	0.33	$1.75	0.34	0.33	$1.75
		CZ 2, 10-13	0.23	0.31	0.30	$1.69	0.31	0.30	$1.69
		CZ 14,15	0.23	0.31	0.30	$1.69	0.31	0.30	$1.69
31-40% WWR	North	CZ 1,16	0.23	0.47	0.45	$1.84	0.47	0.45	$1.84
		CZ 3-5	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 6-9	0.23	0.61	0.59	$1.87	0.61	0.59	$1.87
		CZ 2, 10-13	0.23	0.47	0.45	$1.84	0.47	0.45	$1.84
		CZ 14,15	0.23	0.40	0.38	$1.81	0.40	0.38	$1.81

Table F-3: Lighting Measure Efficiency Levels and Incremental Costs

Primary Function	HE Measure	Title 24 - 2001	Common Practice 2001	Incremental Cost per SqFt over CP01	Title 24 - 2005	Common Practice 2005	Incremental Cost per SqFt over CP05
All Other	0.45	0.6	0.6	$0.11	0.6	0.6	$0.11
Auditorium	1.50	2.0	1.5	$0.00	1.5	1.5	$0.00
Auto Repair	0.70	1.2	1.2	$0.03	1.1	1.1	$0.02
Banks/Financial Institutions	1.10	1.4	1.4	$0.22	1.2	1.2	$0.07
Classrooms/Training	1.00	1.6	1.3	$0.08	1.2	1.2	$0.05
Commercial Storage	0.48	0.6	0.5	$0.00	0.6	0.5	$0.00
Conference Centers	1.12	1.5	1.5	$0.28	1.4	1.4	$0.21
Convention Centers	1.30	1.5	1.5	$0.08	1.4	1.4	$0.04
Corridors	0.45	0.6	0.6	$0.11	0.6	0.6	$0.11
Dining	0.82	1.1	1.4	$0.20	1.1	1.4	$0.20
Dressing Room (Gymnasium)	0.60	0.9	0.9	$0.10	0.8	0.8	$0.07
Electrical Rooms	0.52	0.7	0.7	$0.13	0.7	0.7	$0.13
General Commercial Work - High Bay	0.67	1.2	0.7	$0.00	1.1	0.7	$0.00
General Commercial Work - Low Bay	0.67	1.0	0.7	$0.00	1.0	0.7	$0.00
General Industrial Work - High Bay	0.67	1.2	0.7	$0.00	1.1	0.7	$0.00
General Industrial Work - Low Bay	0.67	1.0	0.7	$0.00	1.0	0.7	$0.00
Grocery Stores	1.30	1.6	1.6	$0.26	1.6	1.6	$0.26
Gymnasium/Exercise Center	0.90	1.0	1.6	$0.06	1.0	1.6	$0.06
Hotel Function Area	1.50	2.2	2.2	$0.26	1.5	1.5	$0.00
Hotel Lobby	1.10	1.7	1.7	$0.06	1.1	1.1	$0.00
Industrial Storage	0.54	0.6	0.6	$0.03	0.6	0.6	$0.03
Kitchen/ Food Preparation	1.27	1.7	1.5	$0.17	1.6	1.5	$0.17
Laundry	0.67	0.9	0.9	$0.17	0.9	0.9	$0.17
Lecture	1.20	1.6	1.6	$0.26	1.2	1.2	$0.00
Library - Reading Areas	0.89	1.2	1.2	$0.22	1.2	1.2	$0.22
Library - Stacks	1.12	1.5	1.5	$0.28	1.5	1.5	$0.28
Locker Room	0.60	0.8	0.8	$0.11	0.8	0.8	$0.11
Lounge/Recreation	0.99	1.1	1.1	$0.07	1.1	1.1	$0.07
Main Entry Lobby	1.20	1.5	1.2	$0.00	1.5	1.2	$0.00
Malls, Arcades, and Atria	0.89	1.2	1.2	$0.22	1.2	1.2	$0.22
Mechanical Rooms	0.52	0.7	0.7	$0.13	0.7	0.7	$0.13
Medical and Clinical Care	1.10	1.4	1.1	$0.00	1.2	1.1	$0.00
Meeting Centers	1.40	1.5	1.5	$0.24	1.4	1.4	$0.00
Motion Picture Theater	0.81	0.9	0.9	$0.06	0.9	0.9	$0.06
Multipurpose Centers	1.12	1.5	1.5	$0.28	1.4	1.4	$0.21
Museum Exhibit	2.00	2.0	2.0	$0.00	2.0	2.0	$0.00
Office	0.90	1.3	1.1	$0.08	1.2	1.1	$0.08
Performance Theater	1.26	1.4	1.4	$0.09	1.4	1.4	$0.09
Precision Commercial Work	0.96	1.5	1.0	$0.01	1.3	1.0	$0.01
Precision Industrial Work	0.96	1.5	1.0	$0.01	1.3	1.0	$0.01
Reception/Waiting	0.50	1.1	1.1	$0.06	1.1	1.1	$0.06
Religious Worship	1.40	2.1	1.4	$0.00	1.5	1.4	$0.00
Restrooms	0.45	0.6	0.6	$0.11	0.6	0.6	$0.11
Retail Sales	1.30	2.0	1.5	$0.06	1.7	1.5	$0.06
Stairs	0.45	0.6	0.6	$0.11	0.6	0.6	$0.11
Support Areas	0.45	0.6	0.6	$0.11	0.6	0.6	$0.11
Vocational Room	1.00	1.6	1.6	$0.16	1.2	1.2	$0.05
Wholesale Showrooms	1.30	2.0	2.0	$0.06	1.7	1.7	$0.03

Table F-4: Mechanical Measure Efficiency Levels and Incremental Costs

			Efficiency Units	HE Measure	Title 24 - 2001	Common Practice 2001	Incremental Cost per Ton Over CP01	Title 24 - 2005	Common Practice 2005	Incremental Cost per Ton Over CP05
Air Conditioner Cooling Efficiency										
Air cooled	< 65000	Single pkg	SEER	14.5	9.7	13.0	$176	13.0	13.0	$176
	< 65000	Split sys	SEER	14.5	10.0	13.0	$56	13.0	13.0	$56
	65 -135		EER	11.8	10.3	11.0	$149	11.0	11.0	$149
	135 - 240		EER	11.5	9.7	10.8	$110	10.8	10.8	$110
	240 - 760		EER	10.0	9.5	10.0	$0	10.0	10.0	$0
	>760		EER	10.0	9.2	10.0	$0	9.2	10.0	$0
Water and Evaporatively	< 65000		SEER	12.1	12.1	12.1	$0	12.1	12.1	$0
	65 -135		EER	14.0	11.5	14.0	$0	11.5	14.0	$0
	135 - 240		EER	14.0	11.0	14.0	$0	11.0	14.0	$0
	> 240		EER	14.0	11.0	14.0	$0	11.0	14.0	$0
Heat Pump Cooling Efficiency										
Air cooled	< 65000	Single pkg	SEER	14.0	9.7	13.0	$209	13.0	13.0	$209
	< 65000	Split sys	SEER	14.0	10.0	13.0	$68	13.0	13.0	$68
	65 -135		EER	11.5	10.1	11.0	$182	11.0	11.0	$182
	135 - 240		EER	10.8	9.3	10.8	$0	10.8	10.8	$0
	240 - 760		EER	10.0	9.0	10.0	$0	10.0	10.0	$0
	>760		EER	10.0	9.0	10.0	$0	9.0	10.0	$0
Water-Source	< 17		EER	14.0	11.2	14.0	$0	11.2	14.0	$0
	17 - 65		EER	14.0	12.0	14.0	$0	12.0	14.0	$0
	65 -135		EER	14.5	12.0	14.0	$36	12.0	14.0	$36
Heat Pump Heating Efficiency										
Air cooled	< 65000	Single pkg	HSPF	7.7	6.6	7.7	Covered in Cooling Costs	7.7	7.7	Covered in Cooling Costs
		Split sys	HSPF	8.5	6.8	8.0		7.9	8.0	
	65 -135		COP	3.4	3.2	3.4		3.4	3.4	
	> 135		COP	3.3	3.1	3.3		3.3	3.3	
Water-Source	all		COP	5.0	4.2	4.6		4.2	4.6	
Chiller										
Air Cooled	With Condenser Elecrically Operated	All capacities	COP	3.49	2.80	2.93	$32	2.80	2.93	$32
	Without Condenser Elecrically Operated	All capacities	COP	3.20	3.10	3.10	$40	3.10	3.10	$40
Water Cooled	Reciprocating			5.23	4.20	4.42	$13	4.20	4.42	$13
	Screw + scroll	< 150 t	COP	5.58	4.45	4.82	$33	4.45	4.82	$33
		150 - 300	COP	6.12	4.90	5.76	$7	4.90	5.76	$7
		> 300	COP	6.88	5.50	5.86	$8	5.50	5.86	$8
	Centrifugal	< 150 t	COP	6.27	5.00	5.76	$58	5.00	5.76	$58
		150 - 300	COP	6.89	5.55	5.96	$65	5.55	5.96	$65
		> 300	COP	7.64	6.10	6.28	$58	6.10	6.28	$58
Air Cooled	Single Effect	All	COP	0.60	0.60	0.60	$0	0.60	0.60	$0
Water Cooled Absorption	Single Effect	All Capacities	COP	0.7	0.7	0.7	$0	0.7	0.7	$0
Absorption	Fired	Capacities	COP	1.2	1.0	1.0	$53	1.0	1.0	$53
	Fired	Capacities	COP	1	1.0	1.0	$0	1.0	1.0	$0
Fan power										
	CV	> 25 hp	W/cfm	0.70	0.80	1.10	$0.60	0.80	1.10	$0.60
	VAV	> 25 hp	W/cfm	1.10	1.25	1.47	$0.60	1.25	1.47	$0.60

Table F-5: Grocery Store Refrigeration Measures and Measure Cost

Equipment	Base Efficiency Measure	HE Measure	Cost	Unit
Refrigerated Cases	Standard fan motor	ECM Evaporator fan motor	$76	per motor
	Standard dual-pane doors	Advanced Reach-in doors	$300	per door
	No Controls	Anti-sweat heater controls	$56	per LF
	Fixed suction pressure control	Floating suction pressure control	$25	per LF
Condenser	Fixed head pressure	Minimum condenser setpoint (floating head pressure)	$300	per ton
	Standard air cooled condenser	Oversized air cooled condenser	$350	per ton
	Standard water cooled condenser	Oversized water cooled condenser	$279	per ton

