TURN Comments on the IOUs' "60 Day Report" on Modifications to their 2010-2012 Energy Efficiency Portfolios based on Energy Division's 2006-2008 EM&V Reports

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I. Introduction and Overview

Pursuant to Decision 07-09-043[1] the IOUs are required to submit a report on how they will modify their 2010-2012 Energy Efficiency (EE) programs per Energy Division's (ED) Final Performance Basis Report:

> Within 60 days of public release, program administrators will respond in writing to the final report findings and recommendations indicating what action, if any, will be taken as a result of study findings as they relate to potential changes to the programs. Energy Division can choose to extend the 60 day limit if the administrator presents a compelling case that more time is needed and the delay will not cause any problems in the implementation schedule, and may shorten the time on a case-by-case basis if necessary to avoid delays in the schedule.

ED issued its "Draft 2006-2008 Energy Efficiency Evaluation Report" April 15, 2010, and the final "2006-2008 Energy Efficiency Evaluation Report" July 8, 2010. ("ED's Report").[2] ED's Report adjusts the IOUs' reported accomplishments (savings and cost-effectiveness) per the thirteen ED consultants' 2006-08 evaluation studies ("Consultants' Reports). ED's Report also provides findings and recommendations to improve next cycle EM&V, savings, and cost-effectiveness.[3]

The Consultants' Reports also contain additional critical information and data concerning changes to portfolio market strategies, programs designs, and EE measures, to meet and exceed the Commission's EE goals in a reliable and cost-effective manner. Because the IOUs' 60-Day Report references ED's consultants' more extensive and detailed reports (which are in aggregate thousands of pages),[4] Energy Economics, Inc.

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[1] D.07-09-043, "Interim Opinion on Phase 1 Issues: Shareholder Risk/Reward Incentive Mechanism for Energy Efficiency Programs", September 20, 2007. Attachment 7; "Procedures for Review and Approval of Earnings/Penalties under the EE RRIM", "Final Claim", Item 5, page 4.

[2] Or per D.07-09-043, "Final Performance Basis Report."

[3] ED's Report, Section 2, provides summary findings and recommendations for program categories Residential, Commercial, Industrial and Agricultural, Codes & Standards. Non-Resource. Behavior Studies and IOU Process Evaluations are also discussed. Section 9 provides ED's high-level recommendations for programmatic, evaluation, and policy changes. For ease of review, the eleven recommendations are reproduced as Attachment 1.

[4] As discussed in more detail in Section V. Conclusion, many of the consultants did not employ a standard format or template; or provide findings and recommendations in a central location such as an executive summary or introductory section. This necessitated a great deal of effort on the part of Energy Economics, Inc. to extract comprehensive high-level findings that permit a summary of both the consultants' findings

(EE, Inc.) prepared Attachment 2, summarizing the ED consultants' findings and recommendations from the thirteen final reports.

Setting aside the insistent haggling by some parties that ED's 2006-08 EM&V work not be used as a reliable assessment of IOUs program achievement on the 2006-08 program cycle or through time,[5] the fact that ratepayer-funded EE programs are not achieving the desired results is inescapable. Before turning to our specific comments regarding the IOUs' 60-Day Report, EE Inc. offers the following observations:

- It is crucial to not lose sight of the fact that frustration with the M&V results does not mean the evaluation methods were flawed. In our view, the frustrations experienced to date do not so much reflect inadequacies in evaluation methods as they do a lack of innovation in program design, and conflicting commitments on the part of IOUs (on the one hand, to their shareholders who expect a rate of return,[6] and on the other, to the ratepayers who fund these programs and deserve cutting-edge programs and assurance that the state's energy and GHG goals are being met).

- California must focus on reducing energy consumption in absolute terms. Attachment 3, "Electricity Consumption Trends: California and the Rest of the

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and recommendations as well as an assessment of the degree to which the IOUs' 60-Day Report was responsive.

[5] See comments of the IOUs and NRDC in R.09-01-019 and R.10-05-006.

[6] While much attention is given to shareholder incentives for the IOUs' spending the ratepayers' money on EE programs, our reference here to "shareholders expecting a rate of return" concerns traditional "supply-side investment". That is, the utility industry maintains a high propensity for capital due to ongoing load growth and replacement and refurbishment of existing generation, transmission, and distribution (GTD) infrastructure. Even with aggressive EE(and other distributed resources), the nature of the business is, and will in large part remain, the production and delivery of electricity by means of capital-intensive facilities. Command over capital as a means of corporate survival and growth is not just desirable, but an utter necessity for electric utilities.

The ability to make capital investments is promoted when usage (particularly usage during peak periods) is growing. Most wires investments are driven by peak load growth in local areas (either increasing use per customer or increases caused by the addition of new customers). Generation investments are also often justified by the need to meet loads during unhedged peak periods. Recovery of capital investments requires IOU revenues that are at minimum stable and at best increasing over time. This is achieved by IOUs' cultivating electricity sales through the following occurrences: the addition of new customers; overall growth in use per customer; and retention and growth of sales during strategic high-cost periods.

U.S.", shows the per capita and absolute change in residential and total electricity consumption between 1960 and 2008 (California and the rest of the U.S.), as well as the reductions in consumption that are consistent with meeting AB32 targets. This data indicates that California's 2004-2008 per capita electricity consumption is increasing, and at a rate greater than in the rest of the U.S. Also, California's total consumption is also increasing, instead of trending downward responsive to AB 32.

- The biggest barrier to EE is the higher up front capital cost of more expensive but still cost-effective higher efficiency energy using equipment and appliances. Regardless of who administers ratepayer-funded EE programs, it makes sense to focus more squarely on making EE more affordable through on- and off-bill financing mechanisms and reducing the overhead cost of the current utility-rebate program design model. As Table 1 shows, the ratio of utility incentive to non-incentive costs ranges from approximately 40/60% PG&E, to 50+/ 50- % SCE, SDG&E/SoCalGas.[7]

[7] Source: PG&E June 30th Advice Letter Compliance Table 4.2; PG&E, SCE, SDGE and SCG November 2009 Compliance Table 4.2
The category Direct Implementation (Incentives & Rebates) includes Direct Install Labor Activity, i.e. incentives to contractors. The categories used in this table were created by ED in order to compare IOU budgets. While they are designed to make comparisons feasible, the categories and the budgets within them may not be entirely consistent across IOUs.

This analysis only captures a portion of the utility non-incentive costs associated with administering EE programs. The IOUs deliberately choose not to include significant portions of their administrative costs and their program costs in their EE budgets by leaving out labor overheads such as pensions, benefits, workers' compensation, payroll taxes, and administrative costs directly related to labor such as human resources departments and costs of office space. Application 08-07-021, "TURN Amendment to Comments on the Jt. IOUs' Revised Showings of March 2, 2009", April 23, 2009, Section H. Overall Spending and A&G Trends, beginning at page 64.

TURN Table 1: Budget Breakdown by E3 Cost Category (% total budget)				
	PG&E	SCE	SDGE	SCG
Administrative Costs	10.8	10.2	9.6	9.9
Marketing & Outreach	7.9	7.7	7.6	5.6
Direct Implementation (Non Incentives & Rebates)	36.9	25.4	24.8	26.7
EM&V Costs	4.0	4.0	4.0	4.0
Total Costs excluding Incentives and Rebates	59.5	47.3	45.9	46.2
Direct Implementation (Incentives & Rebates)	**40.5**	**52.7**	**54.1**	**53.8**
Total	100.0	100.0	100.0	100.0

II. Fundamental Issues Not Addressed in the IOUs' 60-Day Report

a. The IOUs do not consider the EM&V findings and recommendations on a comprehensive portfolio level basis.

TURN's main critique of the IOU's "60-Day Report" is that it ignores the fact that the 2006-08 IOU portfolios were found to have performed very poorly overall and much less well than was claimed.[8] The Consultants' Reports contain recommendations as to programmatic, evaluation, and policy changes that suggest significant revisions, overhauls, or in some cases cancellation of programs that did not meet expectations. But the IOUs' 60-Day Report avoids this level of scrutiny.

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[8] While important to consider the IOUs' portfolio performance relative to the CPUC goals (2004-08 performance results Jt. IOUs: 72%, 65%, and 71% of the GWh, MW, and therms goals), it is even more disturbing to consider how little the IOUs' EE efforts have impacted load growth.

The CPUC's EE 2004-2013 EE goals (D.04-09-060 September 23, 2004) were to reduce incremental load growth by 65% (i.e. goals to reduce incremental growth by slightly more than one-half). With the Jt. IOUs MW peak demand savings only 65% of the CPUC's goals, this equates to only a 42% savings of incremental load growth.

Because the actual load growth was higher than the forecasted (the 2004 goals decision relied on the CEC's 2003 load forecast), the IOUs' MW savings represent **only 27% of coincident peak** incremental load growth between 2004 and 2008.

(Basis of calculation: 2003-2013 Energy Demand Forecast used in setting the 2004-2012 EE goals forecasted an increase of 3,609 MW in coincident peak (CP) demand between 2004 and 2008. For this time period, CA CP demand increased by 5,285 MW – for an increase in actual over forecast of 1676 MW or 46.5%. CEC 100-03-022, August 2003: http://www.energy.ca.gov/reports/2003- 08-08_100-03-002.PDF and http://www.energy.ca.gov/2009publications/CEC-200-2009-012/index.html

The problems identified in the Consultants' Reports were not limited to individual programs, much less details of those programs, though all of these were also enumerated. The central findings and recommendations of the consultants' work is not adequately addressed by piecemeal responses to individual program-specific findings—which is all that is found in the IOUs' 60-Day Report—but deserves a comprehensive response that addresses the systemic shortfall in claimed accomplishments (energy savings and cost-effectiveness). Focusing on the details of a given program without acknowledging the in some cases much larger shortcomings is, to pick a car analogy, akin to rotating the tires when the trouble with the car is that the engine is ruined.

b. The IOUs do not discuss possible structural changes in market strategies and program designs.

It is important to keep in mind that the programs under review are strategies for delivering energy savings—means to an end. Continuing them should be contingent on their demonstrated ability to achieve the agreed upon goal. Beyond a certain point—after the same thoroughgoing criticisms have been made repeatedly—tweaking a program (or claiming that detailed changes will be pursued) may have become an end in itself, the pursuit of energy savings taking a back seat to continuing the program.

For instance, ED's Report Recommendation #5 notes that early warnings about a lopsided portfolio and expected underperformance were first ignored by the IOUs, and then borne out by the Consultants' Reports.[9] Although this summary statement includes three fundamental critiques: lack of diversity within the portfolio, failure to heed warnings about the likelihood of unacceptably low savings, and abysmal program performance, the IOUs'60-Day Report focuses almost exclusively on minutiae, or in some cases disagree with specific recommendations in ways that suggest an unacceptably slow phasing out of basic CFLs per D.09-09-047.[10] This is borne out by TURN's comparison of 2006-08 Energy Division *ex post* adjusted and 2010-12 IOUs' projected

[9] ED Report, July 8, 2010, Section 9. Recommendations, "The Commission's approval of the portfolio included strong warnings that the evaluated savings were likely to be much lower based on data that was available in 2004. Despite these warnings, only one IOU reduced the savings assumptions, while other IOUs ramped up bulb installations. In the end the evaluation found only about 25% of the reported CFLs to be installed and operating." (p. 133)

[10] D. 09-09-047 September 23, 2009, p. 123. The utilities take pride in collectively rebating over 95 million CLFs during 2006-08 through the upstream lighting program.

EE savings by end uses and lighting measure groupings presented in Section V and Attachment 4. Per the IOUs' 2010-12 portfolio compliance filings, the utilities EE portfolios appear to be more of the same 2006-08 short-term energy savings, with a significant contribution of the projected EE savings from basic screw-in CFLs: the IOUs' forecast of GWh energy savings from basic CFLs in 2010-12 is only about 100 GWh less than the ED's evaluated savings.

The CFL issue is further compounded by the IOUs' continuing ratepayer-discounted basic CFLs in the large home improvement retailers. Per TURN Attachment 2, Report #2 Upstream Lighting Program, p. 11, the fourth bulleted recommendation:

> "Eliminate basic twister/spiral-style CFLs rebates for CFLs in "big box" stores within the large home improvement, mass merchandise, and membership club channels."

This recommendation is not addressed at all in the main text of the IOUs' 60-Day Report, but rather in "the weeds" of the IOUs' 100+ page Attachment, (p. 4) where the IOUs appear intent on continuing to discount basic CFLs to the big box stores, albeit at reduced levels of up-stream incentives to the manufacturers.[11]

c. The IOUs do not recognize the dynamic nature of the portfolio; for instance sun setting of programs and/or energy efficiency measures is not considered.

[11] IOU Responses to EM Impact, Process, and Market Assessment Recommendations, Attachment, Residential Sub Program: 2006-2008 Upstream Lighting Program (ULP), (p.4):

"We have agreed to reduce the level of up-stream incentives to the manufacturers for selected retail stores. This alternative can produce results that reliably address the root purpose of the recommendation, but with better outcomes for the overall program. It is not possible for us to maintain our program without working relationships with an extensive network of retailers participating. Likewise, we need this same extensive network to help push advanced lighting products per your request. Restricting basic CFLs in some sectors may therefore have repercussions on specialty CFL success. Since this is a statewide program with local administration, each IOU will implement different strategies to try and accommodate this request.

Additionally, the IOUs believe that because we can compensate for free ridership issues using internal strategies, the sale of basic twister/spiral CFLs in Big Box will contribute to improving socket saturation at a volume not otherwise achievable. The IOUs believe this can be done cost-effectively according to current protocols."

In the present effort to implement "lessons learned" in the 2010-12 portfolios, the focus is not on how to stay ahead of the game, how to recognize the appropriate time to sunset programs that have achieved market transformation, or identify a scale on which to locate the scope or degree of change to program design called for by the EM&V. The IOUs interpreted the Commission's directive much more modestly: what individual program modifications do we have to make to the 2010-12 portfolios? There is no evidence of a larger vision that acknowledges what the evaluated portfolio has failed to accomplish, or articulates what the present version could achieve.