Table F-6: Food Service Equipment Measures and Measure Cost

Measure	Base	High Efficiency	Incremental Cost Per Unit	Unit
High efficiency gas griddle	25 kBtu/hour	20 kBtu/hour	$1,051	Lineal foot
High efficiency electric griddle	65% Efficiency	75 % Efficiency	$960	Lineal foot
High efficiency gas fryer - 30-50 lbs. cap	25 kBtu/hour	15 kBtu/hour	$65	Pound capacity
High efficiency electric fryer - 45-65 lbs. cap	2.8 kW/hour	2.4 kW/hour	$159	Pound capacity
High Efficiency Gas Pizza or Bake oven	40% Efficiency	50% Efficiency	$1,500	Deck
High Efficiency Electric Pizza or Bake oven	50% Efficiency	80% Efficiency	$2,000	Deck
High Efficiency Gas Range oven	40% Efficiency	50% Efficiency	$1,500	Deck
High Efficiency Electric Range oven	50% Efficiency	80% Efficiency	$2,000	Deck
High Efficiency Gas Convection, combi, or retherm oven	40% Efficiency	50% Efficiency	$1,000	Deck
High Efficiency Electric Convection, combi, or retherm oven	50% Efficiency	80% Efficiency	$1,000	Deck
High Efficiency Electric Food warmer			$1,044	Each
High Efficiency Gas Rangetop	30% Efficiency	60% Efficiency	$500	Burner

Integrated Design

Comprehensive integrated design strategies applied to commercial buildings can have significant impacts of measure bundle costs. Measures designed as "load avoidance" strategies, such as efficient lighting, high performance glazing, cool roofs, demand-controlled ventilation, etc., can reduce the peak cooling loads and size of the mechanical systems. The cost savings resulting from downsizing HVAC systems in response to these load avoidance strategies can partially or in some cases completely offset the incremental costs of the measures. To account for these interactions in the measure bundle analysis, the peak HVAC system loads associated with each bundle were calculated by DOE-2, and cost savings resulting from HVAC system downsizing was estimated. The marginal costs of the HVAC systems as a function of capacity were estimated from the 2005 R. S. Means "Costworks" database. They include material, labor, and contractor mark-up costs for reductions in the size of primary equipment (chillers, boilers, cooling towers, etc.), secondary distribution equipment (air handlers, unitary packaged equipment, terminal units, pumps, etc., etc.), and distribution systems (duct work, piping, etc.). Incremental design costs required to calculate equipment size reductions were deducted from the HVAC size reduction credits, as shown in Table F-7.

Table F-7: HVAC Downsizing Credits

HVAC System Type	System sizing credit per ton
Packaged rooftop or split system	$2,000
Built-up system with water-cooled chiller	$2,960
Built-up system with air-cooled chiller	$2,630

Based on interviews with design assistance providers at AEC, design assistance costs that vary by building size were used, as shown in Table F-8.

Table F-8: Design Assistance Cost Assumptions

Building Size (SF)	Design Assistance Cost ($/SF)
<10,000	$1.00
10,000 - 50,000	$0.50
50,000 -100,000	$0.40
100,000 - 500,000	$0.20
500,000 -1,000,000	$0.10

Developing the Packages

The shell, lighting, mechanical, refrigeration, and food service equipment measures were applied to the full set of 996 buildings. Measures were introduced into the dataset to meet the energy savings targets relative to 2001 and 2005 Title 24. Energy savings for the 2001 code bundles were evaluated using total source energy savings for electricity and natural gas. Energy savings for the 2005 code bundles were evaluated using the time-dependent valuation (TDV) multipliers for electricity and natural gas applied to the hourly DOE-2 outputs. The measures used in each package are shown in Table F-9.

Table F-9: Measure Bundle Packages

Measure type	15% above 2001	25% above 2001	10% above 2005	15% above 2005
Lighting - LPD	X	X	X	X
Mechanical - HVAC efficiency	X	X	X	X
Mechanical - fan power		X		X
Envelope - walls and roofs		X		X
Envelope - windows	X	X	X	X
Refrigeration – display case measures		X		X
Refrigeration – condenser measures	X	X	X	X
Food service	X	X	X	X

Least-Cost Package Results

The energy savings in kWh and therms per year were calculated for the measure bundles in each CEC climate zone. Energy savings per year were derived by subtracting the energy usage of the building with the measure bundle installed from the common practice baseline energy usage per year. The following presents the cost and savings for reaching the targets under the 2001 Standards and the 2005 Standards separately. As explained above, the results were aggregated into four climate regions.

- **CNC Climate Zone 1:** CEC Title 24 Climate Zones 1-5, 16
- **CNC Climate Zone 2:** CEC Title 24 Climate Zones 6-7
- **CNC Climate Zone 3:** CEC Title 24 Climate Zones 8-10
- **CNC Climate Zone 4:** CEC Title 24 Climate Zones 11-15

2001 Standards

The incremental cost of each measure bundle (*Cost*), the compliance margin of the base case prototype (*Base Compliance*), and the compliance margin reached by adding the package to the base case prototype (*Package Compliance)* relative to the 2001 Standards, along with the electricity and natural gas savings for each climate zone group are shown in Table F-10 to Table F-17. Compliance margins for this set of runs were evaluated on a source energy basis. Common practices in commercial new construction are generally more efficient than the Title 24 energy standards, thus the energy savings relative to the common practice baseline are lower than the savings relative to the code baseline. In some cases, common practice was more efficient that the measure package efficiency, resulting in negative base compliance. Gas savings relative to the common practice baseline is negative in some buildings, due to heating interactions with measure packages designed primarily to save electricity. Incremental costs were calculated to include the costs of the measures and the credits available from downsizing HVAC systems in response to reduced peak cooling loads. In some cases, the HVAC downsizing credit exceeded the measure costs, resulting in negative incremental costs.

Table F-10: Energy Savings and Costs by Building Type – 15% Above 2001 Standards – Climate Zones 1-5 and 16

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	2.4%	15.9%	$0.40	2.46	0.0120
Schools	7.7%	18.6%	$1.28	0.95	-0.0109
Grocery Stores	-0.3%	12.5%	$3.37	9.74	-0.0272
Health Care	1.9%	7.6%	$0.77	1.09	-0.0100
Lodging	-4.2%	13.5%	$0.62	4.68	0.0869
Large Office	4.5%	15.8%	-$1.00	1.58	0.0027
Misc.	5.7%	12.2%	$0.68	1.50	-0.0213
Restaurants	-1.0%	11.7%	$7.19	5.83	0.3475
Retail	12.5%	18.1%	$1.13	1.54	-0.0228
Small Office	4.8%	12.9%	$0.40	1.35	-0.0110
Warehouse	1.7%	8.4%	$0.39	0.99	-0.0059
All	4.2%	13.8%	$0.00	1.61	-0.0023

Table F-11: Energy Savings and Costs by Building Type – 15% Above 2001 Standards – Climate Zones 6-7

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	4.3%	16.8%	$0.44	1.96	-0.0057
Schools	6.8%	17.3%	$0.12	1.19	-0.0114
Grocery Stores	0.9%	15.3%	$3.37	8.14	-0.0410
Health Care	3.2%	10.4%	$0.74	2.11	-0.0023
Lodging	0.1%	1.4%	$1.17	1.00	0.0000
Large Office	8.2%	18.7%	-$0.07	1.36	-0.0001
Misc.	5.5%	8.1%	$0.93	1.00	-0.0227
Restaurants	0.1%	11.2%	$17.06	8.17	0.8877
Retail	6.3%	16.6%	$1.31	2.02	-0.0057
Small Office	-1.1%	10.0%	-$0.19	2.57	0.0023
Warehouse	24.1%	26.5%	$0.45	0.06	-0.0003
All	4.5%	12.7%	$0.64	1.58	-0.0010

Table F-12: Energy Savings and Costs by Building Type – 15% Above 2001 Standards – Climate Zones 8-10

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	8.6%	15.8%	$1.39	1.24	-0.0119
Schools	7.5%	19.9%	$3.49	1.35	-0.0082
Grocery Stores	1.0%	18.3%	$3.46	10.09	-0.0307
Health Care	-2.9%	13.6%	$1.31	2.20	-0.0030
Lodging	-7.4%	6.5%	$0.65	3.98	-0.0023
Large Office	8.7%	15.8%	$1.12	0.92	-0.0037
Misc.	6.0%	11.1%	$1.30	1.00	-0.0021
Restaurants	-1.9%	12.5%	$12.95	7.64	0.9303
Retail	11.6%	17.5%	$1.29	1.38	-0.0072
Small Office	-0.4%	12.8%	$2.39	2.06	-0.0034
Warehouse	9.7%	14.5%	$0.35	0.20	-0.0008
All	6.5%	14.3%	$1.42	1.10	0.0015

Table F-13: Energy Savings and Costs by Building Type – 15% Above 2001 Standards – Climate Zones 11-15

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	1.9%	16.1%	$0.59	2.44	-0.0110
Schools	0.6%	14.1%	$0.94	1.68	-0.0183
Grocery Stores	2.0%	14.9%	$3.27	9.29	-0.0656
Health Care	7.3%	11.8%	$1.36	1.01	-0.0425
Lodging	-6.2%	6.3%	$1.01	3.54	-0.0037
Large Office	5.6%	12.6%	$0.78	0.99	-0.0121
Misc.	5.9%	11.5%	$1.28	1.13	-0.0185
Restaurants	-1.0%	7.5%	$6.03	5.58	0.1604
Retail	11.9%	16.1%	$1.73	1.25	-0.0257
Small Office	6.3%	16.7%	$0.98	1.45	-0.0105
Warehouse	18.1%	21.1%	$0.26	0.14	-0.0010
All	7.0%	14.6%	$0.82	1.03	-0.0119

Table F-14: Energy Savings and Costs by Building Type – 25% Above 2001 Standards – Climate Zones 1-5 and 16

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	2.4%	24.4%	$0.45	3.24	0.0992
Schools	7.7%	22.4%	$0.66	1.07	0.0062
Grocery Stores	-0.3%	22.6%	$4.96	16.42	0.0492
Health Care	1.9%	14.5%	-$1.24	1.97	0.0234
Lodging	-4.2%	19.1%	$0.88	5.68	0.1605
Large Office	4.5%	22.0%	-$2.06	2.12	0.0388
Misc.	5.7%	19.7%	$0.53	2.35	0.0429
Restaurants	-1.0%	12.8%	$6.94	6.54	0.3611
Retail	12.5%	23.8%	$0.12	2.50	0.0135
Small Office	4.8%	21.7%	-$0.27	2.21	0.0406
Warehouse	1.7%	13.5%	$0.31	1.50	0.0129
All	4.2%	20.4%	-$0.66	2.31	0.0381

Table F-15: Energy Savings and Costs by Building Type – 25% Above 2001 Standards – Climate Zones 6-7

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	4.3%	24.3%	$0.63	2.64	0.0429
Schools	6.8%	22.7%	-$0.33	1.49	0.0144
Grocery Stores	0.9%	31.7%	$3.78	16.35	0.0162
Health Care	3.2%	19.9%	-$0.14	4.62	0.0254
Lodging	0.1%	1.6%	$1.17	1.08	0.0000
Large Office	8.2%	25.5%	-$2.16	1.87	0.0382
Misc.	5.5%	13.9%	$0.05	2.23	0.0306
Restaurants	0.1%	12.1%	$16.47	9.34	0.9094
Retail	6.3%	22.3%	-$0.05	2.95	0.0101
Small Office	-1.1%	16.9%	-$4.38	4.09	0.0108
Warehouse	24.1%	37.5%	$0.26	0.34	0.0001
All	4.5%	19.0%	-$0.95	2.55	0.0234