A larger view of what programs that seek to transform markets for energy-using products accomplish would suggest that a successful EE program reduce/eliminate the conditions which justified the program in the first place. Planning for a phasing out of a given program (or EE measure) is both prudent and suggests that those in charge recognize the dynamic qualities of market transformation and understand the larger context within which these programs operate.

d. The IOUs fail to grasp the significance of the high and rising levels of free ridership evident across a number of programs and measures.

While the basic relationship between free ridership and market transformation is recognized "In some cases, high free ridership can be viewed as a positive indicator of strong market driven efficiency,"[12] one of the obvious conclusions one might draw from this appears in ED's Report:

> "The evaluations also identify areas where net savings may be limited and indicate areas in which the market may be becoming transformed, meaning that no further utility programs and financial incentives to consumers may be necessary to encourage adoption of these technologies. In such cases, the promotion and placement by manufacturers, retailers and other market actors appears to be driving the natural market for efficient technologies." [13]

However, no discussion of this—of phasing out programs that have achieved market transformation as measured in part by free ridership—or its implications for program design are found in the 60-Day Report.

[12] Attachment 2, p.43 (Southern CA Industrial & Agriculture).
[13] 2006-2008 Energy Efficiency Evaluation Report, July 8, 2010, p. vii, emphasis by TURN.

The high levels of free ridership identified across many of the 2006-08 programs is one particularly glaring finding whose program design implications are for the most part misconstrued by the IOUs in their responses. The equipment and appliances featured in the Residential Retrofit program exhibited high free ridership rates (e.g., clothes washers (68-73%), furnaces (81%), dishwashers (76%), RAC (58-74%), downstream lighting (30-55%) etc.). Given the importance of this program and the number of program cycles for which it has been in existence,[14] these numbers strongly suggest a mature program, the need to change course.

e. The IOUs appear unmotivated to narrow the gap between utility-claimed accomplishments and Energy Division measured and verified savings.

The evaluated programs consistently and systematically evidence inflated claimed savings, generous assumptions, high—in some cases very high—free ridership, and a host of other characteristics that exaggerate the benefits anticipated from these programs. What is worse is that many of these negative findings not only point to programs that fell short in terms of their achievements, but the reports document persistent inflation of savings estimates in spite of past evaluation results that suggested these problems in previous program cycles.

Such "utility head-in-the-sand" behavior[15] will only yield a 2010-12 portfolio that serves to exacerbate what ED's Report noted disapprovingly as the widening gap between utility reported and independently measured and verified savings.

> The gap between reported and evaluated savings has been increasing since the 2002-2003 evaluation cycle. The utilities and the Commission established energy savings targets or goals for each program cycle. Using these goals as a benchmark, over the course of the last three program cycles the gap between reported savings and the goals increased, and the difference between evaluated savings and those same goals has also widened, suggesting far lower levels of actual savings. This trend, illustrated in Table 3, suggests that updated savings estimates based on

[14] Not to mention the federal stimulus funding of "Cash for Clunkers [Higher Efficiency Equipment and Appliances]".

[15] This of course sets aside the argument of NRDC that "based on principle" the Commission should use the old *ex ante* numbers rather than the new *ex post* verified numbers for the most important input parameters to the incentive mechanism. See R.09-01-019, Opening Comments of NRDC on Remaining Disputed Issues for the 2006-2008 RRIM True-Up", July 8, 2010.

evaluation results are not being incorporated into projected savings estimates in a timely enough fashion. In addition, the goals themselves, which may be based on similar assumptions, could quickly become outdated. It may also suggest some level of diminishing returns in incremental benefits available from the programs due to rising baseline efficiency level and a general increase in energy efficiency awareness among consumers in the marketplace, as compared to earlier planning assumptions.[16]

f. The IOUs take a passive role as Program Administrator; inappropriately assigning a variety of program design and implementation tasks and duties to Energy Division.

While Energy Division oversaw the EM&V process for the 2006-08 program cycle, the IOUs were and are in charge of running the programs and of assembling a portfolio that achieves the goals agreed upon for the State as a whole. To have any prospect of complying with short and long term objectives which the CPUC and other parties have identified for the State, the IOUs can ill-afford to play the student who's trying to get the professor to help him write the paper. The tone and content of the 60-Day Report fails to convey the IOUs' ownership of the situation, of the programs or how to exploit the results. ED is positioned to pass judgment on what the IOUs propose, program modifications they suggest, etc., but it is not encouraging to read that the IOUs "will request baselines from ED"[17]and "will request guidance from ED [on definitions of standard practice]."[18]

In general the IOUs have seen fit to enumerate extensive lists of minor adjustments to their existing portfolio that they promise to make to the 2010-12 programs. But the substantive reliance on ED when it comes to setting parameters for individual programs indicate what TURN sees as a troubling trend: as the programs fail or evidence poor levels of compliance, etc., the level of responsibility the IOUs take for the programs has shriveled. Relying on ED to coach them through changes that arise in response to the evaluation reports, suggests a desire to distance themselves from the failures identified, and if all else fails – entrench -- in what are still their programs.

[16] ED Report, p. viii.
[17] 60-Day Report, p. 52
[18] Ibid., p. 54.

III. Recurring Findings and Recommendations that are Inadequately Addressed in the 60-Day Report

a. Program activity tracking, documentation and reporting is significantly flawed.

The exhortation to improve program tracking, documentation, and reporting appeared throughout the consultants' final EM&V reports.[19] To have any hope of success, these programs need proper attention to these bookkeeping matters. A negative finding that cuts to the core program administration, and is so ubiquitous across programs deserves a more comprehensive response than the short quips found in the IOUs' 60-Day Report.

Without better tracking, documentation and reporting, the ability to evaluate how well a program performed is hampered: "We strongly recommend that, in future programs, the IOUs should be required to improve their verification rates as well as the quality of the documentation provided to substantiate their claims."[20] But tracking is not only important to evaluators, it also correlates with <u>better</u> results, as the following finding from the evaluation of the HVAC contract group suggests:

> "Programs which had better tracking of the parameters in the ex-ante estimates than others tended to have higher gross realization rates."[21]

The IOUs' response to this criticism in the 60-Day Report most frequently is simply: "the IOUs will adopt this recommendation."[22] Another approach taken by the IOUs is more equivocal: "Once the data requirements are established [i.e. by Energy Division], we can try to accommodate the reporting request," and is less than satisfactory.[23]

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[19] Residential Retrofit (p. 2, 8), Upstream Lighting (p. 11, 12, 17), HVAC (p. 20), Gov't Partnerships (p. 24, 25), Major Commercial (p. 34), Fabrication, Process and Manufacturing (p. 38, 41). All page numbers refer to Attachment 2.
[20] Attachment 2, p. 17.
[21] Attachment 2, p. 20.
[22] 60-Day Report, p. 31, 68, 69, 70, 71, and p. 87.
[23] 60-Day Report, p. 8 and p. 35. This also speaks to the IOUs' passive approach as Program Administrator, choosing instead to inappropriately place any number of program design and implementation tasks and duties on Energy Division discussed in Section II (f).

Inadequate tracking, documentation and reporting undermines the programs at several levels, and the cautious acquiescence to the recommendations does not evidence a proactive stance, a predisposition to making these programs work, or acknowledgement of the responsibility they have to get it right. The tone in which the IOUs agree to or consider complying with the recommendations suggests this information is altogether new rather than something they'd been told before. The ubiquity with which complaints about tracking, documentation, and reporting appeared across the portfolio suggests this to be an endemic problem.

As with the baseline findings (discussed below), problems with tracking and documentation are several. Bad or missing data is one example that does not reflect well on those charged with implementing the program. The Residential Retrofit program was, for instance, found to include "numerous examples of missing and/or incorrect measures and erroneous assignments. […] The tracking data was of limited value, in many cases not identifying the location of the installed measure."[24] The same problems were identified in the Government Partnerships program: "1. Claims of substantial savings were made where there was either no documentation or the documentation was insufficient to determine what actual field implementation of program measures occurred."[25]

But in the final evaluation report on Upstream Lighting the authors went further:

> IOUs should be required to improve their processes for program documentation, tracking and reporting to increase verification rates and better manage program operations. Specifically, IOUs should improve the accuracy, consistency, completeness and quality of program documentation submitted to substantiate claims. At a minimum, sales data and/or sell-through reports should be required on at least a quarterly basis if not monthly.[26]

Although the organization of the 60-Day Report makes this difficult, in the main text of the report EE, Inc. was unable to find any acknowledgment of problems with

[24] Attachment 2, p. 2.
[25] Ibid., p. 24.
[26] Ibid., p. 11.

documentation and reporting for the Upstream Lighting program. The IOUs' response per their 60-Day Report Attachment (p. 1) is fairly dismissive:[27]

> Improvement of verification rates is in line with IOU's continuous improvement initiatives, as are nearly all recommendations in the Impact Evaluation pertaining to program tracking, documentation, and reporting. Most of the recommendations are already standard program implementation practice for the IOUs, however, we are always open to further enhancements. Given the scope of this recommendation, we have concerns about the practicality for actual implementation.

b. The IOUs do not adequately address the elimination of rebates for standard practice energy efficiency improvements.

Another recommendation found in a number of the final evaluation reports is eliminating eligibility for those energy-using measures that are standard practice.[28] In light of the frequency with which consultants found programs to suffer broadly from poor quality control, the need for scrupulous attention to measure eligibility is an important first step in sorting out the problems dogging these programs. A sample response from the 60-Day Report suggests an unwillingness to take responsibility for addressing this most basic of problems:

> "The IOUs are aware that a standard practice is very difficult to define for some industries and will request guidance from ED for such cases."[29]

Although standard practice certainly varies across sectors and over time, the premise of an EE program that purports to accelerate adoption of more efficient variants of available end use technologies is that the market is dynamic. Staying ahead of the curve requires regular updates of the specifications, and provisions for avoiding the kinds of problems identified in these reports. The evaluators point out how the IOUs failed to do this for a number of programs, most notably Commercial Facilities, Codes and Standards, PG&E's Agriculture and Food program, PG&E Fabrication, Process and

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[27] Ibid at 6.
[28] Southern California Industrial and Agricultural Contract Group (p. 29, 30), Major Commercial (p. 34, 36), PGE Fabrication, Process, and Manufacturing Contract Group (p. 38, 40, 42, 43). All page numbers refer to Attachment 2.
[29] 60-Day Report, p. 54.

Manufacturing, Major Commercial Contract Group, and Southern CA Industrial & Agriculture.

An example of a program structured around misspecifications was found in the Southern CA Industrial & Agriculture Program: drycleaner pipe insulation. This effort appears to be a solution looking for a problem that isn't there. Because the compounding problems were so numerous EE, Inc. quotes at length from the consultants' report:

> As noted previously, the dry cleaners segment accounts for 78 percent of pipe insulation sites in the SCG tracking system and about 64 percent of total ex-ante gross impact therm claims. The dry cleaner segment has a lower realization rate than other business type segments (4.6 versus 15.3 percent). This is due to a combination of many factors, including finding lower-than-assumed operating hours, and higher-than-assumed ambient air temperatures. In addition, there was a high likelihood of pre-existing insulation at these sites.
>
> Setting aside the issue of program qualifying status, the laundries achieve just 12 percent of the ex-ante therm impact claim. That is, the realization rate would be 12 percent if we calculated the gross impact relative to bare pipe on all dry cleaner installations, not just program qualifying. In addition, there is a substantial portion of laundry sites with non-program qualifying installations. Thirty-four of the 47 laundries in the on-site M&V sample had pre-existing insulation before the retrofit. The final gross impact realization rate for dry cleaners in SCG service territory is 4.6 percent.[30]

The IOUs fail to mention pipe insulation, dry cleaners, or any of the specific criticisms of this program in either their 60-Day Report or in the Attachment.

Another example involves pump testing in SCE territory: which was found to be so popular that participants were testing their pumps outside of SCE territory without any subsidy. Termed spillover in the evaluation report, this observation suggests advanced levels of market transformation and the need to explore when to phase out the program. It is worth repeating what the evaluators noted, that "The SCE pump test program has been in place since 1911."[31] No mention of the pump test program or its shortcomings is found in either the 60-Day Report or the Attachment. Left to their own devices it does not appear the IOUs are inclined to phase out a program once it is established.

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[30] Southern California Industrial and Agriculture, p. 3-25.
[31] Ibid. p. 5-16.

c. Quality control/quality assurance (QC/QA) (including verifying operational condition of retrofits such as HVAC units) is not sufficient.

While quality control/quality assurance (QC/QA) and verifying operational condition of hardware installations are both of particular interest to evaluators, inadequate attention to either can reduce program effectiveness and should receive attention from program administrators. As with several of the other findings identified here, it is not enough to design a program and then process paper work for the rebates. If the intervention is short-lived, the hardware fails, or something else goes awry, the effort may well be wasted, both in terms of energy savings (the main objective) as well as customer attitudes toward EE programs. A number of the IOUs' programs were found to need more attention to QC/QA or verification that what had been installed was in fact operational.[32]

Recommendations related to better QC/QA spanned several different areas, from a focus on "quality control related to data collection"[33] to "improve[ing] quality control on post installation file review to ensure as-built agrees with program files."[34] The IOUs' reply to this recommendation is:

> "IOU program managers thought this was happening, and procedures are being strengthened to fix problems."[35]

Although the IOUs' broad agreement with these recommendations is encouraging, the shortcomings noted in the consultants' reports were sometimes more serious than the language in the 60-Day Report and Attachment reflect. The overall picture that emerges suggests a low-level commitment to keeping tabs on how the work is actually performed, whether the effort yielded results commensurate with the effort and expense that went into the program. In the Government Partnerships program, for instance, these findings appeared:

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[32] Quality Control: Residential Retrofit (p.3), Commercial Facilities (p.25), Major Commercial (p. 34) and Operational verification: Upstream Lighting (p. 18), Southern California Industrial and Agriculture (p. 27), and Retrocommissioning (p. 34).
[33] 60-Day Report Attachment, p. 12.
[34] 60-Day Report Attachment, p. 75
[35] Ibid.

6. The implementer did not appear to exercise adequate quality control over the installation contractors or oversee adequate documentation of actions taken and/or measures implemented on site.
7. In some cases, the evaluation field tests showed that the units were not properly charged. Such a finding indicates that the field testing by contractors, measure implementation activities, or subsequent events in the field outside of the control of the program did not result in units with properly adjusted refrigerant charge.[36]

QC/QA isn't discussed by the IOUs in either the 60-Day Report or the Attachment.

d. Baseline data on existing energy use is very often incorrect or completely lacking.

A recurring issue noted in several[37] of the consultants' final evaluation reports is the lack—or improper specification—of baseline data. While the evaluation reports criticize the practice of using in situ baselines, the IOUs in their responses make no attempt to defend their established practice, and fail to take responsibility for the problem.[38] Baseline specification is arguably the most commonly recurring complaint, as reflected in the recommendations of the Fabrication, Process and Manufacturing evaluation report:

> End the practice of using in situ baselines over the EUL of the measure as the baseline for estimating savings and paying incentives. Identify projects explicitly in program files as replace-on-burnout, natural turnover, or early replacement. For the replace-on-burnout and natural turnover cases, baselines should be based on the efficiency of alternative new equipment, not the existing in situ equipment. In the case of early replacement, provide evidence and documentation of the remaining useful life of the equipment replaced, the estimated time at which the equipment would have been replaced in the future, and the effect of the program in accelerating early replacement."[39]

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[36] Attachment 2, p. 25.
[37] Especially in evaluations of Programs 7 and 10 in Attachment 2 (Southern California Industrial and Agricultural Contract Group, and PG&E Fabrication, Process and Manufacturing Contract Group).
[38] All EE, Inc. could find was the IOUs' assurance that they "agree with the recommendation" (see e.g., Recommendation 21, on p. 37 of the 60-Day Report).
[39] Attachment 2, p. 38.

Similar criticisms were leveled against the Southern California Industry and Agricultural Contract Group program:

> Baseline equipment was incorrectly selected for ex ante analysis in several of the site-specific gross impact (M&V) sample points. […] In the motor retrofit noted above, the resulting gross savings were zero after the remaining useful life due to the lack of any alternative to the project implemented by the customer (and the lack of any associated program effect).[40]

This matter of baseline specification was summarized in the IOUs' 60-Day Report[41] as:

> **Recommendation 3:** Improve baseline specification, baseline on alternative new equipment rather than in situ.
>
> **IOUs' Response: "**This recommendation is too detailed for inclusion in the PIP [Program Implementation Plan]."

The IOUs' response to this recommendation is more promising than most, but given their lack of interest in this matter to date, it is unclear how much of the promised attention will be paid to this issue:

> **Response:** The IOUs will improve documentation for baselines by developing and publishing baselines for a strategic number of cases. This process will involve external experts as appropriate. The IOUs will request baselines from ED as well. The IOUs acknowledge that the appropriate baseline, whether for new or in situ, depends upon the individual case and the options available to, and being considered by, the customer. The IOUs plan to work with ED to explore these scenarios to develop deeper understanding of the appropriate baseline specification.[42]

The repeated deference to ED in their response does not indicate a proactive stance or suggest the IOUs are taking responsibility for figuring this out. And it is not ED's responsibility to develop baselines for individual products or product categories, although a cooperative relationship is certainly helpful.

As discussed in the ED Report, other concerns link high baseline sales of efficient equipment with high free ridership. "…evidence of high baseline sales of efficient

[40] Attachment 2, p. 29.
[41] 60-Day Report, p. 54
[42] Ibid.

equipment (i.e., high free-rider/free-ridership).The programs should monitor any market data for similar evidence, and consider adjusting program offerings to focus on higher-efficiency products."[43] The 60 Day Report acknowledged this criticism as follows:

> **Recommendation 12:** Programs may want to take ENERGY STAR penetration data into account when selecting which efficiency level(s) to incent.
>
> **IOUs Response:** This is something we already do today. The program team monitors this data independently; in addition, the program baseline study also takes this data into consideration when assessing program measure baselines.[44]

IV. Program-Level Illustration via the Statewide Appliance Recycling Program (ARP) of Larger Problem: EM&V Critiques are more Serious than the Changes Proposed.

The Statewide Appliance Recycling Program (ARP)[45] illustrates the tendency to sugarcoat the findings and recommendations within the EM&V report. The IOUs focus on the details while ignoring the fact that the program itself has outlived its usefulness. The market for used refrigerators, of which the IOUs are aware,[46] evidence that the ARP has been superseded by the private sector's refrigerator collection efforts which do not rely on ratepayer funds. Several of these programs by Sears, Lowe's, and Best Buy have offered free haul away of old refrigerators since 2002 or before, The Home Depot has

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[43] ED Report, p. 14.

[44] 60 Day Report, p. 36.

[45] The overarching goal of ARP is to prevent the continued operation of older, inefficient appliances by offering customers an incentive and free pick-up service. A refrigerator recycling program has been implemented in California statewide since 2002, prior to which it had been implemented exclusively by SCE beginning in 1994. JACO Environmental (JACO) implemented ARP on behalf of PG&E, while The Appliance Recycling Centers of America, Inc. (ARCA) implemented the program within SDG&E's service territory. The two firms shared implementation responsibilities for SCE. An earlier effort by PG&E with a slightly different set of objectives collected roughly 25,000 operating second refrigerators per year beginning in 1978 and continuing through 1989.

Well over one million refrigerators and freezers have been collected through these programs in California alone. The ARP and its predecessor programs were limited to collection of second refrigerators until 1999 when collection of primary refrigerators was permitted. Since then the population of refrigerators collected has shifted heavily toward primary fridges, with roughly 2/3 of refrigerators collected in 06-08 program being primary refrigerators. To be eligible to participate in ARP, a refrigerator must be operable, larger than 10 cubic feet in volume, and operated by a residential utility customer. Though programs in the past have stipulated a minimum age requirement, no such requirement was in place for 2006 - 2008.

[46] See SCE's "An Evaluation of the SCE Appliance Recycling Program Retailer Trial Program," dated May 20, 2010.

offered this service since 2007.[47] In other words, the ARP is approaching 100% freeridership!

The Residential Retrofit Final Evaluation Report includes several thoroughgoing criticisms of the ARP, including the observation that for the first time a majority (56%) of refrigerators collected in this program cycle were manufactured during a period (1993 and younger) which the US DOE was concurrently identifying as being too energy efficient to warrant collection.[48] Although this trend toward post-1992 refrigerators was observed to be accelerating, the IOUs do not take up this matter in their replies. Nor do they address the even more troubling finding that inefficient (i.e. older)[49] refrigerators apparently no longer have any resale potential in California:

> "the used dealers provided information that newer, less than 5 to 10 years old, well maintained (or easily fixable) refrigerators had market value. All older appliances, especially those lacking more recent features (e.g., through the door water/ice) had little to no value."

The report goes on to note,

> "it can be assumed that all units greater than 10 years of age, discarded through a new or used appliance dealer, would have been destroyed independently of the program." [50]

The buffer between a ten year old refrigerator and a pre-1993 model offers additional assurance that it is no longer necessary to intervene on behalf of older refrigerators that program assumptions suggest might have been re-sold in the past.

Also, per the ARP's initial objective of reducing the population of secondary refrigerators, California Energy Commission data on second refrigerators in CA households over time shows that the proportion of CA households that are estimated to have more than one refrigerator operating today is not appreciably lower than when the program began. According to Glen Sharp of the CEC, the saturation of refrigerators in

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[47] Reuben Deumling, personal communication with representatives of these stores, March, 2010.
[48] US DOE, "Refrigerator Market Profile 2009," p. 1-7.
http://www.energystar.gov/ia/partners/manuf_res/downloads/Refrigerator_Market_Profile_2009.pdf
[49] Refrigerator vintage has long been established as a useful approximation of inefficiency.
[50] Attachment 2, p. 10.

CA is still estimated to be 1.19, which translates to roughly one in five households having more than one refrigerator. This number has not changed appreciably since 1980, the first year for which the CEC collected data on this question.

The combination of a successfully transformed market for *used* refrigerators and a rapid increase in refrigerators collected through the program that should not be eligible on energy grounds, the encroachment of the private sector into this realm, and that fact that ARP has not impacted /reduced the saturation of secondary garage/basement refrigerators, all suggest modifications to the program that register on an entirely different scale than what is found in the IOUs' responses.

V. Comparison 2006-08 Energy Division *ex post* Adjusted and 2010-12 IOUs' Projected EE Savings: End Uses and Lighting Measure Groupings

Per the IOUs' 2010-12 portfolio compliance filings, the utilities EE portfolios appear to be more of the same 2006-08 short-term energy savings, with a significant contribution of the projected EE savings from basic screw-in CFLs. Attachment 4 provides eight pie charts provide a comparison of 2006-08 ED ex post adjusted and 2010-12 IOUs' projected EE savings by GWh energy and MW demand at the (1) end use (pie charts 1-4), and (2) lighting key measure (pie charts 5-8), categories.

Pie charts 1- 4 show that end use lighting is projected to be 52% of the GWh energy and 44% MW demand 2010-12 IOU portfolio EE savings as compared to 61% and 51% GWh energy and MW demand 2006-08. Instead of plowing significant new lighting ground via LEDs and systems approaches, pie charts 5-8 show that CFLs still constitute the majority of lighting savings. While the pie charts present a percentage comparison, it is important to note that the IOUs' forecast of GWh energy savings from basic CFLs in 2010-12 is only about 100 GWh less than the ED's evaluated savings. On the whole, EE, Inc. is very concerned that the IOUs 2010-12 lighting program has not changes significantly from previous years, leaving us with the reality that ratepayer-subsidized CFLs reside on the shelves of large home improvement retailers.[51]

[51] Ibid at 6.

V. Conclusion

Updating goals and savings estimates based on evaluation feedback is one, albeit an important, improvement, but it is myopic to assume or hope that this change would take up all the slack evidenced by the evaluation reports, eliminate the discrepancy between the reported and verified savings numbers. The detailed responses to findings and recommendations enumerated in both the 60-Day Report and the Recommendations Report Attachment indicate some recognition of the need for improvements in the structure or execution of the programs, but this limited attention misses the higher-level findings that cast doubt on the overall project. What is missing is the program administrators' will to get the most important numbers right, to grasp the extent to which the program design and execution has failed to meet the goals. Low quality of execution, poor attention to program design, no due diligence, failure to incorporate past EM&V results that found the same problems identified for this program cycle in past evaluations add up to something substantially less than a passing grade.

In terms of consequences for <u>market strategy and program design,</u> the present set of responses found in the IOUs' 60-Day Report do not draw the conclusions which EE, Inc. considers adequate. In several cases the consultants writing the final evaluation reports note that their findings mirror or in some cases are <u>even worse</u> than findings from past EM&V efforts.

> Previous evaluations have identified many of the same issues as identified in this evaluation yet these key problem areas do not seem to have been adequately addressed. This raises a concern as to whether previous evaluation results have been seriously considered or simply cannot be successfully addressed.[52]

The pattern that emerges consists of lax eligibility, insufficient documentation, and high free ridership on the one hand, and optimistic assumptions about savings and cost-effectiveness on the other. The combination has driven a large wedge between ex ante claims and ex post verified savings that the IOUs can't pin on anyone else. To remedy this poor performance it is incumbent on the IOUs to articulate program (*and portfolio*) modifications that are commensurate with the findings and recommendations

[52] Attachment 2, p. 43 (PG&E Fabrication, Processing, & Manufacturing)

of the programs as evaluated. But EE, Inc. has been unable to find evidence of these in the IOUs' 60-Day Report.

Drawing together the information contained in Attachment 2: "Summary of Energy Division's Consultants Final 2006 - 2008 EM&V Report Findings and Recommendations" should have been a relatively straightforward endeavor, but because the individual final EM&V reports varied so much in their structure and the emphasis placed on summarizing the key findings and recommendations, it took a great deal of work to assemble a coherent summary of the findings and recommendations from across the thirteen consultants' reports. EE Inc., faced a similar hurdle when summarizing the high level quantitative information contained in these reports, which in some cases were located prominently and arranged in accessible form, though in other cases these data were buried deep in the reports or were missing altogether.

To simplify extraction of this kind of meta-level information from future EM&V reports, EE, Inc. recommends that ED publish a template in advance. With a template it should be possible in the future for a reader to quickly find and extract several pages from each final report containing the important findings and recommendations (both quantitative and qualitative for purposes of analyzing progress on the larger questions energy efficiency is meant to address.

ATTACHMENT 1:
Summary Energy Division's High-Level Recommendations for Programmatic, Evaluation, and Policy changes.
"2006-2008 Energy Efficiency Evaluation Report" July 8, 2010

9.1 Recommendations for Programmatic Changes

1. Results from the evaluations should be used for improving savings estimates and informing program design in the 2010-2012 cycle and beyond.

2. Program implementers must improve program tracking data collection and maintenance to ensure proper accounting for the technologies installed and actions taken so proper credit can be given.

3. Program implementers should ensure that program rules guiding eligibility are followed.

4. Program implementers should screen large project participants to ensure that net savings are achieved, not those that would have occurred absent the program.

5. The IOUs' energy efficiency program portfolios should diversify the programs and measures they offer so savings are not heavily concentrated in one measure or market delivery strategy as was the case with standard compact fluorescent bulbs in the 2006-2008 program cycle. and operating.