Table F-16: Energy Savings and Costs by Building Type – 25% Above 2001 Standards – Climate Zones 8-10

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	8.6%	23.2%	-$0.43	2.09	0.0173
Schools	7.5%	25.9%	-$1.71	1.84	0.0037
Grocery Stores	1.0%	32.3%	$3.81	17.70	-0.0007
Health Care	-2.9%	27.2%	$0.07	3.89	0.0080
Lodging	-7.4%	11.8%	$0.77	5.39	0.0061
Large Office	8.7%	22.6%	-$1.64	1.62	0.0111
Misc.	6.0%	18.4%	$0.58	1.93	0.0465
Restaurants	-1.9%	14.1%	$13.85	9.48	0.9356
Retail	11.6%	23.5%	-$0.38	2.60	0.0041
Small Office	-0.4%	19.1%	$0.28	2.94	0.0061
Warehouse	9.7%	17.8%	$0.07	0.30	0.0030
All	6.5%	20.6%	-$0.23	1.82	0.0203

Table F-17: Energy Savings and Costs by Building Type – 25% Above 2001 Standards – Climate Zones 11-15

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	1.9%	23.9%	$0.70	3.47	0.0150
Schools	0.6%	19.0%	$0.90	2.04	0.0015
Grocery Stores	2.0%	28.4%	$4.15	17.44	0.0309
Health Care	7.3%	24.6%	$0.31	1.89	0.0424
Lodging	-6.2%	10.6%	$0.87	4.68	0.0029
Large Office	5.6%	18.4%	-$0.06	1.47	0.0128
Misc.	5.9%	19.2%	$0.84	2.02	0.0235
Restaurants	-1.0%	8.9%	$5.73	6.72	0.1642
Retail	11.9%	22.1%	-$0.78	2.33	0.0116
Small Office	6.3%	22.1%	$0.42	1.98	0.0075
Warehouse	18.1%	25.1%	$0.26	0.29	0.0006
All	7.0%	21.4%	$0.38	1.63	0.0092

2005 Standards

The incremental cost of each measure bundles (*Cost*), the compliance margin of the base case prototype (*Base Compliance*), and the compliance margin reached by adding the package to the base case prototype (*Package Compliance)* relative to the 2005 Standards, along with the electricity and natural gas savings for each climate zone group are shown in Table F-18 to Table F-25. Compliance margins for this set of runs were evaluated on a TDV basis.

Table F-18: Energy Savings and Costs by Building Type – 10% Above 2005 Standards – Climate Zones 1-5 and 16

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	-1.1%	12.2%	$0.37	2.18	0.0120
Schools	-1.9%	8.7%	$1.27	0.74	-0.0103
Grocery Stores	0.5%	9.0%	$1.66	6.02	-0.0331
Health Care	-0.3%	5.8%	$0.82	1.04	-0.0106
Lodging	-6.7%	13.8%	$0.62	4.55	0.0918
Large Office	1.8%	13.8%	-$1.02	1.53	0.0030
Misc.	1.6%	9.5%	$0.65	1.44	-0.0165
Restaurants	-2.2%	10.0%	$7.15	5.70	0.3489
Retail	4.9%	12.3%	$1.11	1.56	-0.0112
Small Office	2.0%	10.5%	$0.39	1.25	-0.0109
Warehouse	-0.1%	6.4%	$0.40	0.90	-0.0066
All	1.2%	11.2%	-$0.03	1.49	-0.0010

Table F-19: Energy Savings and Costs by Building Type – 10% Above 2005 Standards – Climate Zones 6-7

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	-0.5%	12.1%	$0.43	1.72	-0.0056
Schools	-0.9%	10.6%	$0.19	1.02	-0.0107
Grocery Stores	0.2%	9.6%	$2.13	4.77	-0.0406
Health Care	1.5%	10.2%	$0.46	2.11	-0.0027
Lodging	0.1%	1.4%	$1.17	1.00	0.0000
Large Office	5.0%	15.6%	-$0.13	1.17	0.0000
Misc.	2.4%	5.5%	$0.95	0.98	-0.0206
Restaurants	-0.9%	8.8%	$17.03	8.13	0.8915
Retail	0.2%	11.8%	$1.28	1.99	-0.0048
Small Office	-3.6%	8.3%	-$0.42	2.56	0.0007
Warehouse	17.1%	18.4%	$0.46	0.02	-0.0003
All	0.7%	9.4%	$0.58	1.49	-0.0007

Table F-20: Energy Savings and Costs by Building Type – 10% Above 2005 Standards – Climate Zones 8-10

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	2.3%	10.1%	$1.44	1.07	-0.0119
Schools	-0.7%	10.2%	$3.82	0.96	-0.0084
Grocery Stores	0.8%	11.7%	$1.95	5.91	-0.0443
Health Care	-6.2%	10.5%	$1.21	2.00	-0.0035
Lodging	-8.3%	5.5%	$0.64	3.52	-0.0011
Large Office	5.2%	12.5%	$1.14	0.83	-0.0047
Misc.	3.1%	8.4%	$1.30	0.95	-0.0037
Restaurants	-3.5%	9.7%	$12.97	7.42	0.9363
Retail	4.8%	11.2%	$1.30	1.27	-0.0055
Small Office	-4.0%	9.2%	$2.53	1.85	-0.0026
Warehouse	7.9%	12.5%	$0.35	0.18	-0.0008
All	2.5%	10.1%	$1.47	0.96	0.0012

Table F-21: Energy Savings and Costs by Building Type – 10% Above 2005 Standards – Climate Zones 11-15

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	-4.4%	9.7%	$0.57	2.14	-0.0102
Schools	-7.4%	6.9%	$0.94	1.48	-0.0179
Grocery Stores	1.2%	9.4%	$1.90	5.75	-0.0844
Health Care	1.6%	7.6%	$1.36	0.95	-0.0418
Lodging	-7.6%	4.5%	$1.09	3.12	-0.0020
Large Office	3.4%	10.8%	$0.78	0.96	-0.0129
Misc.	2.4%	7.2%	$1.31	0.82	-0.0181
Restaurants	-2.7%	5.9%	$5.99	5.41	0.1681
Retail	5.7%	10.5%	$1.72	1.19	-0.0265
Small Office	1.0%	12.9%	$1.00	1.45	-0.0102
Warehouse	16.0%	17.8%	$0.26	0.08	-0.0011
All	3.0%	10.3%	$0.80	0.86	-0.0123

Table F-22: Energy Savings and Costs by Building Type – 15% Above 2005 Standards – Climate Zones 1-5 and 16

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	-1.1%	19.4%	$0.49	2.88	0.0971
Schools	-1.9%	12.0%	$0.69	0.83	0.0072
Grocery Stores	0.5%	14.0%	$3.34	9.42	-0.0126
Health Care	-0.3%	12.1%	-$0.97	1.83	0.0237
Lodging	-6.7%	19.3%	$0.91	5.47	0.1634
Large Office	1.8%	19.2%	-$1.99	2.01	0.0386
Misc.	1.6%	16.3%	$0.52	2.18	0.0499
Restaurants	-2.2%	11.2%	$7.00	6.33	0.3601
Retail	4.9%	17.4%	$0.18	2.41	0.0090
Small Office	2.0%	18.1%	-$0.21	1.96	0.0420
Warehouse	-0.1%	11.4%	$0.32	1.37	0.0195
All	1.2%	16.9%	-$0.63	2.08	0.0391

Table F-23: Energy Savings and Costs by Building Type – 15% Above 2005 Standards – Climate Zones 6-7

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	-0.5%	18.0%	$0.62	2.23	0.0419
Schools	-0.9%	14.7%	-$0.23	1.26	0.0127
Grocery Stores	0.2%	19.7%	$2.61	9.41	0.0046
Health Care	1.5%	18.3%	-$0.58	3.97	0.0228
Lodging	0.1%	1.6%	$1.17	1.08	0.0000
Large Office	5.0%	21.4%	-$2.04	1.62	0.0382
Misc.	2.4%	9.6%	$0.11	1.89	0.0287
Restaurants	-0.9%	9.9%	$16.49	9.34	0.9054
Retail	0.2%	17.2%	-$0.06	2.80	0.0109
Small Office	-3.6%	14.4%	-$4.30	3.85	0.0040
Warehouse	17.1%	30.2%	$0.27	0.29	0.0001
All	0.7%	14.6%	-$0.91	2.28	0.0217

Table F-24: Energy Savings and Costs by Building Type – 15% Above 2005 Standards – Climate Zones 8-10

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	2.3%	18.1%	-$0.36	1.84	0.0213
Schools	-0.7%	16.3%	-$1.50	1.40	0.0042
Grocery Stores	0.8%	21.5%	$2.92	10.88	-0.0258
Health Care	-6.2%	22.7%	$0.24	3.45	0.0090
Lodging	-8.3%	10.4%	$0.76	4.74	0.0074
Large Office	5.2%	19.4%	-$1.64	1.46	0.0125
Misc.	3.1%	15.0%	$0.55	1.85	0.0460
Restaurants	-3.5%	11.7%	$13.75	9.15	0.9391
Retail	4.8%	17.4%	-$0.36	2.36	0.0039
Small Office	-4.0%	15.6%	$0.46	2.68	0.0065
Warehouse	7.9%	15.4%	$0.09	0.26	0.0029
All	2.5%	16.2%	-$0.20	1.61	0.0203

Table F-25: Energy Savings and Costs by Building Type – 15% Above 2005 Standards – Climate Zones 11-15

Building Type	Base Compliance	Package Compliance	Cost ($/SF)	Electricity Savings (kWh/SF)	Gas Savings (therm/SF)
College	-4.4%	17.3%	$0.69	3.07	0.0145
Schools	-7.4%	11.8%	$0.86	1.80	0.0023
Grocery Stores	1.2%	18.2%	$3.09	10.84	-0.0120
Health Care	1.6%	19.4%	$0.32	1.79	0.0427
Lodging	-7.6%	8.8%	$0.97	4.20	0.0044
Large Office	3.4%	16.8%	-$0.08	1.44	0.0131
Misc.	2.4%	15.1%	$0.86	1.67	0.0253
Restaurants	-2.7%	7.4%	$5.74	6.48	0.1698
Retail	5.7%	17.0%	-$0.80	2.26	0.0151
Small Office	1.0%	18.1%	$0.45	1.94	0.0079
Warehouse	16.0%	21.7%	$0.26	0.23	0.0006
All	3.0%	16.6%	$0.36	1.39	0.0090

F.3 Development of ASSET Commercial New Construction Model Inputs

Awareness

The analysis used the awareness of 100% for all units built under the 2001 standards. Because of the Standards change in 2005, an awareness of 80% was used starting in 2006 for high efficiency units built under the 2005 standards, which then increases by 5% each year. Awareness is defined such that the percent aware is the share of decision makers within the feasible market who have been exposed to a technology and have formed an opinion about the operating characteristics of that option.