9.2 Recommendations for Evaluation Changes

6. Energy Division should continue to improve on collaboration with implementers and other stakeholders to build the value of evaluation products and results.

7. Future evaluation studies should be designed and implemented in coordination with program implementation to have greater influence on mid-course corrections and improving estimates along the way.

8. Review of cost data submitted by the utilities, including the costs of installed technologies or measures within the programs, must be integrated into future energy efficiency evaluations to appropriately measure cost-effectiveness of the portfolios.

9. Early notification strategies should be implemented to enable analysis prior to installation of the technology or action taken in order to better capture the impact of the intervention.

9.3 Recommendations for Policy Changes

10. The Commission should consider evaluation priorities for future program cycles that recognize expanded program and policy objectives for energy efficiency. The evaluation framework for 2006-2008 may not address the multiple and diverse evaluation needs for meeting AB32, the California Strategic Plan for Energy Efficiency, and Long-Term Procurement Plan objectives.

11. The incentive mechanism should segregate the measurement of savings and cost-effectiveness from earnings in order to remove disincentives to making productive use of the information flowing from the EM&V work and encourage the pursuit of all Commission energy efficiency policy goals.

ATTACHMENT 2:
Summary of Energy Division's Consultants
Final 2006-2008 EM&V Report Findings and Recommendations

1. Residential Retrofit High Impact Measure Evaluation Report

The Cadmus Group, Itron, Jai J. Mitchell & Associates, KEMA, PA Consulting Group, Summit Blue

This report includes 12[1] High Impact Measure (HIM) groups: Furnaces, Clothes Washers, Dishwashers, HE Gas Water Heaters, Showerheads and Aerators, Insulation, Refrigerator Recycling, Room Air Conditioners, Pool Pumps and Motors, and the Downstream Lighting Program.

Programs included are:

1. PGE2000, SCG3517, SCG3510 (Furnaces)
2. SDGE3023, PGE2000, SCG3517 (Clothes Washers)
3. SDGE3024, PGE2000, SDG3517 (Dishwashers)
4. SDGE3024, PGE2000 (Water Heaters)
5. SDGE3035, SDGE3017, SCG3517 (Showerheads, Faucet Aerators)
6. PGE2000, SCG3517, SDGE3024 (Insulation)
7. PGE2000, SCE2500, SDGE3028 (Appliance Recycling)
8. PGE2000, SDGE3024, SCE2501 (Room Air Conditioners)
9. SDGE3024 (Pool Pumps)
10. PGE2000, PGE2078, SCE2502, SCE2501, SDGE3017, SDGE3006 (Downstream Lighting)

Findings and Recommendations are found on the following pages of the report:
p. v-vii, p. 22-23, p. 48-49, p. 60-63, p. 74-77, p. 88-90, p. 101-111, p. 150-152, p. 173-75, p. 186-88, p. 204-06

Recommendations and Discussion of Findings

The evaluation of the Residential Retrofit Programs revealed a number of high-level findings and recommendations, including:

- ***The assumed UES values should either correctly apply the most recent DEER values or clearly document, through work papers, how the values were derived***. There were a number of examples, including furnaces and dishwashers, where IOUs had incorrectly applied DEER values (e.g., one utility apparently mistakenly claimed the dishwasher annual kWh savings as the annual therm savings). In addition, in a number of cases (e.g., clothes washers, showerheads/aerators, insulation, and room ACs), the utilities were unable to provide the full set of work papers that were used to determine the claimed savings values. The source of the claimed savings values should be fully transparent to any reviewer.

- ***The self-report approach identified a number of programs with high free-ridership. Programs should continue to monitor for evidence of high free-ridership and adjust program offerings accordingly***. For example, the National ENERGY STAR retailer partner data has demonstrated consistently high market share for ENERGY STAR dishwashers, even after standard changes in 2007, providing some evidence of high baseline sales of efficient equipment (i.e., high free-rider/free-ridership). The programs should monitor any market data for similar evidence, and consider adjusting program offerings to focus on higher-efficiency products (e.g., more efficient CEE10 tier levels).[2]

- ***IOUs should provide detailed guides/maps between E3 calculators and tracking database***. There were numerous examples of missing and/or incorrect measures and erroneous assignments. This can be facilitated by providing a consistent unique ID associated with each

[1] Refrigerant Charge and Airflow and Upstream Lighting are treated separately, leaving ten HIMs.
[2] Information on the Consortium for Energy Efficiency (CEE) can be found at http://www.cee1.org

transaction/record within their tracking database that does not change by reporting year/quarter, and by providing a consistent unique ID associated with each E3 line item to ensure there are not duplicative records in the E3.

There were also a number of important measure- and program-specific findings and recommendations, including:

- ***Furnaces* (PGE2000, SCG3517, SCG3510)**: The findings relating to the temperature set points indicate that additional study is needed to determine the actual gas consumption of furnaces at the different efficiency levels across climate zones and to measure the sensitivity of these set-points to actual weather conditions, fuel prices and economic conditions. At a minimum, it would appear that the assumptions in DEER should be updated to reflect the actual settings that occupants are using.

- ***Clothes Washers* (SDGE3023, PGE2000, SCG3517)**: As both electric and gas savings were documented during our evaluation activities, dual-fuel utilities like SDG&E may wish to consider claiming savings on both fuels for efficient clothes washers. Further investigation regarding the amount of dryer usage and alternative drying methods may also be warranted as part of future evaluation efforts.

- ***Showerheads and Aerators* (SDGE3035, SDGE3017, SCG3517)**: Future evaluations should consider modeling the change in actual hot water usage based on the installed measure definition. The change in hot water use (measured in gallons per day) is a critical parameter and modeling impacts would benefit from current pre- and post-measurement data. Additionally, IOUs should coordinate closely with water utilities to avoid duplication of efforts.

- ***Insulation* (PGE2000, SCG3517, SDGE3024)**: Utilities should conduct more frequent and rigorous site inspections to check that installations are meeting program eligibility requirements. This evaluation found that a substantial number of insulation participants did not meet the program eligibility requirements, typically because pre-existing attic insulation exceeded the program limit of R-11 or wall insulation was already present or installed between two similarly conditioned/unconditioned spaces.

- ***Refrigerator Recycling* (PGE2000, SCE2500, SDGE3028)**: The evaluation recommends that future evaluations utilize *in situ* metering (as opposed to the United States Department of Energy (DOE) lab testing, or a combination of approaches) to evaluate the savings generated by refrigerator recycling. *In situ* better accounts for usage and household characteristics in the participating population compared to DOE testing, plus standalone *in situ* metering would reduce evaluation costs while still achieving robust results. The evaluation further recommends that greater emphasis be placed on quality control related to data collection, including the accurate collection of all relevant appliance characteristics such as configuration, age, and size. These are critically important to the estimation of gross savings.

- ***Pool Pumps and Motors* (SDGE3024)**: Utilities should consider conducting enhanced verification to ensure that program participants are eligible for incentives. For example, the evaluation found that approximately 20% of SDGE3024 participants had installed pumps that were not eligible for the program. In addition, 30% of SDGE3024 Pool Pump Reset Agreement participants reported on their applications that they were not running during peak hours prior to participation (and thus ineligible), yet these customers were still sent incentives and included as program participants.

- ***Downstream Lighting Program* (PGE2000, PGE2078, SCE2502, SCE2501, SDGE3017, SDGE3006)**: The Downstream Lighting Programs should provide more accurate and verifiable data in the IOU tracking database so the measures can be more easily verified by third party evaluators. The tracking data was of limited value, in many cases not identifying the location of the installed measure. The programs should also improve the quality of the program fixtures to mitigate early failures and make sure that property managers have spare bulbs and access to low-cost replacement bulbs.

1. Furnaces (PGE2000, SCG3517, SCG3510)

While the PGE2000 HIM verification efforts revealed that all (100%) of the furnaces were installed and operating in the PG&E service territory, the net of free-ridership analysis indicated that more than three quarters (81%) of the participants were free-riders.

2. Clothes Washers (SDGE3023, PGE2000, SCG3517)

Free-ridership is far higher than predicted. While the IOUs had only assumed 20% free-ridership, the self-report NTGR estimated free-ridership of 68%-73%. The self-report NTGR is also substantially higher than the market share data reported by the Department of Energy (DOE). The National ENERGY STAR Retailer Partners are required to annually provide sales data to the DOE for dishwashers, clothes washers, room air conditioners, and refrigerators. In 2006-2008 the National ENERGY STAR retailer partners reported the market share data for ENERGY STAR clothes washers (which is also inclusive of all the more efficient CEER tiers) was 38% in 2006, 42%, and 24%, respectively. Additionally, the 2007 Itron Market Share Report42 found that 45% of California clothes washer sales were ENERGY STAR rated or higher. While this is not an estimate of free-ridership, it is an indication that sales of ENERGY STAR clothes washers were in the 24%-42% range throughout the U.S., substantially lower than the self-reported estimate of free-ridership in this study.

Unit Energy Savings (UES) are generally lower than claimed. The metered data reveal that, in general, expected gas energy savings are substantially lower than the claimed savings values. Because work papers were unavailable it is difficult to determine what assumptions went into the utility values.

Table 45. Summary of Key Evaluation Parameters for Clothes Washers

Parameter			IOU Claimed (A)	Evaluated (B)	Difference (A-B)
SDGE3023	NTG		0.80	0.31	0.49
	% Installed		100%	99.4%	0.6%
	ENERGY STAR Clothes Washer (2006-2008)	UES: Therms/year	21.9	12.82	9.08
		UES: kWh/year	-	102.49	-102.49
PGE2000	NTG		0.80	0.31	0.49
	% Installed		100%	99.5%	0.5%
	ENERGY STAR CEE Tier 1 MEF 1.60 /1.80	UES: Therms/year	15.00	4.07	10.93
		UES kWh/year	69.60	177.17	-107.57
		UES: kW/year	0.00	-[49]	0.00
	ENERGY STAR CEE Tier 1 MEF 1.80	UES: Therms/year	20.00	4.07	15.93
		UES kWh/year	79.20	177.17	-97.97
		UES: kW/year	0.00	-	0.00
	ENERGY STAR CEE Tier 2 MEF >= 2.0 WF 4.6 - 6.0	UES: Therms/year	17.73	10.17	7.56
		UES kWh/year	272.80	288.76	-15.96
		UES: kW/year	0.17	-	0.17
	ENERGY STAR CEE Tier 2 MEF >= 2.0 WF 4.6 - 6.0	UES: Therms/year	19.70	10.17	9.53
		UES kWh/year	314.40	288.76	25.64
		UES: kW/year	0.18	-	0.18
	ENERGY STAR CEE Tier 3 MEF >= 2.0 WF 4.6 - 6.0	UES: Therms/year	20.00	10.17	9.83
		UES kWh/year	107.28	288.76	-181.48
		UES: kW/year	0.03	-	0.03
SCG3517	NTG		0.80	0.29	0.51
	% Installed		100%	98%	2%
	Tier 1	UES: therms/year	19.65	9.15	10.50
	ENERGY STAR Clothes Washer - Tier 1	UES: therms/year	7.25	9.15	-1.90

3. Dishwashers (SDGE3024, PGE2000, SDG3517)

While the SDGE3024 HIM verification efforts revealed that nearly all (99.7%) of the dishwashers were installed and operating in the SDG&E service territory, the net of free-ridership analysis indicated that approximately three-quarters of the participants (75.5%) were free-riders.

This high free-ridership rate, however, is consistent with the market share data reported by the Department of Energy (DOE). The National ENERGY STAR retailer partners are required to provide the DOE with annual sales data for dishwashers, clothes washers, room air conditioners, and refrigerators. In 2006, the National ENERGY STAR retailer partners reported that the market share data for ENERGY STAR dishwashers was 94%. In 2007 and 2008, more rigorous standards for ENERGY STAR dishwashers took effect, and market share decreased to approximately 80% and 67%, respectively. While this is not an estimate of free-ridership, it is an indication that sales of ENERGY STAR dishwashers were extremely high throughout the U.S., including in states where utilities did not provide incentives.

4. Water Heaters (SDGE3024, PGE2000)

This evaluation found a high percentage of free-riders for high-efficiency gas water heaters and conducted a search for market share data to provide additional context for the current findings.
Shower heads & faucet aerators:

SUMMARY OF KEY EVALUATION PARAMETERS

Table 79 provides key parameters for SDGE3035, SDGE3017 and SCE3517 low-flow showerheads, while Table 80 provides key parameters for SDGE3035, SDGE3017 low-flow faucet aerators.

Table 79. Summary of Key Evaluation Parameters for Low-flow Showerheads

Utility Program	Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
SDGE3035	NTG	0.89	0.72	0.17
	% Installed/Eligible	100%	80%	20%
SDGE3017	NTG	0.89	0.68	0.21
	% Installed/Eligible	100%	59%	41%
SCG3517	NTG	0.80	0.70	0.10
	% Installed/Eligible	100%	76%	0.24

Table 80. Summary of Key Evaluation Parameters for Low-flow Faucet Aerators

Utility Program	Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
SDGE3035	NTG	0.89	0.75	0.14
	% Installed/Eligible	100%	77%	0.23%
SDGE3017	NTG	0.89	0.59	0.30
	% Installed/Eligible	100%	59%	41%

6. Insulation (PGE2000, SCG3517, SDGE3024)

SUMMARY OF KEY EVALUATION PARAMETERS
The key areas evaluated with regard to measure impact are the energy savings and NTG ratio. Energy savings have been presented and discussed above. NTG ratios are summarized in Table 92 below.