Willingness, Feasibility, Technology Density, and Applicability

The analysis used a willingness and feasibility factor of 100%. The technology density and applicability used were 1.

Commercial New Construction Floor Stock

The tables contain the floorstock by utility, climate zone, and building type are available in Appendix C. The floorstock forecast was provided courtesy of the CEC and is dated March 2004.

Energy Time-Of-Use Shares and Coincident Peak Factors

The following table lists the energy time-of-use shares associated with each technology and segment for commercial new construction units. The energy time-of-use shares change by region. Using the name of the energy time-of-use share, the actual load shape and peak factors are listed in Table F-27.

Table F-26: Energy Time-Of-Use Shares by Technology and Segment

Technology Name	Segment	Energy Time-Of-Use Share	Changes by
COL_01_00	COL	COL_T24Elec	Region
COL_01_15	COL	COL_T24Elec	Region
COL_01_25	COL	COL_T24Elec	Region
COL_05_00	COL	COL_T24Elec	Region
COL_05_10	COL	COL_T24Elec	Region
COL_05_15	COL	COL_T24Elec	Region
GRC_01_00	GRC	GRC_T24Elec	Region
GRC_01_15	GRC	GRC_T24Elec	Region
GRC_01_25	GRC	GRC_T24Elec	Region
GRC_05_00	GRC	GRC_T24Elec	Region
GRC_05_10	GRC	GRC_T24Elec	Region
GRC_05_15	GRC	GRC_T24Elec	Region
HLT_01_00	HLT	HLT_T24Elec	Region
HLT_01_15	HLT	HLT_T24Elec	Region
HLT_01_25	HLT	HLT_T24Elec	Region
HLT_05_00	HLT	HLT_T24Elec	Region
HLT_05_10	HLT	HLT_T24Elec	Region
HLT_05_15	HLT	HLT_T24Elec	Region
LDG_01_00	LDG	LDG_T24Elec	Region
LDG_01_15	LDG	LDG_T24Elec	Region
LDG_01_25	LDG	LDG_T24Elec	Region
LDG_05_00	LDG	LDG_T24Elec	Region
LDG_05_10	LDG	LDG_T24Elec	Region
LDG_05_15	LDG	LDG_T24Elec	Region
MSC_01_00	MSC	MSC_T24Elec	Region
MSC_01_15	MSC	MSC_T24Elec	Region
MSC_01_25	MSC	MSC_T24Elec	Region
MSC_05_00	MSC	MSC_T24Elec	Region
MSC_05_10	MSC	MSC_T24Elec	Region
MSC_05_15	MSC	MSC_T24Elec	Region

Table F-26 (cont'd): Energy Time-Of-Use Shares by Technology and Segment

Technology Name	Segment	Energy Time-Of-Use Share	Changes by
LGO_01_00	LGO	LGO_T24Elec	Region
LGO_01_15	LGO	LGO_T24Elec	Region
LGO_01_25	LGO	LGO_T24Elec	Region
LGO_05_00	LGO	LGO_T24Elec	Region
LGO_05_10	LGO	LGO_T24Elec	Region
LGO_05_15	LGO	LGO_T24Elec	Region
SMO_01_00	SMO	SMO_T24Elec	Region
SMO_01_15	SMO	SMO_T24Elec	Region
SMO_01_25	SMO	SMO_T24Elec	Region
SMO_05_00	SMO	SMO_T24Elec	Region
SMO_05_10	SMO	SMO_T24Elec	Region
SMO_05_15	SMO	SMO_T24Elec	Region
RST_01_00	RST	RST_T24Elec	Region
RST_01_15	RST	RST_T24Elec	Region
RST_01_25	RST	RST_T24Elec	Region
RST_05_00	RST	RST_T24Elec	Region
RST_05_10	RST	RST_T24Elec	Region
RST_05_15	RST	RST_T24Elec	Region
RET_01_00	RET	RET_T24Elec	Region
RET_01_15	RET	RET_T24Elec	Region
RET_01_25	RET	RET_T24Elec	Region
RET_05_00	RET	RET_T24Elec	Region
RET_05_10	RET	RET_T24Elec	Region
RET_05_15	RET	RET_T24Elec	Region
SCH_01_00	SCH	SCH_T24Elec	Region
SCH_01_15	SCH	SCH_T24Elec	Region
SCH_01_25	SCH	SCH_T24Elec	Region
SCH_05_00	SCH	SCH_T24Elec	Region
SCH_05_10	SCH	SCH_T24Elec	Region
SCH_05_15	SCH	SCH_T24Elec	Region
WRH_01_00	WRH	WRH_T24Elec	Region
WRH_01_15	WRH	WRH_T24Elec	Region
WRH_01_25	WRH	WRH_T24Elec	Region
WRH_05_00	WRH	WRH_T24Elec	Region
WRH_05_10	WRH	WRH_T24Elec	Region
WRH_05_15	WRH	WRH_T24Elec	Region

Table F-27 lists the energy time-of-use shares for commercial new construction end uses by region. The TOU periods are the same as those given in previous sections of the appendix. The summer peak coincidence factor is also included.

Table F-27: TOU Load Shapes and Summer Peak Factors

Energy Time-Of-Use Share	Region	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak	Summer Peak Factor
COL_T24Elec	Region 1	16%	13%	25%	18%	28%	1.15
COL_T24Elec	Region 2	20%	16%	21%	21%	22%	1.22
COL_T24Elec	Region 3	22%	15%	23%	19%	21%	1.28
COL_T24Elec	Region 4	22%	18%	22%	18%	20%	1.16
GRC_T24Elec	Region 1	10%	9%	32%	13%	35%	1.03
GRC_T24Elec	Region 2	10%	10%	33%	13%	35%	1.05
GRC_T24Elec	Region 3	10%	10%	33%	13%	35%	1.06
GRC_T24Elec	Region 4	10%	10%	33%	13%	34%	1.07
HLT_T24Elec	Region 1	15%	11%	28%	18%	28%	1.17
HLT_T24Elec	Region 2	12%	11%	30%	16%	31%	1.09
HLT_T24Elec	Region 3	18%	12%	26%	19%	24%	1.12
HLT_T24Elec	Region 4	20%	15%	22%	20%	22%	1.34
LDG_T24Elec	Region 1	11%	10%	30%	14%	34%	1.06
LDG_T24Elec	Region 2	15%	8%	27%	21%	28%	1.01
LDG_T24Elec	Region 3	10%	11%	33%	12%	34%	1.04
LDG_T24Elec	Region 4	10%	11%	34%	11%	34%	1.02
MSC_T24Elec	Region 1	20%	13%	22%	23%	22%	1.08
MSC_T24Elec	Region 2	20%	13%	22%	24%	21%	1.20
MSC_T24Elec	Region 3	21%	14%	22%	22%	21%	1.24
MSC_T24Elec	Region 4	23%	15%	20%	22%	19%	1.25
LGO_T24Elec	Region 1	15%	12%	28%	17%	28%	1.08
LGO_T24Elec	Region 2	13%	12%	28%	17%	30%	1.08
LGO_T24Elec	Region 3	14%	12%	28%	17%	29%	1.01
LGO_T24Elec	Region 4	16%	13%	29%	16%	27%	1.04
SMO_T24Elec	Region 1	14%	12%	28%	15%	31%	1.06
SMO_T24Elec	Region 2	14%	12%	29%	15%	31%	1.13
SMO_T24Elec	Region 3	13%	13%	28%	15%	31%	1.09
SMO_T24Elec	Region 4	15%	13%	28%	15%	28%	1.11
RST_T24Elec	Region 1	12%	11%	30%	15%	32%	1.02
RST_T24Elec	Region 2	12%	11%	30%	14%	32%	1.29
RST_T24Elec	Region 3	12%	11%	30%	14%	32%	1.02
RST_T24Elec	Region 4	13%	12%	30%	14%	31%	1.00

Table F-27 (cont'd.): TOU Load Shapes and Summer Peak Factors

Energy Time-Of-Use Share	Region	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak	Summer Peak Factor
RET_T24Elec	Region 1	18%	17%	19%	25%	21%	1.32
RET_T24Elec	Region 2	19%	16%	19%	26%	20%	1.15
RET_T24Elec	Region 3	19%	19%	17%	26%	19%	0.99
RET_T24Elec	Region 4	18%	16%	22%	22%	22%	1.61
SCH_T24Elec	Region 1	19%	12%	23%	21%	24%	1.11
SCH_T24Elec	Region 2	17%	12%	24%	22%	25%	1.14
SCH_T24Elec	Region 3	19%	12%	22%	21%	25%	1.40
SCH_T24Elec	Region 4	21%	14%	23%	22%	21%	1.17
WRH_T24Elec	Region 1	12%	10%	30%	15%	33%	1.05
WRH_T24Elec	Region 2	17%	12%	28%	20%	23%	1.32
WRH_T24Elec	Region 3	14%	11%	28%	18%	29%	1.19
WRH_T24Elec	Region 4	12%	11%	28%	17%	32%	1.05

Appendix G

Industrial New Construction Methodology and ASSET Inputs

As part of the 2006 New Construction Potential study, RLW Analytics (RLW) was charged with estimating the potential energy savings from energy efficiency features in the new construction and major renovation of industrial facilities in three market sectors in California: electronics manufacturing, wastewater treatment, and refrigerated warehouses. The potential savings estimates specifically targeted anticipated projects that will be eligible for incentives from the Savings By Design (Savings By Design) nonresidential new construction incentive program.

The increase in load for the evaluated sectors in the CEC's 2003-2013 Demand Forecast was used as a proxy for the new construction load.[1]

Because energy consumption in industrial facilities is more a function of output than plant square footage, energy savings are expressed as a percentage of the forecasted sector load increase. Incremental measure costs are expressed as $ per kWh saved per year.

In this appendix, results are presented at the measure level rather than on a package basis, as is the case for both residential and commercial new construction. This is because: 1) unlike commercial facilities, industrial facilities have limited interactive effects between measures and 2) many of the industrial buildings that participate in Savings By Design install and receive rebates for individual measures.

G.1. Objective

The primary objective of the industrial component of the New Construction Potential Study was to find the savings potential for industrial facilities buildings that would approximate the Savings By Design projects for the electronics manufacturing, wastewater treatment and refrigerated warehouses market sectors by IOU planning area.[2]

1 California Energy Commission. *California Energy Demand 2003-2013 Forecast.* 2003.

2 While refrigerated warehouse and wastewater treatment are usually considered commercial load, the NC Potential Advisory Group requested that they be analyzed in more detail and therefore included them in this industrial analysis.

G.2. Investigated Market Sectors

The methodology employed to estimate energy savings potential was quite different from the residential and commercial components of this study due to the highly varying nature of industrial facilities. The industrial methodology varied by sector and depended on the available data. For electronic manufacturing, potential savings were assessed through an end-use disaggregation and the savings were applied considering the market applicability of the measure. Alternatively, wastewater treatment and refrigerated warehouse savings potential were calculated using a sample of projects similar to the commercial analysis. The applicability of any given measure for these sectors was determined by the saturation of the measure in the sample.

Electronics Manufacturing

Electronics manufacturing was defined as facilities with standard industrial classification (SIC) codes 36 and 357. The SIC 36 sector was further split into two groups of facilities: clean rooms (SIC 3674, semiconductor manufacturing), and conventional facilities, which included the remainder of the SIC 36 load increase (hereafter referred to as 36x). The buildings, processes, installed equipment, and end-use energy consumption of these two facility types are fundamentally different enough that they were analyzed separately.

The increase in load for both sectors was disaggregated by end use. Potential measures and the incremental costs associated with the implementation of the measures were developed and tailored to each end use. The applicable measures were applied to each load increase to generate savings estimates.

Load Forecast. According to the 2003-2013 Energy Demand Forecast, there is no expected increase in SIC 357 load; therefore, the focus of the analysis is SIC 36 facilities. The forecasted load increases for both types SIC 36 facilities included in the analysis are shown Table G-1.

Table G-1: Distribution of Forecasted SIC 36 Load Increase

SIC 36 Load	PG&E (GWh)	SCE (GWh)	SDG&E (GWh)
Clean Room Facilities (3674)			
2003 Load	1759.8	717.7	115.9
2008 Load	1954.0	866.8	128.0
2013 Load	2013.9	960.8	135.4
2003-2008 Increase	194.1	149.1	12.1
2003-2013 Increase	254.1	243.2	19.6
Conventional Facilities (36x)			
2003 Load	952.3	1090.0	261.6
2008 Load	1090.9	1228.5	285.8
2013 Load	1165.4	1313.1	299.3
2003-2008 Increase	138.6	138.5	24.2
2003-2013 Increase	213.1	223.1	37.7

Conventional Facilities

SIC (36x) Conventional Facility: Load Disaggregation by End Use

Excluding semiconductor-related manufacturing, electronics manufacturing contains numerous subsectors broadly characterized as precision and general industrial space types. The Energy Information Administration's Manufacturing Energy Consumption Survey (MECS 2002) provides the most current information regarding end-use distribution of SIC 36 facilities, as shown in Table G-2.[3]

3 Energy Information Administration, Department of Energy. *2002 Manufacturing Energy Consumption Survey*. www.eia.doe.gov/emeu/mecs

Table G-2: Conventional Facility Energy Use by End Use

Conventional	Load Share
HVAC	28.6%
Machine Drive	17.6%
Lighting	12.8%
Process Heating	11.3%
Process Cooling	9.0%
Other Facility Support	6.7%
Compressed Air	5.2%
End Use Not Reported	4.4%
Electro-chemical Process	1.4%
Other Process	2.8%

SIC 36x Conventional Facility: Savings and Cost Analysis

After the entire sector load was disaggregated, each of the end uses were analyzed in depth. SIC 36x facilities were evaluated with a two-prong approach. HVAC and lighting end uses were evaluated with a methodology similar to the commercial analysis. All other measure, broadly classified as "process" end uses considered measures individually.

Secondary sources were used to characterize the energy consuming equipment in each end use, the baseline efficiencies of the equipment, and the measures with energy saving potential for each end use. This following section provides details for the SIC 36x end-use analysis beginning with the process end uses.

SIC 36x Process End Uses

Motors. U.S. Industrial Motor Market Assessment gives the distribution of SIC 36x motor energy usage by unit size and application.[4] The four categories of applications are fans, pumps, air compressors, and "other." Table G-3 presents the relative energy usage and average hours of operation of SIC 36 motors. In this analysis, the same distributions were assumed.

[4] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (U.S. DOE EERE). *2002 U.S. Industrial Electric Motor System Market Opportunities Assessment*. 2002.

Table G-3: SIC 36 Motor Usage and Size Distribution by Application

Size Range	Fans	Pumps	Air Compressors	Other	All
Energy Usage Distribution					
1-5 HP	68%	18%	1%	13%	14.6%
6-20 HP	24%	18%		75%	23.7%
21-50 HP	7%	23%	54%	12%	28.1%
51-100 HP		40%	24%		28.8%
101-200 HP			21%		4.8%
Annual Hours of Operation					
1-5 HP	3,326	5,585	4,878	3,732	4,838
6-20 HP	2,691	5,613		4,913	5,090
21-50 HP	2,160	7,200	5,495	6,069	6,181
51-100 HP		6,437	7,036		6,541
101-200 HP			8,400		8,400
All Sizes	3,026	6,251	6,270	4,819	5,815

The study team used Motor Master 4.0 software to generate Table G-4 for calculating incremental motor costs and efficiencies for each motor size bin.

Table G-4: Motor Efficiency and Incremental Cost by Size

Size Range	EPACT Eff.	Premium Eff.	Inc $/hp
1-5 HP	87.0	89.5	$22.52
6-20 HP	91.6	93.0	$29.92
21-50 HP	93.3	94.5	$16.99
51-100 HP	94.7	95.4	$16.51
101-200 HP	95.4	96.2	$19.18

The incremental costs of variable speed drives (VSD), shown in Table G-5, were taken from the DEER 2001 Update Study.[5] Subsequent discussions with VSD manufacturers confirmed that these estimates are still valid.

5 Xenergy, Inc. *2001 DEER (Database for Energy Efficient Resources) Update Study.* Prepared for the California Energy Commission. August 2001.

Table G-5: VSD Incremental Cost by Controlled Motor Size

Size	$/HP
5 HP	$385
10 HP	$265
15 HP	$231
20 HP	$202
40 HP	$157
50 HP	$136
200 HP	$89

Compressed Air Systems. A sample of six Savings By Design projects with compressed air measures were used to calculate energy savings and incremental measure costs from VSD air compressors and thermal mass dryers. PG&E's compressed air system baseline studies and program documentation describe the baseline conditions and assumptions required for analysis of these projects.[6] Compressed air measure costs were backed out from measure payback from the Savings By Design project files.

VSD Air Compressors. VSD air compressors save energy via greater efficiency during part load operation. There is a large difference in savings for large (100+hp) and smaller (<100hp) compressors because smaller compressors operate at part load more often. The size distribution of air compressors for SIC 36 is given by the U.S. Industrial Motor Assessment.[7] The incremental measure costs were extracted from Savings By Design project files.

Thermal Mass Compressed Air Dryers. Baseline compressed air dryers use constant refrigeration to maintain a refrigerant-to-air heat transfer as air passes through the system. Thermal mass air dryers cool the air via an intermediate fluid, usually propylene glycol. The refrigeration system only maintains a setpoint for the intermediate fluid and can cycle off when not needed, thereby providing a part load match. The standard dryer continues to run in a recirculation/bypass mode even when cooling is unnecessary. These types of air dryer save approximately 2% of compressed air energy and are applicable to 75% of the market.

Process Cooling Measures

Process cooling refers to facility cooling requirements other that space cooling.

Waterside Economizer for Process. The use of a waterside economizer, such as a plate and frame heat exchanger, is often used for HVAC applications but rarely for process cooling

[6] Pacific Gas & Electric. *Compressed Air System New Construction Energy Baselines and Program Requirements.* New Construction Energy Management Program. 2002.

[7] U.S. DOE EERE 2002 op. cit.

applications. Free cooling is the term used for the weather conditions that permit use of only cooling tower energy, which can be up to 10 times more efficient than using both cooling tower and chiller energy. The applicability of 60% represents the percent of facilities utilizing process cooling equipment.

Dual Temperature Cooling Loops. Process cooling water typically has different requirements than water for space cooling. Operating dual temperature cooling loops can allow different chillers to operate at different setpoints to improve efficiency. The applicability of this measure is 60% (the percent of facilities using process cooling equipment) with the potential drawback being the cost of an additional chilled water loop.

Table G-6 summarizes the results of the process measure analysis.

Table G-6: Summary of SIC 36x Conventional Facility Process Measures

Base Case Description	Energy Efficiency Measure	Incremental Cost $/kWh	Savings Over Baseline	Applicability	Sector Savings
No VSD	COP = 6.27	$0.36	25%	50%	2.20%
EPACT Motors	Motor VSD	$0.12	7%	90%	1.03%
CV Compressor 100+HP	NEMA PE Motors	$0.25	5%	11%	0.03%
CV Compressor <100HP	VSD Compressor	$0.08	28%	40%	0.57%
Baseline Air Dryer	VSD Compressor	$0.20	2%	75%	0.08%
No Free Cooling	Measure LPD = 0.96	$0.16	12%	60%	0.65%
Standard Chiller	Water Economizer for Process Cooling	$0.05	10%	50%	0.45%

SIC 36x Lighting and HVAC End Uses

Like the commercial sector, lighting and HVAC end uses are subject to Title 24 energy code and have interactive effects. Therefore, to accurately estimate potential savings, these end uses were analyzed with a building sample of DOE2 models similar to the commercial analysis. The detailed methodology for the commercial analysis is found in Appendix P.

In brief, the commercial analysis developed a set of least-cost packages of measures that achieved energy savings relative to minimally code compliant buildings. The packages had measure targets of 15% and 25% savings relative to 2001 Title 24 standard and 10% and 15% savings relative to the more stringent 2005 standards. The measures included for the packages for SIC 36x models are shown in Table G-7.

Table G-7: Measure Packages for SIC 36x Models

Measure type	15% above 2001	25% above 2001	10% above 2005	15% above 2005
Lighting - LPD	X	X	X	X
Mechanical - HVAC efficiency	X	X	X	X
Mechanical - fan power		X		X
Envelope - walls and roofs		X		X
Envelope - windows	X	X	X	X

A building sample of 13 SIC 36x facility simulation models were extracted from the Nonresidential New Construction (NRNC) database to produce the potential estimates for this sector. Since this sample did not have statewide coverage, all 13 models were simulated in all 16 CEC climate zones. The results were aggregated to the four CNC climate zones described below.

- **CNC Climate Zone 1:** CEC Title 24 Climate Zones 1-5, 16
- **CNC Climate Zone 2:** CEC Title 24 Climate Zones 6-7
- **CNC Climate Zone 3:** CEC Title 24 Climate Zones 8-10
- **CNC Climate Zone 4:** CEC Title 24 Climate Zones 11-15

Measure cost considerations were not only the incremental costs of higher efficient equipment and high performance materials, but also the credit for downsizing mechanical systems and the costs of design assistance.