Table 91. Insulation Per Unit Energy Savings Claimed and Evaluated

Utility Program	Measure	Climate Zone	Vintage[4] Code	Utility Claim Per Unit Therm Savings (A)	DEER 2005 Per Unit Therm Savings	Evaluated Realization Rate from CSA Model	Evaluated Per Unit Therm Savings (B)	Difference (A-B)
SCG3517	Attic Insulation	10	3, 4	0.0313	0.0313	156.40%	0.0490	0.0177
	Wall Insulation	10	3	0.0993	0.0993	36.28%	0.0360	(0.0633)
SDGE3024	Attic Insulation	7, 10	3, 4, 5	0.0227	0.0227	166.22%	0.0377	0.0150
	Wall Insulation	7, 10	3	0.0838	0.0838	42.93%	0.0360	(0.0478)

Table 92. Summary of Key Evaluation Parameters for Insulation

Program	Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
PGE2000	NTG Weighted (Therms)	0.80	0.26	0.54
SCG3517	NTG Weighted (Therms)	0.89	0.30	0.59
SDGE3024	NTG Weighted (Therms)	0.89	0.25	0.64

7. Appliance Recycling Program (PGE2000, SCE2500, SDGE3028)

Similar to the previous evaluation – which contained a robust market analysis of the used appliance market in California - the used dealers provided information that newer, less than 5 to 10 years old, well maintained (or easily fixable) refrigerators had market value. All older appliances, especially those lacking more recent features (e.g., through the door water/ice) had little to no value.

To investigate the "possibly" responses further, market research undertaken for this evaluation confirmed the findings of the previous evaluation that most new and used appliance dealers do not sell used refrigerators unless they are full-featured units less than 5 to 10 years old. Consequently, it can be assumed that all units greater than 10 years of age, discarded through a new or used appliance dealer, would have been destroyed independently of the program. This same assumption was applied to those participants indicating they would have donated their appliance to charity. Units less than 10 years of age discarded through these channels likely would have remained active, and therefore were not indicative of free-ridership.

As evident in the table, the *in situ* -based savings estimates – which were used to report evaluated gross savings – are considerably lower than the *ex ante* estimates.

Table 135. Per-Unit Gross and Net Energy Savings (kWh/Year) – 2006-2008 Refrigerator Recycling

Utility	Ex ante		DOE		In situ	
	Gross	Net	Gross	Net	Gross	Net
PGE	1,946	681	1,265	651	1,130	582
SCE	1,656	1,017	1,147	644	1,087	559
SDGE	1,946	681	1,136	657	960	494

While a downward trend in energy savings is typical of appliance recycling programs (each subsequent implementation cycle recycles increasingly efficient models), the magnitude of the difference between the 2006-2008 *ex ante* and evaluated savings is substantial and noteworthy for several specific reasons. First, as discussed in detail in the report, this evaluation departed from the historical precedent of using DOE testing to report energy savings in favor of *in situ* metering.

Second, for the first time a significant percentage (56%) of eligible appliances in the program were manufactured after the DOE's first appliance efficiency standard became effective (1993).

Third, for two of the utilities (PG&E and SDG&E) the *ex ante* values were based on the findings of the 2002-2003 statewide evaluation, not the more recent 2004-2005 evaluation.

8. Room Air Conditioners (PGE2000, SDGE3024, SCE2501)

Free-ridership is far higher than predicted. While the IOUs had only assumed 20% free-ridership, the self-report NTG estimated free-ridership of 58%-74%. This high rate, however, is somewhat inconsistent with the market share data reported by the Department of Energy (DOE).

Unit Energy Savings are generally lower than claimed Unfortunately, utility work papers were not available for this measure, so we are unable to expand on the reason for the disparity. Room AC measures are also not included in DEER 2004-2005 or DEER 2008.

9. Pool Pumps (SDGE3024)

The main area for improvement would be in verifying that the rebated unit was on the list of eligible pool pumps. Specifically, only 79% of single speed and 82% of multispeed pool pumps visited onsite were verified to be on the list of eligible pumps . Additionally, the inputs and algorithms used to calculate savings were updated in this evaluation resulting in a decrease in the claimed per unit demand savings and a decrease in the per unit energy savings . A summary of the claimed vs. evaluated key parameters is presented in Table 173 and Table 174.

Table 173. Key Evaluation Parameters for SDGE3024 Single Speed Efficient Pool Pumps and Motors

Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
NTG	0.80	0.32	0.48
% Installed	100%	96.7%	3.3%
% Qualified Model	100%	79%	21%
UES: kWh/year	650	578.6	11%
UES kW/year	0.104	0.373	259%

Table 174. Key Evaluation Parameters for SDGE3024 Multispeed Efficient Pool Pumps and Motors

Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
NTG	0.89	0.32	0.57
% Installed	100%	99.5%	0.5%
% Qualified Model	100%	82%	18%
UES: kWh/year	1400	810.1	42%
UES kW/year	0.54	0.153	72%

POOL PUMP RESET AGREEMENT FINDINGS AND RECOMMENDATIONS

The inputs and algorithms used to calculate savings were updated in this evaluation resulting in an increase in the claimed per unit demand savings (from 1 to 1.19kW) and a decrease in the per unit energy savings (from 900 to 217kWh) . A summary of the claimed vs. evaluated key parameters is presented in Table 175.

Because such a large percentage of participants in the Pool Pump Reset Agreement are considered ineligible, the IOUs should consider screening the program applications to verify eligibility before

incentives are paid to participants. As noted above, 30% of SDG&E Pool Pump Reset Agreement participants reported, on their applications, that they were not running during peak hours prior to participation, yet these customers were still sent incentives and included as program participants.

Table 175. Key Evaluation Parameters for SDGE3024 Pool Pump Reset Agreement

Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
NTG	0.89	0.73	0.16
% Eligible and compliant			
% Eligible	100%	51%	49%
% Compliant	100%	87%	13%
Total % Elig. And Compliant	100%	38%	62%
UES: kWh/year	900	217.2	76%
UES kW/year	1	1.19	19%

10. Downstream Lighting
Multi-Family Rebate Programs (PGE2000, SCE2502, SDGE3017)
Lighting Exchange Programs (SCE2501, SDGE3006)
Comprehensive Manufactured/Mobile Home Program (CMMHP) (PGE2078)

14.6 Discussion of Findings and Recommendations Downstream Lighting
MULTI-FAMILY LIGHTING FINDINGS AND RECOMMENDATIONS

Because the multi-family lighting programs varied so dramatically, so did the claimed savings and verification rates, as shown below in Table 201 through Table 202. While the NTG was typically not substantially different from the claimed values, the verification rate of the installed measures tended to be low. The IOUs could improve the DLP, and increase the future verification rate, in two ways:
Provide more accurate and verifiable data in the IOU tracking database so that the measures could be more easily verified by third party evaluators. The tracking data was of limited value, in many cases not identifying the location of the installed measure. In some cases the property manager could not even identify the program bulbs for the onsite inspectors.

Improve the quality of the program fixtures to mitigate early failures. Residents and property managers expressed frustration regarding the early failure of program bulbs, as well as the difficulty of finding replacement bulbs and the high cost of the replacement bulbs. In some cases, property managers replaced pin-based CFL program fixtures with traditional screw-based sockets as this was less expensive than purchasing a hard-to-find replacement bulb. Higher quality fixtures would minimize early failures, and making sure property managers have spare bulbs and access to low-cost replacement bulbs would prevent many cases of early fixture removal.

Table 199. Key Savings Parameters SDGE3017

Measure	Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
Interior CFLs	NTG	0.89	0.75	0.14
	% Installed	100%	71%	29%
	UES: kWh/year	43.46	36.28	7.19
	UES kW/year	0.006	0.003	0.003
Linear Fluorescents	NTG	0.89	0.72	0.17
	% Installed	100%	92%	8%
	UES: kWh/year	17.52	25.55	(8.03)
	UES kW/year	0.042	0.002	0.039

Table 200. Key Savings Parameters SCE2502

Measure	Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
Exterior CF Fixtures	NTG	0.78	0.75	0.03
	% Installed	100%	87%	13%
	UES: kWh/year	207.76129	166.16	41.60
	UES kW/year	0	0.006	(0.006)
Interior CF Fixtures	NTG	0.78	0.77	0.01
	% Installed	100%	71%	29%
	UES: kWh/year	54.68	57.87	(3.17)
	UES kW/year	0.005	0.004	0.001
Interior CFLs	NTG	0.78	0.78	0.00
	% Installed	100%	72%	28%
	UES: kWh/year	41.42	74.94	(33.52)
	UES kW/year	0.004	0.005	(0.002)
Linear Fluorescents	NTG	0.89	0.77	0.12
	% Installed	100%	77%	23%
	UES: kWh/year	17.80	38.14	(20.34)
	UES kW/year	0.002	0.004	(0.002)

Table 201. Key Savings Parameters PGE2000

Measure	Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
MF Interior CF Fixtures	NTG	0.89	0.80	0.09%
	% Installed	100%	87%	13%
	UES: kWh/year	94	73.08	21.05
	UES kW/year	0.012	0.005	0.006
MF Exterior CF Fixtures	NTG	0.89	0.80	0.09
	% Installed	100%	89%	11%
	UES: kWh/year	194.46	183.98	10.47
	UES kW/year	0	0.005	(0.005)
MF Interior CFLs	NTG	0.89	0.59	0.30
	% Installed	100%	89%	11%
	UES: kWh/year	145.81	97.94	47.87
	UES kW/year	0.018	0.007	0.011
MF Linear Fluorescents	NTG	0.89	0.81	0.08
	% Installed	100%	77%	23%
	UES: kWh/year	159.05	24.57	134.48
	UES kW/year	0.020	0.002	0.017

DISCUSSION OF LIGHTING EXCHANGE FINDINGS AND RECOMMENDATIONS

The two lighting exchange programs, SDGE3006 and SCE2501, have substantially lower evaluated savings than claimed savings. The free-ridership numbers were quite high (30% to 55%), and the claimed UES savings appeared to be excessively high: in some cases, the per-fixture claimed savings was upwards of 440 kWh.

Table 202. Key Evaluation Savings Estimates for Lighting Exchange

Measure	Parameter	IOU Claimed (A)	Evaluated (B)	Difference (A-B)
SDGE3006 (Interior CFL)	NTG	0.80	0.44	0.36
	% Installed	100%	100%	0%
	UES: kWh/year	47.4	31.60	15.75
	UES kW/year	0.00	0.00	0.00
SCE2501 (Interior CF Fixtures)	NTG	0.80	0.66	0.14
	% Installed	100%	93%	7%
	UES: kWh/year	67.69	37.69	30.00
	UES kW/year	0.00	0.00	0.00

2. Final Evaluation Report: Upstream Lighting Program Vol. 1

KEMA, The Cadmus Group

This report encompassed three types of high-impact measures (HIMs): screw-in compact fluorescent lamps (CFLs), energy efficient lighting fixtures, and light emitting diode (LED) measures. The Upstream Lighting Program was a component of PG&E's Mass Markets umbrella program, with the residential portion included within PGE2000 and the nonresidential portion included within PGE2080. For SCE, both the residential and nonresidential portions of the Upstream Lighting Program were included within the Residential Energy Efficiency Incentives Program (SCE2501). For SDG&E, the Upstream Lighting Program was considered a stand-alone, residential program (SDGE3016).

1. PGE2000 and PGE2080
2. SCE2501
3. SDGE3016

Findings and Recommendations are found on the following pages of the report: p. xiv, p. 71-88

Recommendations

The evaluation has produced the following high-level recommendations for program improvement:

- IOUs should use the results of this evaluation to validate/modify ex-ante energy savings and peak demand impacts for 2010-2012, especially for key parameters estimated through this evaluation including: leakage rates, residential v. nonresidential sales, installation rates, HOU, peak CF, and NTGR values.

- IOUs should be required to improve their processes for program documentation, tracking and reporting to increase verification rates and better manage program operations. Specifically, IOUs should improve the accuracy, consistency, completeness and quality of program documentation submitted to substantiate claims. At a minimum, sales data and/or sell-through reports should be required on at least a quarterly basis if not monthly. These reports plus additional documentation should be provided for every product rebated so that independent verification can be completed on a regular basis.

- IOUs should take measures to minimize sales to non-IOU customers, monitor the market for evidence of leakage both prior to and after the initial sale, and report quarterly on the results of these efforts.

- IOUs should continue to rebate basic twister/spiral-style CFLs but only within selected retail stores (i.e., discount stores, discount grocery chains, small/independent grocery stores, and small/independent stores of any type located in rural areas). IOUs should eliminate rebates for basic twister/spiral-style CFLs in "big box" stores within the large home improvement, mass merchandise, and membership club channels. Subsidization of any type of CFL should be considered a short-term strategy in light of upcoming changes to federal lighting efficacy regulations.

In addition, Energy Division and/or the IOUs should consider conducting the additional recommended studies to further improve the reliability of both gross and net impact estimates for future energy efficient lighting programs. We have offered several recommendations within two broad categories of analysis – i.e., extended analyses to be completed on the existing set of evaluation data, and additional studies leveraging existing evaluation data to fill gaps and track changes over time.

6. Findings and Recommendations

Overall, the IOUs realized about 25% of their ex-ante claims for net energy and 20% of their peak demand reduction claim.

6.1 Summary of Findings

Drivers of the differences between IOU claims and ex-post evaluated impacts are summarized below.

6.1.1 Quantity of Measures Sold to Residential and Nonresidential IOU Customers

Overall, the evaluation verified that nearly 98 million lighting products were rebated by the IOUs, shipped from participating manufacturers to various retailers throughout the state, and eventually sold to residential and nonresidential IOU customers. This represents a 13% adjustment from the IOU claim of nearly 113 million. This adjustment takes into account (1) the results of the invoice/application verification effort, (2) an assessment of product shipments not sold by December 31, 2008, (3) and sales to non-IOU customers (i.e., leakage).

6.1.1.1 Invoice/Application Verification

The results from invoice/application verification provided an estimate of the quantity of measures claimed v. verified. PG&E and SDG&E, 96% of the claimed units were verified and for SCE the verification rate was determined to be 99%. In addition to quantity of measures claimed, the verification effort assessed additional metrics such as the type of product rebated, the amount of the rebate paid, the name/location of the manufacturer and retailer shipping/receiving the products, and the shipment and sales dates. The verification effort also assessed the overall quality of the information and sources provided by the IOUs to document these metrics. The rates for all three verification results are shown in Table 37 by IOU.