Unlike the commercial sector, the forecast of anticipated new construction is given in terms of load rather than square footage. Therefore, the savings results are presented as a percentage of sector load and incremental measure costs are given in units $ per kWh per year saved to remain consistent with the rest of the industrial analysis. Note that HVAC and lighting end uses consume approximately 41.4% of SIC 36x sector load and the savings results are given in terms the entire sector load.

Similar to the results of the commercial analysis, packages with envelope measures show a negative incremental cost for the entire measure package. This is a result of system sizing credit, the cost savings associated with reduced cooling and heating system capacity. Even after considering the added cost of integrated design assistance to properly specify correct system size, the downsizing credit is greater than the cost of all measures.

Table G-8: Results of HVAC and Lighting Measure Packages

Climate Zone	Package Electrical Savings	Incremental Measure Cost ($/kWh per yr)	Electricity Savings (% of Sector Load)
15% above 2001 Standards			
1-5, 16	9.92%	$1.50	4.11%
6,7	11.32%	$0.98	4.69%
8-10	13.75%	$1.20	5.69%
11-15	10.68%	$1.62	4.42%
25% above 2001 Standards			
1-5, 16	28.80%	($0.28)	11.92%
6,7	29.55%	($0.28)	12.23%
8-10	39.25%	($0.29)	16.25%
11-15	29.34%	($0.22)	12.15%
10% above 2005 Standards			
1-5, 16	9.08%	$0.10	3.76%
6,7	10.45%	$0.10	4.32%
8-10	12.48%	$0.09	5.17%
11-15	9.84%	$0.09	4.07%
15% above 2005 Standards			
1-5, 16	26.57%	($0.07)	11.00%
6,7	27.37%	($0.06)	11.33%
8-10	36.49%	($0.06)	15.11%
11-15	27.15%	($0.07)	11.24%

Clean Room Facilities

SIC 3674 Clean Room Facility Load Disaggregation by End Use

There are two basic categories of SIC 3674 clean room facilities: production facilities and research and development (R&D) facilities. The differences between these two types of facilities are substantial enough that the population of future projects needs to be considered when estimating an energy consumption end-use distribution. Rumsey Engineers, clean room design experts, assert that in California the primary function of newly constructed and/or renovated clean room space will be mostly R&D facilities.[8] The ongoing Lawrence Berkeley National Laboratory (LBNL) Clean Room Benchmarking Study provided a starting

[8] Correspondence with Peter Rumsey and Kim Traber. January-March 2005

point for load disaggregation of R&D clean room energy usage by end use.[9] This end-use distribution was refined through discussions with Rumsey Engineers to accurately reflect the usage of R&D clean rooms consistent with new construction in California. The finalized end-use distribution for clean rooms is shown in Table G-9.

Table G-9: Clean Room Energy Use by End Use

End Use	Load Share
Fans	31%
HVAC Pumps	10%
Chillers	14%
Process Tools	15%
De-ionized Water	5%
Compressed Air	8%
Process Vacuum	7%
Lights	4%
Miscellaneous	4%
Plug Loads	2%

SIC 3674 Clean Room Facility Savings and Cost Analysis

Although some of the conventional facility end-use analysis is applicable to clean room facilities, such as lighting and compressed air, separate analyses are necessary in most cases.

A sample of five Savings By Design clean room facility projects was used to generate estimates of savings and costs for measures unique to clean room facilities. The incremental costs were first calculated in terms of simple payback for the measure considered. The simple paybacks for the clean room specific measures were calculated from the project sample. The payback estimates for these measures were discussed with the senior staff of Rumsey Engineers as a quality control step. In a few cases, the calculated paybacks were adjusted to agree with Rumsey Engineers' experience. During this same discussion, Rumsey Engineers senior staff provided estimates of market applicability for all of the clean room specific measures to the study team. Table G-10 presents the incremental cost for each high efficiency measure included in the analysis.

The payback figures were converted into incremental cost per annual energy savings (kWh saved per year). Where payback estimates were not available, incremental cost were calculated using expected effective full load hours (EFLH) of the systems considered.

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[9] Lawrence Berkeley National Laboratory. *Clean Room Benchmarking Study*. http://ateam.lbl.gov/cleanroom/benchmarking/index.htm

SIC 3674 Clean Room Energy Efficiency Measures

Several of the measures analyzed are described by PG&E's Clean room Energy Baseline Report by Rumsey Engineers and the LBNL Clean room Benchmarking Study.[10,11.] Additional measures are drawn from Savings By Design projects, case studies, and further conversations with Rumsey Engineers. Incremental costs of clean room-specific measures were backed out from simple payback estimates.

Fan Systems. Fan systems are the largest energy consuming end use in clean rooms. Approximately two-thirds of fan energy is consumed for recirculation air, and the other third is for make-up air. The baseline efficiency for recirculation systems is 2,222 CFM/kW and 926 CFM/kW for makeup systems. The efficiency of the recirculation system design measures applied are averages from the LBNL Cleanroom Energy Benchmarking Study for the particular designs. The standard effective full load hours of clean room fan system in 8760 hours per year.[12]

Exhaust System Optimization. Exhaust optimization may be achieved by staging exhaust stacks off a common plenum or header, or any other strategy that eliminates the need to pull air strictly for dilution of harmful airborne compounds. This measure saves 10% of fan system energy and is the most cost-effective fan system measure. However, only 30% of 3674 clean room facilities have the type of airborne contamination that would be applicable for this measure.

Unoccupied Airflow Setback. Typical clean room fan systems run constantly to maintain cleanliness levels. However, since human activity is the primary source of contaminants, fan systems may be controlled to allow an unoccupied recirculation airflow rate setback. Typical energy savings of this measure average 15% of fan energy use. This may be achieved either through a combination of time clock and occupancy sensors or, more expensively and slightly more accurately, by the use of a particle counter controlled system. Due to equipment costs, the first option is currently more cost effective. It is estimated that 75% of clean rooms have operating schedules that would realize savings from this measure.

Pressurized Plenum Design. The most cost effective efficient design option for new construction recirculation systems is a pressurized plenum design. This design uses a large VAV air handler to overcome the pressure drop required of air filters located between the plenum and clean room space, instead of the standard small constant volume fan filter units. The control afforded by this design can reduce the recirculation airflow rate as low as conditions dictate rather than using an on/off control. The reduced flow rates decrease the

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10 Rumsey Engineers. *Cleanroom Energy Baseline Study.* Prepared for Pacific Gas & Electric. 2003

11 LBNL op. cit.

12 Rumsey 2003 Op. cit.

pressure drop across the high efficiency filter and typically result in a recirculation system with efficiencies over twice that of a baseline system. The market applicability for this design measure is approximately 50%.

Efficient Fan Selection. Overall fan system efficiency is the product of fan, drive, and motor efficiencies. The baseline for overall fan system efficiency is 60%. The combination of a directly coupled fan (which has no drive losses), an efficient fan, and premium efficiency motor can achieve an overall efficiency of 70% while delivering the same flow rate. The market applicability for this type of optimal fan system selection is 50%.

Reduced Air Change Rates. The baseline air change rates for clean rooms are ten air changes per hour (ACH), although rates as high as 15 ACH or more have been observed. In most cases, the desired level of cleanliness for production may be achieved while using reduced air change rates, averaging 6 ACH. The market applicability for this measure is approximately 75%.

Low Pressure Drop Filters.[13] Designing filter banks with an increased surface area and using low pressure drop filters also improves fan system efficiency. A baseline air filter pressure drop is 1.1 inches water gage. Efficient filter combinations can achieve pressure drop as low as 0.1 in. water gage. Widely available filters (75% applicability) can save 8% of fan system energy.

Low Face Velocity Air Handler Design. Baseline air handing units have a face velocity of 500 feet per minute. A low face velocity air handler design will yield a reduction in pressure drop and increase energy savings. Face velocities in the 200-300 feet per minute range can reduce energy consumption by 10% and would apply to 75% of the market. This measure requires early intervention in the design process and the additional costs of an increased air handler size, though payback is still less than three years.

Efficient Fan Filter Units. The most feasible efficient design option for renovation and late intervention projects for recirculation systems is efficient fan-filter units (2,555 CFM/kW). Benchmarking and efficiency standards are emerging for these units, which are particularly common in the semiconductor industry. The large market for these designs is represented in the high applicability factor of 75%.

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[13] Weale, J., P. Rumsey, D. Sartor, L. Eng Lock. *How Low Can You Go? Low Pressure Drop Laboratory Design*. Lawrence Berkeley Laboratory . December 2001. http://btech.lbl.gov/papers/49366.pdf

Space Cooling Measures

The cooling load for clean rooms facilities is primarily internal load and is largely not a function of weather. Space cooling incremental measure costs are evaluated with an estimated 3504 effective full load hours per year.[14]

High Efficiency VSD Chiller with Condenser Wet Bulb Temperature Reset. The combination of a VSD and high efficiency chiller greatly increases energy savings. In initial measure analyses, the presence of a high efficiency chiller alone was analyzed, but it was found that, due to frequent part load operation, high efficiency is only truly realized with the application of VSD. This measure has a market applicability of 75%.

Variable Primary Cooling Loop. Baseline clean room pump systems employ a constant-volume primary and variable-volume secondary cooling loop configuration. A system designed with a variable-volume primary-only cooling loop with VSD control will typically save 20% of pump energy. Market applicability is estimated at 50%.

NEMA Premium Motor and Efficient Pump Selection. The baseline industrial pump system, which uses EPACT efficient motors and standard pumps, has a combined efficiency of 74%. Using premium efficiency motors and efficient pumps can increase efficiency to an average of 80%. The applicability of both measures is 50%.[15]

Process Vacuum Systems and De-Ionized Water System Measures

Clean room facilities use enough process vacuum and de-ionized water to be classified as separate end uses. The majority of energy usage by process vacuum and de-ionized water systems is consumed by pump systems. The measures were evaluated assuming a 5815 EFLH, the typical usage of a drive motor for this market sector reported in the U.S. Industrial Motor Market Assessment.

NEMA Premium Motor and Efficient Pump Selection. The average industrial pump system using EPACT efficient motors and standard pumps has an efficiency of 74%. Improving the pump components can improve efficiency to an average of 80% using premium efficiency motors and efficient pumps. The applicability of this measure is 50% for both end uses.

Variable Speed Drive. Motor savings may be realized in both process vacuum and de-ionized water end uses via VSD control of pumping applications**.** Motor VSD costs are based on the Database of Energy Efficient Resources (DEER) and from manufacturers' info

[14] Mills, et al. *Energy Efficiency in California Laboratory-Type Facilities*. 1996

[15] Motor cost and savings are determined using the U.S. Industrial Motor Market Assessment and MotorMaster+ software, U.S. Department of Energy.

and savings calculation methodology from IEEE references. The applicability of these measures is 50% for both end uses.

Table G-10: Summary of Clean Room Measures

Base Case Description	Energy Efficiency Measure	Incr. Cost $/kWh	Savings Over Baseline	Applicability	Sector Savings
Standard Distributed Exhaust	Exhaust Optimization	$0.05	10%	30%	0.32%
Constant Operation	Unoccupied Airflow Setback	$0.06	15%	75%	2.31%
Standard Ducted System	Pressurized Plenum	$0.07	28%	50%	2.87%
Standard Efficiency Fan System	Efficient Fan Selection	$0.10	7%	50%	0.33%
10 ACH	Proper Air Change Rates (6 ACH)	$0.08	26%	75%	6.05%
Standard Filter	Low Pressure Drop Filter	$0.08	8%	75%	1.86%
Standard AHU	Low Face Velocity AHU	$0.25	10%	75%	2.33%
Standard Efficiency Filter Units	Efficient Fan Filter Units	$0.31	13%	75%	2.00%
Non VSD Chiller, Fixed Condensing Temp	High Efficiency VSD Chiller +Wet Bulb Offset	$0.10	16%	75%	1.68%
No Waterside Economizer	Waterside Economizer	$0.16	12%	60%	1.01%
Single Cooling Loop	Dual Temperature Cooling Loops	$0.33	9%	60%	0.76%
Primary and Secondary Loop	Primary Only VSD HVAC Pumps	$0.07	20%	50%	1.00%
CV Compressor <100HP	VSD Air Compressor <100HP	$0.08	28%	59%	1.31%
CV Compressor 100+HP	VSD Air Compressor 100+HP	$0.25	5%	16%	0.07%
Refrigeration Air Dryer	Thermal Mass Air Dryer	$0.20	2%	75%	0.12%
Standard Pump and Motor	NEMA Premium Motor + Efficient Pump	$0.10	7%	50%	0.23%
Throttled/Cycling	Process Vacuum Pump VSD	$0.29	25%	50%	0.88%
Standard Pump and Motor	NEMA Premium Motor + Efficient Pump	$0.10	7%	50%	0.16%
Throttled/Cycling	De-ionized Water Pump VSD	$0.29	25%	50%	0.63%
Title 24 LPD =1.3	High Efficacy Lighting LPD=0.96	$0.19	26%	50%	0.52%
Common Practice LPD =1.0	High Efficacy Lighting LPD=0.96	$0.14	4%	50%	0.08%

Wastewater Treatment

For this study, wastewater treatment is defined as municipal wastewater treatment plants (WWTPs), also known as publicly owned treatment works (POTWs). This market sector was evaluated with all committed and completed Savings By Design WWTP projects since the inception of the program in 1999.

The method employed for assessing the potential energy savings was to consider the Savings by Design projects as a representative sample of the population of newly constructed and thoroughly renovated WWTP projects.[16]

Load Forecast. WWTP load is classified as SIC 4952, sewerage systems. The CEC's 2003-2013 forecast does not provide load forecast estimates for the four-digit subsectors of SIC 495, sanitary services.[17] Because 4952 is the dominate load of 495, all other four-digit subsectors were considered negligible and the SIC 495 estimates were used as a proxy for SIC 4952, as shown in Table G-11.

Table G-11: WWTP Load Forecast

SIC 495 Load Forecast	PG&E (GWh)	SCE (GWh)	SDGE (GWh)
2003 Load	837.5	790.3	50.7
2008 Load	901.1	844.1	54.8
2013 Load	959.0	900.1	58.0
2003-2013 Increase	63.6	53.8	4.1
2003-2008 Increase	121.5	109.8	7.3

WWTP Savings and Cost Analysis

A wide array of measures exists in the sample of Savings By Design projects, which have been broadly classified into seven measure types described below. Measure baselines were taken directly from PG&E's Wastewater Baselines Studies.[18,19]

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16 Although this methodology is not ideal, the lack of data on future projects leaves very limited options for this analysis

17 CEC August 2003 op. cit.

18 M/J. Industrial Solutions. *Municipal Wastewater Treatment Plant Energy Baseline Study.* PG&E New Construction Energy Management Program. June 2003.

19 SBW Consulting. *Energy Benchmarking Secondary Wastewater Treatment and Ultraviolet Disinfection Processes at Various Municipal Wastewater Treatment.* Prepared for Pacific Gas & Electric. February 2002.

Premium Efficiency Motors and VSD Controls. EPACT efficiency motors and throttled on/off control is considered baseline for all WWTP applications.

Low Pressure Ultraviolet (UV) Disinfection Lamps. Medium pressure UV lamps are considered baseline equipment for tertiary UV disinfection systems. Low pressure lamps are more energy efficient but at considerable cost with paybacks ranging from 5 to over 10 years in the projects investigated for this analysis.

Belt-Press Dewatering. Centrifugal dewatering is considered the baseline method of sludge dewatering. The belt press technique uses less energy per unit mass but needs a larger footprint for solar drying as the processed sludge has a higher water content than sludge processed with a typical centrifugal dewatering method.

High Efficiency Blowers. High efficiency blower systems realize energy savings by providing aeration air at better efficiencies than standard systems. Currently, systems are evaluated on a project-by-project basis and compared to original design. Blower systems with sufficient turn-down capabilities can save energy by matching power to load during "low flow" periods.

Reduced Pipe Friction. Effluent pumping energy savings may be realized by using a pipe with a diameter larger than originally specified and/or low friction coating on the inside of the pipe. This measure requires project-specific baseline analysis.

Reduced Pumping Head. Energy savings are realized when infrastructure design is altered to reduce the vertical distance that plant throughput is pumped. This is accomplished by lowering the level of a holding pond or removal of an obstruction that is being "pumped over."

Design Change. This measure refers to changing the fundamental technology of a facility in order to achieve energy savings. For example, under certain conditions, a sequence batch reactor can be used in place the common activated sludge technology with less energy requirements.

Incremental Measure Costs

Table G-12 presents the incremental cost for the measures included in the analysis. These costs were developed directly from Savings By Design project files and from discussions with manufacturers, Motor Master software, and the DEER 2001 Update Study.

Table G-12: Summary of WWTP Measure Savings and Cost

Efficiency Measures	Baseline Conditions	Energy Savings (% of Sector Load)	Incremental Measure Cost ($/kWh per Year Saved)
PE Motors and VSDs	EPACT Motors and On/Off or Throttle Control	10.2%	$0.08
Low Pressure UV lamps	Medium Pressure UV Lamps	8.2%	$0.48
Belt Press Dewatering	Centrifuge Dewatering	0.1%	$0.02
Efficient Blower	Standard Efficiency Blowers	6.5%	$0.56
Reduced Pipe Friction	Standard Piping	2.1%	$0.72
Pumping Head Reduction	Original or Standard Design	0.2%	$0.13
Design Change	Original or Standard Design	0.2%	$0.06

Refrigerated Warehouses (RWH)

Refrigerated warehouses (RWHs) are defined as facilities dominated by reduced temperature storage space.

Load Forecast. Since refrigerated warehouses are, technically, a commercial building type, the CEC 2003-2013 forecast includes refrigerated warehouses in its commercial building forecast and reports the predicted usage by end use.[20] Table G-13 the forecast of the end uses considered for this analysis, refrigeration, and interior lighting.

Table G-13: RWH Forecast Summary

	PG&E (GWh)	SCE (GWh)	SDGE (GWh)
2003 Load	423.8	262.6	14.7
2008 Load	459.0	297.2	16.6
2013 Load	505.0	330.5	18.0
2003-2008 Increase	35.2	34.6	1.9
2003-2013 Increase	81.2	67.9	3.3

<u>RWH Savings and Cost Analysis</u>

Eight prototype DOE2.2R RWH models were created for analysis of this market sector. The models used to project energy savings and incentive levels of each project were modified to reflect actual operating conditions found at the facility during an evaluation site visit conducted previously. These models were run with the appropriate weather data to generate

[20] CEC August 2003, op. cit.

whole premise impacts. Then parametric runs of individual measures were made in order to generate savings at the measure level. Individual measure savings were then proportioned down to balance with whole premise savings. In this manner, anticipated interactive effects of measures are accounted for even though savings are presented at the measure level.

There are two essential types of refrigerated warehouse considered for this analysis: distribution facilities/public storage warehouses and produce (fruit and vegetable) cold storage facilities. Produce facilities are generally smaller than distribution warehouses, but have considerably more energy usage on a per square foot basis. Distribution facilities and public cold storage, while having slightly different functions, have similar enough equipment and load profiles that they can be treated as the same building type for purposes of this analysis.

RWH Baseline

California's Title 24 energy regulations are largely not applicable to the refrigerated warehouse market sector. Attributes of common practice in RWH facilities is largely unavailable for California due the limited number of facilities being constructed. Additionally the deep penetration of the Savings By Design program for this market sector reduces the pool of available nonparticipants.

The assumed baseline features are included in the document *Basecase Summary for Refrigerated Warehouses*. This non-published "living" document is used as a guideline for the determination of baseline features for Savings by Design refrigerated warehouses on a project-specific basis. The document is continuously updated to reflect changes in technology, available data, and market conditions. Table G-14 presents the base case and measure features for refrigerated warehouse project evaluation.

Table G-14: RWH Measure and Baseline Features

Features	Baseline Description	Efficiency Measures
Condensing temperature for air condenser	10 and 15 F TD for LT and MT,	Low Approach, Variable Setpoint
Condensing temperature for evaporative condenser	Between 18 and 25 F TD	Low Approach, Variable Setpoint
Condenser specific efficiency	330 BTU/Watt for evaporative, 53 BTU/Watt for air cooled	Condenser with Higher than Baseline Efficiencies
Minimum condensing temperature	85 F SCT most cases	Floating Head Pressure, Variable Setpoint
Condenser control	Fixed setpoint, fan cycling , two speed if single fan	VSD Fan
Compressor control	Fixed setpoint or slide valves on screw compressors. On/off	Variable Setpoint
Zone control	Fixed setpoint cycling LL solenoid or EPR	Floating Suction Pressure
Evaporator fan control	Full time 100% operation unless scheduled load or highly variable load.	VSD Control
Fan/Compressor motor efficiency	Title 24/ EPACT Motors	NEMA Premium/CEE Motors
Lighting Control	Manual/Timer	Occupancy/Daylighting Control

Measures

Floating Head Pressure, VSD Control of Condenser Fans, and Variable Setpoint (Wet Bulb Offset). These measures have synergistic effects and are typically considered, analyzed and implemented as a bundle in Savings By Design projects. This group of measures is included in most Savings By Design RWH projects.

Air Unit (Evaporator Fan) VSD Control. VSD control saves fan power in facilities with variable load. Therefore, more savings are realized with this measure at seasonal produce facilities with greatly varying load than at large distribution facilities.

Lighting Controls. Lighting control measures in Savings By Design RWH projects utilize bi-level lighting with occupancy control inside cold storage areas and daylighting controls in adjacent dry storage areas to achieve energy savings. Given the 0.6 baseline LPD for the storage occupancy, few projects qualify based on installed LPD alone.

Floating Suction Pressure. Installing floating suction pressure capability allows suction pressure setpoint adjustment based upon load. This realizes compressor energy savings and is a viable measure in most RWH facilities.