Generally, PG&E exhibited the lowest overall verification score (85%) as well as the lowest overall quality score (62%). This was driven by records not matching between the invoice/application documents and the program tracking databases on more factors other than just quantity, as well as overall poorer quality of the documentation/sources provided by PG&E. In addition, several of PG&E's invoices/applications could not be verified at all (no documentation was provided to validate claims) and therefore these cases were not included in the ex-post savings analysis.

6.1.1.2 Shipment v. Sales

Given the upstream nature of this program, knowing exactly what types of and how many products were sold when through which retailers on which date is a key factor in determining net impacts. However, the IOU program tracking databases provided information about product shipments, not sales. The evaluation found that 12% of the units shipped in 2008 were not sold by the end of 2008. This is based on interviews with participating manufacturers, retail buyers and retail store managers, and it was generally confirmed as part of the installation rate analysis. Therefore, absent information on actual sales by year (if not by month and year), the evaluation result was used to adjust the quantity of measures claimed by the IOUs in 2008.

6.1.1.3 Leakage

The leakage rates estimated through this evaluation reflect the expected differences by IOU – i.e., PG&E experiences less leakage to non-IOU customers than SCE and SDG&E given the proximity of these two IOUs to highly populated, non-IOU service territories (i.e., LADWP, US-Mexico border). The leakage rates estimated through this evaluation seem reasonable given the upstream nature of the program as well as the sheer volume of shipments experienced during 2006-2008. It should be noted that the estimate of leakage developed through this evaluation does not take into account leakage prior to sale (i.e., shipments to retailers located outside of the IOU service territories) and/or leakage due to reselling (i.e., units purchased by IOU customers and then resold to non-IOU customers). For these reasons, the leakage rates estimated through this evaluation should be considered conservative. That said, there was little quantitative or qualitative evidence of significant leakage prior to sale and/or through reselling in large volumes.

Table 36: Ex-post Net Annual Energy and Peak Demand Impacts from the 2006-2008 Upstream Lighting Program[40]

All IOUs	Ex-post Net Annual Energy Impacts (kWh/yr)			Realization Rates		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	233,563,499	991,965,497	1,225,518,996	13%	31%	24%
Fixtures	5,515,310	34,698,155	40,213,465	12%	40%	30%
LEDs	3,642,433	55,774,810	59,417,243	28%	63%	58%
All Measures	242,711,241	1,082,438,463	**1,325,149,704**	13%	32%	**26%**
All IOUs	**Ex-post Net Peak Demand Impacts (kW)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	36,921	92,832	129,753	10%	31%	20%
Fixtures	907	3,304	4,211	64%	94%	86%
LEDs	2	0	2	0%	0%	0%
All Measures	37,831	96,136	**133,966**	11%	32%	**20%**
PG&E	**Ex-post Net Annual Energy Impacts (kWh/yr)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	117,737,877	451,606,531	569,344,407	9%	26%	19%
Fixtures	1,959,136	11,360,311	13,319,447	14%	25%	22%
LEDs	1,604,310	23,328,540	24,932,850	12%	77%	58%
All Measures	121,301,323	486,295,382	**607,596,706**	9%	27%	**20%**
PG&E	**Ex-post Net Peak Demand Impacts (kW)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	19,072	41,677	60,748	8%	26%	16%
Fixtures	318	1,092	1,410	23%	104%	57%
LEDs	0	0	0	0%	n/a	0%
All Measures	19,390	42,769	**62,158**	8%	26%	**16%**
SCE	**Ex-post Net Annual Energy Impacts (kWh/yr)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	104,222,710	488,030,297	592,253,008	20%	39%	34%
Fixtures	3,298,080	21,511,148	24,809,228	10%	60%	36%
LEDs	1,619,159	25,172,084	26,791,242	n/a	72%	76%
All Measures	109,139,949	534,713,529	**643,853,478**	19%	41%	**34%**
SCE	**Ex-post Net Peak Demand Impacts (kW)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	15,935	45,038	60,973	12%	41%	26%
Fixtures	546	2,028	2,574	n/a	94%	119%
LEDs	2	0	2	n/a	0%	2%
All Measures	16,484	47,066	**63,550**	13%	42%	**28%**
SDG&E	**Ex-post Net Annual Energy Impacts (kWh/yr)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	11,592,911	52,328,670	63,921,581	n/a	19%	23%
Fixtures	258,094	1,826,696	2,084,790	n/a	30%	34%
LEDs	418,964	7,274,186	7,693,150	n/a	31%	33%
All Measures	12,269,969	61,429,552	**73,699,521**	n/a	20%	**24%**
SDG&E	**Ex-post Net Peak Demand Impacts (kW)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	1,915	6,117	8,031	n/a	22%	29%
Fixtures	42	184	226	n/a	62%	77%
LEDs	0.4	0.0	0.4	1%	n/a	1%
All Measures	1,957	6,301	**8,258**	n/a	23%	**30%**

[40] The revisions to this table were submitted as part of the errata document posted on December 18, 2010.

Table 37: Summary of Full Results from Verification Effort

	Quantity Only	All Verification Metrics	Documentation Quality
PG&E	96%	85%	62%
SCE	99%	99%	88%
SDG&E	96%	94%	81%

6.1.1.4 Residential v. Nonresidential

PG&E and SDG&E assumed that a portion of the rebated measures would be installed in nonresidential settings. Generally, PG&E assumed a 90%/10% residential-nonresidential "split" for all of the measures rebated through the Upstream Lighting Program, and SCE assumed that 90% of screw-in CFLs would be installed in residential settings. SCE also assumed a portion of the fixtures and LEDs rebated would be installed by nonresidential customers. The evaluation determined that the residential-nonresidential "split" for the Upstream Lighting Program was as follows:[3]

- PG&E: 94% residential, 6% nonresidential
- SCE: 94% residential, 6% nonresidential
- SDG&E: 95% residential, 5% nonresidential

In the case of PG&E, this result had the effect of lowering the overall realized impacts as measures were shifted from a nonresidential to residential allocation. This also generally lowered SCE's realized impacts although for some measures (where no nonresidential savings were claimed) overall ex-post impacts were higher. SDG&E achieved higher overall realized savings due to this adjustment.

6.1.2 Gross Savings Inputs

Key differences between the ex-ante and ex-post gross savings inputs include:

- Screw-in CFL installation rates were found to be about 15% lower than ex-ante estimates for residential measures and about 7% lower for nonresidential measures.

- Per unit gross savings estimates were reduced by about half due to improvements in the estimates for annual operating hours, peak coincidence factors and delta watts. For example:
  - Ex-ante values for average daily residential HOU were about 2.2 and ex-post values were determined to be 1.8 for all IOUs.
  - For delta watts, ex-post values for the most commonly installed screw-in CFLs were about 20% lower than the ex-ante values.

These results are discussed in detail below.

6.1.2.1 Installation Rates

6.1.2.1 Installation Rates

The residential modeling and analysis completed as part of this evaluation was helpful in developing a much deeper understanding of the relationship between CFL acquisition, storage, installation, and removal. The evaluation was less successful in producing model results that showed the effect of the program over time in moving residential customers from non-users to partial users to saturated users, as well as the relating program activity levels to changes in purchase, storage and installation. Customers' responses were generally unreliable, which to some extent was expected. In addition, due mainly to the upstream nature of the program and the lack of reliable data on actual sale dates, program activity could not be directly mapped to purchase timing. Finally, changes in CFL usage within a given survey "wave" (telephone plus onsite verification) were inconsistent with changes between waves. Nevertheless, the approach used to estimate residential installation rates combined some elements of the modeling with some simpler estimation steps. Essentially, we constructed a trajectory that accounts for the flow of CFLs shipped and purchased, as well as rates of installation and replacement. This trajectory builds from the observed CFL use and storage rates in 2004-2005 to those observed through this evaluation in 2008- 2009. To remain consistent with evaluation policy and protocols, the evaluation produced and applied a "cumulative installation rate" for the residential sector (i.e., of all CFLs purchased or acquired through December 31, 2008, the fraction that had ever been installed). The cumulative installation rates calculated on this basis were lower than the ex-ante estimates, for all three IOU:

[3] The revisions for SCE and SDG&E were submitted as part of the errata document posted on December 18, 2010.

- PG&E: 67% (v. 76% ex-ante)
- SCE: 77% (v. 90% ex-ante)
- SDG&E: 67% (v. 90% ex-ante)

This is the most appropriate metric for calculating lifetime savings. While some measures installed in 2006 or 2007 may have burned out or broke by 2008, the average measure life accounts for some early losses. The residential installation rate analysis assumed a six-year average measure life. This is roughly consistent with the most recent DEER estimates, but lower than the program assumptions. This assumption was necessary to account for the total shipment volumes and the observed numbers of CFLs in homes at the end of 2008. Reassessment of measure life is outside the scope of this evaluation. Nonetheless, it is worth noting that a longer measure life assumption either would imply that a higher fraction of bulbs are never installed, or would leave a substantial fraction of program shipments unaccounted for. The approaches taken for residential v. nonresidential are slightly different – the nonresidential installation rate is expressed as the fraction of all CFLs purchased that were installed and operating during the verification period (early 2009), or what we have called the "cumulative surviving installation rate" in our residential analysis. The difference between these two approaches should produce higher installation rates for the residential v. nonresidential sectors since the residential method gives credit for measures that were installed at some point during 2006-2008 (but may have burned out or been removed) whereas the nonresidential method only gives credit for measures still installed post-2008. For example, in the residential analysis, the overall "cumulative installation rate" was 71% whereas the "cumulative surviving installation rate" for residential was 65%. However, the nonresidential installation rates determined for this program were higher than the residential estimates. Nevertheless, the nonresidential installation rates were generally in line with the IOU's ex-ante estimates:

- PG&E: 73% (v. 76% ex-ante)
- SCE: 81% (v. 90% ex-ante)
- SDG&E: 76% (v. 90% ex-ante)

Given this somewhat close alignment with ex-ante and the relatively small portion of the rebated measures installed in nonresidential applications (6% overall), there is little impact from the differences in the approaches used to determine installation rates for the residential v. nonresidential sectors.

6.1.2.2 Average Daily Hours-of-Use (HOU)

The average daily residential HOU estimates developed through this evaluation were found to be about 20% lower than was found in previous studies. This is likely attributable to increasing saturations of CFLs in homes. The analysis found that HOU tends to decline as saturations increase; however, this relationship was observed only for larger numbers (5 or more) of CFLs installed. This finding confirms that initial CFL installations tend to go into higher use fixtures. Average daily residential HOU estimates were produced for CFLs overall, as well as those identified as having been rebated through the program. In addition, HOU estimates were produced for a variety of different CFL types (e.g., twister/A-lamp shaped CFLs, globe-style CFLs, reflector-style CFLs, other). Table 38 presents the overall average daily residential HOU estimates for each category; IOU-specific estimates are provided in Appendix B.

6.1.2.3 Peak Usage

Peak usage (or coincidence factor, CF) was based on the same metering sample as annual HOU. Consistent with the HOU findings, across all CFLs, peak use was found to be lower than that found in previous studies. However, the relationship between saturation and peak usage was not as strong as it was for HOU. Statewide results by CFL type are shown in Table 41, and Table 42 presents statewide results for segments of interest. IOU-specific results are presented in Appendix B.

6.1.3 Net Savings Inputs

One of the largest impacts on the overall realization rate result for the 2006-2008 Upstream Lighting Program is the lower NTGR estimate determined through this evaluation for screw-in CFLs. This section discusses some of the complexities involved in determining the appropriate definition of "net" for the

Upstream Lighting Program, leading to our decision to rely on multiple methods for developing NTGR estimates. These complexities also made it more difficult to interpret and assess the reliability of the results from these estimation methods. In the end, the final recommended NTGR estimates represent our best judgment based on a preponderance of evidence.

6.1.3.1 Definitional Challenges

NTGR estimates are very difficult parameters to estimate for any upstream program and, in particular, for the 2006-2008 Upstream Lighting Program. First, the program, for the most part, does not collect information on customers who purchased the rebated products so typical contact methods (i.e., telephone surveys) are not as reliable. In addition, due to its upstream nature, the "program" is often completely transparent to the customer and, therefore, even if we knew who had purchased an IOU-discounted CFL, typical participant self-report methods for estimating free ridership are problematic because respondents cannot comprehend what is meant by the "with or without the program" scenarios.

In addition, manufacturers and retailers in some ways are the true "participants" in these types of programs – i.e., they receive the incentive payment directly from the IOUs and pass it on to the consumer in the form of discounted products. But for this very reason, the NTGR estimates of some participating manufacturers and retailer buyers may be biased, as discussed earlier in this report.

More importantly, by definition, upstream programs interact in the market differently than traditional downstream programs causing different types of both direct and indirect effects.

For example, in any given program year, the IOUs provide incentive allocations to specific manufacturers and/or retailers. This causes both direct and indirect effects in the market, with the indirect effects being very difficult to quantify. For example, "channel shift" (i.e., sales through one channel that may have occurred through other channels had the program allocation been different, if not zero) was assessed through this evaluation but quantified with great uncertainty. This uncertainty was not only due to the indirect nature of the effect but also due to incomplete information about consumer ability or willingness to shop more widely for CFLs if they could not find them in their usual shopping destinations. Similarly, the distinction between of participant v. non-participant spillover is blurred because of the upstream, transparent nature of the program.

Finally, the IOUs have been operating this type of large-scale, upstream program since at least 2004, with prior versions implemented as early as the late 1990s. Given the size of the 2006-2008 Upstream Lighting Program, and the momentum generated by prior program year efforts, it is difficult to establish an appropriate baseline against which to evaluate the net effects of the 2006-2008 effort alone. Distributing nearly 100 million discounted CFLs into California's market is likely to have had effects outside of California during 2006-2008 that cannot be easily measured now that the program is over. Similarly, having engaged with key players in the market as far back as the late 1990s and having a lead role in developing the upstream program model, the IOU programs in California have likely created cumulative effects that are no longer distinguishable from broader market changes that have taken place over this same time period and, in particular, toward the end of 2007 and into early 2008.[4]

6.1.3.2 Interpretive Challenges

It is within this complex and changing market context that this evaluation attempted to derive an estimate of NTGR for the 2006-2008 Upstream Lighting Program. Three different approaches were used with the hope of being able to triangulate for a final estimate:

- Supplier and consumer self-report methods
- Econometric models (e.g., pricing/conjoint elasticity models, revealed preference purchase models, stated preference purchaser elasticity models)

[4] See the CPUC's CFL Market Effects study for a more complete summary of CFL programs in California. In addition, the CFL Market Effects report discusses in much greater detail all the challenges of using quasi experimental California vs. non-California methods to try to measure the net effects of California's Upstream Lighting Program.

- Total sales (market-based) approach

However, self-report estimates from both suppliers and consumers were believed to be biased (in different directions). Some of the econometric models were based on data that were similarly biased in different directions (conjoint elasticity v. stated preference purchaser elasticity models). Finally, the total sales approach captured both cumulative program effects and non-participant spillover, the effects from which might also bias the results in both directions.

In the end, the final recommended NTGR estimates represent our best judgment based on a preponderance of evidence. Variations in the NTGR results by channel influenced the overall results in significant and meaningful ways (which, given the different IOU distributions by channel, caused variation in NTGR estimates by IOU). As a result, NTGR estimates that were not derived using channel specific estimates weighted to reflect the IOU-specific distributions were considered to be less reliable than those derived from channel-specific research.

In addition, given the challenges in identifying "participants" (as described above), results not directly linked to the Upstream Lighting Program (i.e., generic, self-reported CFL purchases, hypothetical CFL purchases or trade-offs, etc.) were considered less valid than results based on observed, actual IOU discounted CFL purchases.

Finally, given the timing of this evaluation (and the broad market changes occurring toward the end of 2007 and into early 2008, as discussed above), we are concerned that none of the NTGR results derived from the various methods can be considered representative of the 2006-2008 program. Most of the data collection that supported the various NTGR analyses was implemented between mid-2008 and mid-2009. The only NTGR estimate that was defined as representative of the full 2006-2008 program effect was based on the supplier self-report approach. However, we do not believe that these estimates, which tend to be the highest of all of the estimates, are accurately capturing the effect of this difference in timing – rather, it is likely that the supplier self-report estimates are higher than other estimates as a result of the respondent biases discussed in this report.

6.1.3.3 Final NTGR Estimates

The IOUs had been using 0.75-0.80 NTGR values for residential applications and, in some cases, up to 0.96 for nonresidential applications. The final recommended NTGR estimates values for the 2006-2008 Upstream Lighting Program were determined through this evaluation to be as follows:

- PG&E: 0.49
- SCE: 0.64
- SDG&E: 0.48

Despite the caveats discussed above and throughout the report, the final recommended NTGR estimates represent the most reasonable estimates available for attributing net impacts to the 2006-2008 Upstream Lighting Program. The main reason for the difference between the IOU-specific NTGR estimates has to do with variations in distributions by retail channel – i.e., SCE shipped a much greater portion of the rebated measures through channels for which the program has had the greatest influence on sales (e.g., discount stores, small grocery stores).

It is likely that these estimates may not represent the best estimates going forward since, as discussed above, the market for energy efficient lighting continues to change and the effects of ongoing IOU interventions, new standards, and changes in the broader California economic conditions may not have been adequately captured through this analysis.

6.2.1 Recommendations for Improving Program Tracking, Documentation and Reporting

- We strongly recommend that, in future programs, the IOUs should be required to improve their verification rates as well as the quality of the documentation provided to substantiate their claims.

6.2.2 Recommendations for Improving Program Design and Operational Performance

- Like many other jurisdictions throughout the US, California's IOUs should eliminate basic twister/spiral-style CFLs rebates for CFLs in "big box" stores within the large home improvement, mass merchandise, and membership club channels. These stores exhibit large volume sales outside the program. Even for specialty CFLs, subsidization within these channels is likely a short-term strategy due to the federal lighting efficacy regulations that go into effect in 2012.

6.2.3 Recommendations for Future Research and Analysis

- Lighting end-use consumption estimates. The 2009 statewide Residential Appliance Saturation Survey (RASS) instrument was administered to over 700 of the Residential Lighting Metering Study participants. These data have not been data entered or cleaned for use in the ongoing RASS analysis but could be leveraged for subsequent analyses. By combining RASS data with the detailed metering and inventory data for this sample of homes a much improved lighting endues consumption estimate could be developed. This analysis would require the annualization of the non-CFL lamps indicated above as another analysis activity to use the data from this evaluation.

3. HVAC High Impact Measures and Specialized Commercial Contract Group Programs

KEMA, The Cadmus Group, Summit Blue

This report encompassed a grouping of programs and measure evaluations consisting of three heating, ventilation and air conditioning high-impact measures (HVAC HIMs), including residential and small commercial applications as well as a grouping of programs and measures called the Specialized Commercial Contract Group (CG) consisting of and two non-HIM programs with M&V for measures with future potential, and a diverse array of relatively new, energy-efficiency programs directed at the non-residential sector.
The HVAC HIM evaluation measures looked at **refrigerant charge and airflow** (RCA), **air conditioner replacement**, and **duct-sealing**
Non-HIMs: Management Affiliates Partnership Program, Energy-Efficiency Program for Entertainment Centers, Upstream HVAC/PTAC, and Upstream HVAC/Motors Program.

1. PGE2000, PGE2078, SCE2502, SCE2507, SDGE3035 (Res RCA)
2. PGE2068, PGE2080, SCE2507, SDGE3043 (C&I RCA)
3. SCE2507, SDGE3029, (Res AC Replacement)
4. SCE2507, SDGE3029, PGE2080 (C/I AC Replacement)
5. PGE2000, PGE2078, SCE2502, SCE2507, SDGE3035 (Res Duct Seal)
6. SCE2537 (MAP: CO Sensor)
7. SCE2537 (MAP: Turbocor)
8. SCE2561 (Entertainment Centers: CO2 Demand Control Ventilation)
9. SDGE3029 (Upstream HVAC: PTAC/PTHC)
10. SDGE3029 (Upstream HVAC: High Efficiency Motors)
11. SCE2537 (MAP: CO2 Demand Control Ventilation)
12. SCE2537 (MAP: Daylight Harvesting Lighting)
13. SCE2537 (MAP: Hotel Keycard Energy System)
14. SCE2537 (MAP: HVAC Cycle Manager)
15. SCE2537 (MAP: Lighting Power Regulator)
16. SCE2537 (MAP: Lighting Project)
17. SCE2537 (MAP: Lighting Retrofit)
18. SCE2537 (MAP: VFD)
19. SCE2537 (MAP: Window Film)
20. SCE2504 (Integrated Schools: Green Campus)
21. SCE2504 (Integrated Schools: Green Schools)
22. SCE2504 (Integrated Schools: LivingWise Screw-in CFL 14 Watt)
23. SCE2504 (Integrated Schools: LivingWise Screw-in CFL 23 Watt)
24. SCE2504 (Integrated Schools: LivingWise Showerhead)
25. SCE2504 (Integrated Schools: LivingWise Faucet Aerators, Kitchen)
26. SCE2504 (Integrated Schools: LivingWise Faucet Aerators, Bathroom)
27. SCE2504 (Integrated Schools: LivingWise Air Filter Alarm)
28. SCE2504 (Integrated Schools: LivingWise LED Night Light)
29. PGE2061 (Enhanced Automation Initiative)
30. SCE2565 (Escalator PowerGenius)
31. SCE2535 (80 PLUS)

Findings and Recommendations are found on the following pages of the report:
p. 96-98, p. p. 154-55, p. 175-76, p. 253-55

5.7 RCA Findings and Recommendations

1. For both the residential and commercial sectors, the evaluated savings estimates were lower than the ex-ante estimates due to lowered performance degradation factors observed in the pre- and post-RCA metering. The residential UES showed continued potential for energy savings through

proper application of the RCA measure. The C&I RCA results were lower on average and highly variable, which suggests the specific application of charge adjustments to small commercial units should be subject to additional M&V early on in future-programs to establish best and sustainable practices.

2. The installation rate for residential RCA was 52% and 55% for the largest programs and 89% for CMMHP. The installation rate for C&I RCA was between 45% and 68%. The HVAC team used instrumentation expected to produce more precise measurements and expected the rates to be lowered due to the use of more precise tools. The installation rates for C&I RCA were lower than expected and early M&V should further explore verification testing. The HVAC team recommends establishing an independent service tool list and protocol used for residential and C&I RCA verification testing and standard tables and data quality procedures to validate program-collected and evaluator-collected data.

3. For the residential sector, the evaluated results for the largest programs had lowered savings due to differing observed distributions than the ex-ante assumptions of the building type, vintage, charge correction, and in some cases tonnage or climate zone. Programs which had better tracking of the parameters in the ex-ante estimates than others tended to have higher gross realization rates.

4. For the C&I RCA measures, the low results for final net savings suggest that an approach not based on deemed unit savings may be appropriate such as a measured performance approach. Programs should consider measurements of the operating performance before and after servicing to better establish savings claims given the variability in observed measure performance. If larger future samples for the C&I measure are achieved that show similar results as this study, then the measured performance approach would be strongly recommended.

5. The free-ridership rates for the programs evaluated with the standard method were higher than the ex-ante estimates and in some cases were extremely high. The respondents who were aware of the program may not have fully understood their contractor's participation and the contractors who were identified were less responsive than participants. The rates of free-ridership for future programs should be based on early M&V that is coupled with process evaluation to develop the most appropriate methods to mitigate and further evaluate mid-market incentives.

6. The program tracking data were generally not well linked to the detailed performance data on RCA maintenance and those data were obtained to varying degrees. The programs should have strong links of rebates and savings data to program units and contractor measurement data. Recommendations include a statewide unit identification standard and sticker, standard program measurement data table definitions, and development of common data definitions for key parameters. Program implementers need to notify and inform customers when they sign up to participate in programs.

7. Implementers also need to attempt to get participants to agree to terms and conditions that allow measurement and verification work upon request.

8. The RCA programs were designed to collect system diagnostic and/or performance indicator data prior to applying measures. The diagnostic measurements taken by the contractor that determine whether or not the unit needs refrigerant added or removed must be recorded since these pre-maintenance data cannot be replicated after adjustments are made to refrigerant levels. Measurements of pre-conditions including factory charge, charge adjustments, power draw, and airflow should be recorded along with the diagnostic parameters.

6.6 Split System Air Conditioner Replacement Findings and Recommendations

1. For both the residential and commercial sectors, the IOU estimates for both energy savings and grid-level demand in milder climate zones, such as in climate zones 6 and 7, are too high and the

deemed estimates need revision. This is most likely because the cooling need is less than the IOU anticipated.

2. For the residential sector, the evaluated results for the hotter climates exceeded the IOU expectations for units replaced on burnout. The evaluation used a lower efficiency empirically derived base case than was assumed by the utility, that is, the IOU assumed better performance for the average code-compliant unit than was observed.

3. For the commercial sector, the evaluated results showed greater realization rates for early replacement units than those replaced on burnout. This was due to the evaluation using a larger degradation from code-level baseline performance to early replacement baseline performance than the IOU estimates used.

4. In the commercial sector, while 10% of the installed units fit the DEER ideal performance estimated, the remainder of the units exhibited deteriorated performance. This deteriorated performance was confirmed in terms of unusually high supply air temperature and unusually high compressor power at times of low outdoor air temperature. The average performance for the code compliant unit is considerably less than the ideal unit and evidences the field installation issues that if corrected, would improve performance. The same finding applies to the residential sector.

5. The evaluated grid-level peak demand estimates differed from the IOU estimates because the evaluated grid-level peak demand estimates used the most recent ALJ definition of system grid peak. We recommend the IOU estimates use the most recent ALJ definition for consistency.

4. Small Commercial Contract Group High Impact Measure Evaluation Plan

Itron, Inc.

The Final Report did not include any Findings or Recommendations

5. Commercial Facilities Contract Group Direct Impact Evaluation Final Report

ADM Associates, Inc., Innovologie LLC, Marketing Excellence, Inc., C. J. Brown Energy, P.C., David Claridge, Ph. D.

This Contract Group encompassed two programs and two High Impact Measures (HIMs)

1. PGE2005 (PG&E program for high technology facilities: data centers, laboratories, and biotechnology facilities)
2. PGE2007 (PG&E program for large commercial buildings)
3. Refrigeration strip curtains
4. Refrigeration door gaskets

Findings and Recommendations are found on the following pages of the report: p. 3-12 – 3-14, p. 4-10 – 4-11, p. 5-14-5-15

3.6 Discussion of Findings and Recommendations from Evaluation of PGE 2005

Table 3-10 provides data comparing net savings as projected in the PGE2005 Program Implementation Plan, as claimed at the end of the program cycle, and as verified achieved through this evaluation effort. As can be seen, the net savings claimed were significantly higher than the savings projected in the PIP. However, ex post evaluated savings were significantly lower than claimed. Net ex post evaluated savings fell below net claimed savings primarily because (1) the gross realization rates were significantly less than 1 and (2) the net-to-gross ratio was were lower than the values PG&E assigned to measures in determining claimed net savings.