Efficient Compressor Motor. Savings By Design provides incentives premium efficiency compressor motors.

Incremental Measure Costs

The incremental cost estimates for RWH measures are taken from estimates taken directly from Savings By Design project file estimates. The savings are normalized to dollars per annual energy savings in kWh as shown in Table G-15. PG&E cost are different due to difference in anticipated facility types. The difference in measure savings comes from public storage/distribution warehouse and produce warehouses. PG&E was assumed to have 40% of its anticipated load comprised of produce warehouses, whereas SCE and SDG&E only had a 5% produce facility load.

Table G-15: Summary of RWH Measure Savings and Incremental Costs

Energy Efficiency Measure	Baseline Description	Measure Savings (% of Sector Load)	Inc. Measure Cost ($/kWh of Savings/yr)	
			SCE a SDG&E	PG&E
Floating Head Pressure, Variable Setpoint, Variable Fan Speed	Fixed Setpoint, CV or Two-Speed Fans	6.18%	0.16	0.17
Air Unit VSDs	CV or Two-Speed Fan	9.19%	0.09	0.11
Lighting Controls	Manual Control or Timers	6.50%	0.27	0.27
PE Compressor Motor	EPACT Compressor Motor	0.12%	0.59	0.59
Floating Suction Pressure	Fixed Suction Pressure	9.57%	0.10	0.10
Efficient Condenser	Standard Efficiency Condenser	0.38%	0.11	0.09

G.3. Development of ASSET Industrial New Construction Model Inputs

Awareness

The following table presents the awareness values used in the analysis for industrial new construction.

Willingness, Feasibility, Technology Density, and Applicability

The analysis used a willingness and feasibility factor of 100%. The technology density and applicability used were 1.

Industrial New Construction Energy Load Forecast

As discussed in Section Q.2 above, the industrial new construction load forecast was taken from the CEC's 2003-2013 Energy Demand Forecast.

Energy Time-Of-Use Shares and Coincident Peak Factors

The following table lists the energy time-of-use shares associated with each technology and segment for industrial new construction units. The energy time-of-use shares change by utility or by region. Using the name of the energy time-of-use share, the actual load shape and peak factors are listed in Table G-17.

Table G-16: Energy Time-Of-Use Shares by Technology and Segment

Technology Name	Segment	Energy Time-Of-Use Share	Changes by
REF_FxFn	REF	REF_ELE	Utility
REF_FlHP	REF	REF_ELE	Utility
REF_CVFn	REF	REF_ELE	Utility
REF_AVFD	REF	REF_ELE	Utility
REF_MnCn	REF	REF_Light	Utility
REF_LtC	REF	REF_Light	Utility
REF_EPCM	REF	REF_ELE	Utility
REF_EfCM	REF	REF_ELE	Utility
REF_FxSP	REF	REF_ELE	Utility
REF_FlSP	REF	REF_ELE	Utility
REF_StCn	REF	REF_ELE	Utility
REF_EfCn	REF	REF_ELE	Utility
WWT_ThCn	WWT	WWT_ELE	Utility
WWT_VFD	WWT	WWT_ELE	Utility
WWT_MPUV	WWT	WWT_ELE	Utility
WWT_LPUV	WWT	WWT_ELE	Utility
WWT_CnDW	WWT	WWT_ELE	Utility
WWT_PDW	WWT	WWT_ELE	Utility
WWT_StEB	WWT	WWT_ELE	Utility
WWT_EfBl	WWT	WWT_ELE	Utility
WWT_01	WWT	WWT_ELE	Utility
WWT_RPF	WWT	WWT_ELE	Utility
WWT_02	WWT	WWT_ELE	Utility
WWT_PHR	WWT	WWT_ELE	Utility
WWT_OrDs	WWT	WWT_ELE	Utility
WWT_Des	WWT	WWT_ELE	Utility
S36_StEM	S36	S36_Motor	Utility

Table G-16 (cont'd): Energy Time-Of-Use Shares by Technology and Segment

Technology Name	Segment	Energy Time-Of-Use Share	Changes by
S36_Pmp	S36	S36_Motor	Utility
S36_ThOF	S36	S36_Proc	Utility
S36_VSD	S36	S36_Proc	Utility
S36_CVAS	S36	S36_Proc	Utility
S36_ACrS	S36	S36_Proc	Utility
S36_CVAL	S36	S36_Proc	Utility
S36_AcrL	S36	S36_Proc	Utility
S36_RfAD	S36	S36_Proc	Utility
S36_TMD	S36	S36_Proc	Utility
S36_StEC	S36	S36_Proc	Utility
S36_HEVC	S36	S36_Proc	Utility
S36_NWEc	S36	S36_Proc	Utility
S36_WtEc	S36	S36_Proc	Utility
S36_01_00	S36	S36_HVAC	Region
S36_01_15	S36	S36_HVAC	Region
S36_01_25	S36	S36_HVAC	Region
S36_05_00	S36	S36_HVAC	Region
S36_05_10	S36	S36_HVAC	Region
S36_05_15	S36	S36_HVAC	Region
CRm_StDX	CRm	CRm_Proc	Utility
CRm_ExOp	CRm	CRm_Proc	Utility
CRm_CnOp	CRm	CRm_OffHr	Utility
CRm_UAS	CRm	CRm_OffHr	Utility
CRm_StDS	CRm	CRm_Proc	Utility
CRm_PrPl	CRm	CRm_Proc	Utility
CRm_SFS	CRm	CRm_Proc	Utility
CRm_EfFS	CRm	CRm_Proc	Utility
CRm_SACR	CRm	CRm_Proc	Utility
CRm_PACR	CRm	CRm_Proc	Utility
CRm_StFl	CRm	CRm_Proc	Utility
CRm_LPDF	CRm	CRm_Proc	Utility
CRm_SAHU	CRm	CRm_Proc	Utility
CRm_LFV	CRm	CRm_Proc	Utility
CRm_SEFU	CRm	CRm_Proc	Utility
CRm_EFFU	CRm	CRm_Proc	Utility
CRm_SCCh	CRm	CRm_Proc	Utility
CRm_HECh	CRm	CRm_Proc	Utility
CRm_NWEc	CRm	CRm_Proc	Utility
CRm_WtEc	CRm	CRm_Proc	Utility

Table G-16 (cont'd): Energy Time-Of-Use Shares by Technology and Segment

Technology Name	Segment	Energy Time-Of-Use Share	Changes by
CRm_SCLp	CRm	CRm_Proc	Utility
CRm_DTCL	CRm	CRm_Proc	Utility
CRm_PSLp	CRm	CRm_Proc	Utility
CRm_POHP	CRm	CRm_Proc	Utility
CRm_PS74	CRm	CRm_Proc	Utility
CRm_PrPm	CRm	CRm_Proc	Utility
CRm_CVCS	CRm	CRm_Proc	Utility
CRm_VACS	CRm	CRm_Proc	Utility
CRm_CVCL	CRm	CRm_Proc	Utility
CRm_VACL	CRm	CRm_Proc	Utility
CRm_RfAD	CRm	CRm_Proc	Utility
CRm_CTMD	CRm	CRm_Proc	Utility
CRm_StPM	CRm	CRm_Proc	Utility
CRm_PMEV	CRm	CRm_Proc	Utility
CRm_ThCn	CRm	CRm_Proc	Utility
CRm_PVPV	CRm	CRm_Proc	Utility
CRm_SPmM	CRm	CRm_Proc	Utility
CRm_PMEW	CRm	CRm_Proc	Utility
CRm_ThrC	CRm	CRm_Proc	Utility
CRm_DWP	CRm	CRm_Proc	Utility
CRm_MCLt	CRm	CRm_Light	Utility
CRm_HeLt	CRm	CRm_Light	Utility

Table G-17 lists the energy time-of-use shares for commercial new construction end uses by region. The TOU periods are the same as those given in previous sections of the appendix. The summer peak coincidence factor is also included.

Table G-17: TOU Load Shapes and Summer Peak Factors

Energy Time-Of-Use Share	Region	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak	Summer Peak Factor	Coincidence Factor
CRm_Light	PG&E	15%	14%	25%	27%	19%	1.00	1.00
CRm_Light	SCE	12%	10%	13%	38%	27%	1.00	1.00
CRm_Light	SDG&E	12%	12%	20%	32%	23%	1.00	1.00
CRm_OffHr	PG&E	0%	0%	50%	0%	50%	1.00	1.00
CRm_OffHr	SCE	0%	0%	50%	0%	50%	1.00	1.00
CRm_OffHr	SDG&E	0%	0%	50%	0%	50%	1.00	1.00
CRm_Proc	PG&E	11%	12%	29%	23%	25%	1.00	1.00

Table G-17 (cont'd): TOU Load Shapes and Summer Peak Factors

Energy Time-Of-Use Share	Region	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak	Summer Peak Factor	Coincidence Factor
CRm_Proc	SCE	9%	5%	20%	24%	42%	1.00	1.00
CRm_Proc	SDG&E	10%	9%	25%	26%	30%	1.00	1.00
REF_Ele	PG&E	11%	12%	35%	17%	25%	1.00	1.00
REF_Ele	SCE	10%	11%	35%	17%	27%	1.00	1.00
REF_Ele	SDG&E	9%	11%	36%	17%	28%	1.00	1.00
REF_Light	PG&E	15%	14%	25%	27%	19%	1.00	1.00
REF_Light	SCE	12%	10%	13%	38%	27%	1.00	1.00
REF_Light	SDG&E	12%	12%	20%	32%	23%	1.00	1.00
S36_HVAC	Region 1	15%	12%	30%	16%	27%	1.45	0.79
S36_HVAC	Region 2	14%	12%	32%	16%	26%	1.36	0.90
S36_HVAC	Region 3	15%	13%	31%	16%	25%	1.36	0.81
S36_HVAC	Region 4	15%	13%	33%	15%	24%	1.29	0.87
S36_Light	PG&E	15%	14%	25%	27%	19%	1.00	1.00
S36_Light	SCE	12%	10%	13%	38%	27%	1.00	1.00
S36_Light	SDG&E	12%	12%	20%	32%	23%	1.00	1.00
S36_Motor	PG&E	10%	11%	32%	19%	28%	1.00	1.00
S36_Motor	SCE	8%	7%	20%	24%	43%	1.00	1.00
S36_Motor	SDG&E	9%	10%	25%	26%	30%	1.00	1.00
S36_Proc	PG&E	11%	12%	29%	23%	25%	1.00	1.00
S36_Proc	SCE	9%	5%	20%	24%	42%	1.00	1.00
S36_Proc	SDG&E	10%	9%	25%	26%	30%	1.00	1.00
WWT_Ele	PG&E	15%	13%	23%	27%	23%	1.00	1.00
WWT_Ele	SCE	15%	13%	23%	27%	23%	1.00	1.00
WWT_Ele	SDG&E	15%	13%	23%	27%	23%	1.00	1.00