Table 3-10. Comparison of Projected, Claimed and Evaluated Net Savings for PGE2005, by Type of Savings

Type of Savings	Net Savings as Projected in PIP*	Total Ex Ante Claimed Net Savings	Total Ex Post Evaluated Net Savings
kWh	46,659,000	107,610,455	26,762,512
kW	6,901	10,705	3,505
Therms	66,597	770,403	59,539

That the overall gross realization rate for kWh savings for PGE2005 was significantly less than 1 is attributable to the importance that internal loads have in calculating energy usage and savings for high tech facilities. The M&V effort revealed that the analyses underlying the claimed savings for projects were often made using a bin method, which is not a robust method when internal loads are high. Moreover, the data collection also revealed that the estimates of internal loads used in the underlying analyses were often significantly higher than the internal loads actually observed at the facilities. In part, this resulted because facilities were being designed in expectation of higher demand than actually materialized.

The net-to-gross ratio for PGE2005 as evaluated was also significantly lower than the values used by PG&E in calculating claimed net savings (e.g., 0.47 for kWh savings as evaluated versus approximately 0.84 for PG&E's claimed savings calculations). The information gathered through the net-to-gross interviews for the evaluation showed that most of the data center projects were initiated by customers. Indeed, customers were aware of the benefits of energy efficiency programs. Most were committed to doing efficiency projects and had project identification and implementation mechanisms in place.

- *Require More Complete Documentation of Assumptions Underlying Specification of Baseline Conditions.*
- *Standardize Project Documentation.*
- *Re-emphasize Review and Inspection of Self-Sponsored Projects.*
- *Ensure That Incentives Can Be Given for Savings for Measures Unique to High Tech Facilities*

4.6 Discussion of Findings and Recommendations from Evaluation of PGE2007

Table 4-9 provides data comparing net savings as claimed at the end of the program cycle and as evaluated as being achieved through this evaluation effort.

Table 4-9. Comparison of Ex Ante Claimed and Ex Post Evaluated Net Savings for PGE2007, by Type of Savings

Type of Savings	Total Ex Ante Claimed Net Savings	Total Ex Post Evaluated Net Savings
kWh	42,342,316	27,824,723
kW	7,035	4,908
Therms	201,597	36,226

Net ex post evaluated savings for PGE2007 fell below ex ante claimed net savings primarily because (1) gross realization rates were less than 1 and (2) the net-to-gross ratio was somewhat lower than the values assigned to the measures by PG&E in determining claimed net savings. For PGE2007, the gross realization rate for kWh savings was estimated to be 79.5%. This realization rate is higher than the 44.6% calculated for PGE2005. The higher realization rate is due mostly to the higher evaluated savings for lighting and HVAC measures in PGE2007 that are relatively more standardized than the measures receiving rebates under PGE2005. The NTGR for PGE2007 that was calculated during this study was 0.60, which was somewhat lower than the NTGR of 0.70 that was used by PG&E in developing net claimed savings.

An additional recommendation was:

- *Ensure Complete Documentation of Assumptions Underlying Specification of Baseline Conditions.*

6. Government Partnerships Programs Direct Impact Evaluation Report

Summit Blue Consulting, PA Consulting Group, Inc., ECONorthwest, Science Applications International Corporation, ADM Associates, Inc., SBW Consulting, Inc., Robert Thomas Brown Company

This Evaluation Report encompassed three programs:

1. University of California, California State University (UC/CSU) Partnership Program,
2. the California Community Colleges (CCC) Partnership Program, and
3. the Palm Desert Partnership Program

Findings and Recommendations are found on the following pages of the report:
p. 48-50, p. 71, p. 102-104

6.7 Discussion of Findings and Recommendations for the UC/CSU/IOU Energy Efficiency Partnership Programs

- *Recommendation 1: Standardize Participant Data Requirements*
- *Recommendation 2: Ensure that Participant Campuses are Aware of M&V Activities as Early as Possible*
- *Recommendation 3: Clearly Differentiate Between Gross and Peak Demand Savings*
- *Recommendation 4: Improve Project Tracking Systems*
- *Recommendation 5: Provide More Opportunities to Exchange Information and Expand T&E Participation*

7.7 Discussion of Findings and Recommendations of the CCC

…the net *ex post* savings achieved through the CCC programs fell short both of the projected and the claimed savings. Net *ex post* savings fell below net claimed savings primarily because of (1) gross realization rates were less than 1 and (2) net-to-gross ratios were lower than the 0.8 value used by the IOUs to determine net savings.
The analysis indicated that while the realization rates for lighting measures were reasonably high (between 49% and 98% across the IOUs, with most in the higher range), the realization rates for HVAC measures were noticeably lower (most between 26% and 40%, with one exception). However, the HVAC measures analyzed were generally part of broader, campus-wide energy efficiency projects often involving changes to a campus's central plant.

8.7.1 Conclusions (Palm Desert Partnership Program)

Refrigerant Charge and Airflow Adjustment:

RCA realization rates were found to be exceedingly low as a result of the following primary factors:

1. Claims of substantial savings were made where there was either no documentation or the documentation was insufficient to determine what actual field implementation of program measures occurred.

2. From the available documentation, there was little evidence that substantial improvements were made for most sites.

3. A significant fraction of the units in the sample had either been replaced or had had significant repairs made including refrigerant charge adjustments *after* participation in the program.

4. For sites where the documentation indicated some measure implementation, the evaluation field tests revealed that many of the units did not exhibit accurate refrigerant charge when checked on site.

5. Overall, the documentation of on-site actions and measure implementations did not provide sufficient information to provide for a robust technical analysis of savings.

6. The implementer did not appear to exercise adequate quality control over the installation contractors or oversee adequate documentation of actions taken and/or measures implemented on site.
7. In some cases, the evaluation field tests showed that the units were not properly charged. Such a finding indicates that the field testing by contractors, measure implementation activities, or subsequent events in the field outside of the control of the program did not result in units with properly adjusted refrigerant charge.

8.7.2 Recommendations

1. The program should improve documentation of RCA measures to ensure that ample evidence exists regarding the measures implemented at each site. Such documentation should include, at a minimum, the following information:
   - Amount of refrigerant added or removed
   - Type of refrigerant
   - Presence of TXV
   - Suction and discharge refrigerant pressure (pre and post charging)
   - Suction and liquid line temperatures (pre and post charging)
   - Ambient temperature (pre and post charging)
   - Entering wet bulb temperature (pre and post charging)
   - Target superheat and sub-cooling (depends on presence of TXV)
   - Actual superheat and sub-cooling (pre and post)
2. The program should provide a higher level of oversight and quality control of installation contractors, including reviewing claims of measure installations and documentation, particularly for new contractors who are just learning the goals and protocols of the program.
3. The program should consider implementing an electronic on-line program tracking database that includes requirements for key data elements and automatic checking of these data elements.
4. The program should improve the documentation requirements for identifying the pre-retirement manufacturer and model number. One possibility would be to require the submission of a photograph of the nameplate as part of the early retirement application.
5. The program should investigate mechanisms for minimizing the “snow bird“ effect and should focus on permanent, year-round residents.

7. 2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group

Itron, Inc.

The SCIA contract group is divided into four measure groupings for reporting evaluation results. These groupings include two HIMs - pipe insulation and steam traps - as well as pump testing, and for the combination of SCE2509 Industrial measures and SCE2510 Agricultural measures that received incentives.

1. SCE2509 (Industrial Energy Efficiency Program)
2. SCE2510 (Agricultural Energy Efficiency Program)
3. SCG3507, SDGE3020, PGE2080 (Steam Traps)
4. SCG3507, SDGE3020, SDGE3012, PGE2080 (Pipe and Tank Insulation)

Findings and Recommendations are found on the following pages of the report:
p. 3-21 – 3-40, p. 4-23 – 4-38, p. 5-10 – 5-18, p. 6-37 - 6-48

A significant portion of sites (43 of 66) had insulation prior to the program incented retrofit. This was a more frequent finding at the smaller retrofits – the sites with pre-existing insulation were about 65 percent of sites, but just about 32 percent of the total linear feet in the sample. Three of the largest installations were identified as new construction, representing less than 5 percent of sites, but 40 percent of the linear feet inspected. These two segments produced very low realization rates, at 1.7 and 0.0 percent, respectively.

Twenty-seven percent of the 66 sites analyzed were determined to have program qualifying installations. These 18 sites represent 21 percent of the total linear feet and have an estimated realization rate of 25 percent. Two sites were partially new construction or new pipe. These sites have a realization rate of a little more than 12 percent, and represent 7 percent of the total linear feet studied.

The moderate size of the realization rate for program qualifying sites is driven largely by finding lower than assumed operating hours. SCG pipe insulation work papers32 state an assumed annual operating time of 7,752 hours per year based on the assumption that steam dry cleaners often have much more moderate operating hours. The average over the 47 dry cleaners in the M&V sample was about 2,400 hours per year. The average among the other business types also fell short of this mark, at 4,964 hours per year.

Another area where the work paper assumptions are not supported by site investigations is in the assumed ambient or environmental conditions surrounding the pipe. The assumed environmental conditions were taken from ASHRAE literature:

“ASHRAE uses an ambient temperature of 65 °F and 7.5 mph wind speed for their tables of recommended thicknesses for pipe insulation.”

These values would seem appropriate to assume if the pipes are operating in outdoor conditions. If the pipes were outside, then the temperature and wind speed estimates would be fairly accurate, if not even slightly conservative in terms of predicted heat loss and energy savings. However, the vast majority of the sites that were surveyed did not have any outside pipes and had much higher ambient temperatures and no wind speed in the area around the piping system. The higher ambient temperature and lack of wind causes less heat loss from the pipes and results in less energy saved by insulating them.

Sites studied in this evaluation had high ambient temperatures, and little outdoor pipe. The high ambient temperatures resulted from enclosed work spaces with machinery and equipment that produces ambient heat. Dry cleaners typically operate with very high ambient temperatures, with an average measured ambient temperature around insulated pipes of about 90 degrees.

Discussion of Dry Cleaner Results (SCG3507, SDGE3020, SDGE3012, PGE2080)
The dry cleaners segment accounts for 78 percent of pipe insulation sites in the SCG tracking system and about 64 percent of total ex-ante gross impact therm claims. The dry cleaner segment has a lower realization rate than other business type segments (4.6 versus 15.3 percent). This is due to a combination of many factors, including finding lower-than-assumed operating hours, and higher-than-assumed ambient air temperatures. In addition, there was a high likelihood of pre-existing insulation at these sites.

Setting aside the issue of program qualifying status, the laundries achieve just 12 percent of the ex-ante therm impact claim. That is, the realization rate would be 12 percent if we calculated the gross impact relative to bare pipe on all dry cleaner installations, not just program qualifying. In addition, there is a substantial portion of laundry sites with non-program qualifying installations. Thirty-four of the 47 laundries in the on-site M&V sample had pre-existing insulation before the retrofit. The final gross impact realization rate for dry cleaners in SCG service territory is 4.6 percent. The final gross impact realization rate for other business types is 15.3 percent, as shown in Table 3-11 of the report.

3.5 Recommendations

Prospective Recommendations for Program Standards and Delivery

Controls should be instituted to ensure compliance with program guidelines.

Program guidelines are designed to support delivery of insulation to segments with lower free ridership and where expected impact is higher. For these reasons, sites with pre-existing insulation and sites installing new pipe are excluded from program qualification.

The majority of participating sites were found to be in violation of one or more of these program rules. An improvement to the expected outcome of similar programs going forward would be related to the institution of effective enforcement of these program guidelines.
As discussed throughout this report, the majority of participating sites were found to be in violation of one or more of these program rules. An improvement to the expected outcome of similar programs going forward would be related to the institution of effective enforcement of these program guidelines.
Controls should be instituted to ensure that incented insulation is not installed on pipe with pre-existing insulation. In addition, controls should ensure that incented insulation is not installed in new construction applications, new pipe additions, and/or pipe replacements.
At minimum, verification of these characteristics should be provided by the installation contractor and the customer prior to distribution of incentive money. Another more stringent alternative would be to require IOU representatives to inspect sites prior to approving
incentive applications. This approach is highly recommended for large installations of insulation, and installations on industrial sites.

Operating Hours

As Table 4-20 of the report shows, the average weighted annual operating hours for high pressure steam traps in refineries is 8,011. Though the refineries run their traps for 8,760 hours throughout the year, the weighted mean annual operating hours are 8,011 after taking into consideration those traps at refineries that were not operational and/or not installed. For the non-refinery facility type, the annual operating hours are obtained from the facility's steam trap audit or from the site contact. Average annual operating hours for high and low pressure traps are considerably lower than the work paper assumption of 7,752 hours for both measure types.

Net-to-Gross Ratio and Net Ex-Post Industrial Results

The industrial self report net-to-gross methodology was used to estimate NTG ratios for the industrial sites using data gathered from the telephone surveys. of the report lists the number of sites used in the industrial net-to-gross methodology, the average NTG ratio for high and low pressure traps, the upper and lower bounds and the relative precision. The NTG ratio for high pressure traps was 0.52 with a relative precision of 0.10 while the NTG ratio for low pressure traps was 0.57 with a precision of 0.09. The estimated NTG ratio is substantially lower than the work paper assumption of 0.96.

Commercial Steam Trap Recommendations (SCG3507, SDGE3020, PGE2080)

The commercial steam trap analysis revealed that the per trap realized therm savings were 14 therms for PG&E and 16 therms for Sempra Utilities. These results support the conclusion that the average commercial steam trap retrofit saves substantially less than the work paper assumptions.

Savings Variability

The data collection led to the determination that, for the sites surveyed, the mean energy savings from steam traps were substantially higher than the ex ante values. The ex ante gross savings for low pressure traps were 638 therms while the ex post gross savings were 1,398 therms and it resulted in an average realization rate of 219%. The ex ante gross savings for high pressure traps were 2,342 therms while the ex post gross savings were 5,033 therms and it resulted in an average realization rate of 215%. While the average realization rate for high and low pressure traps was substantially above 100%, the precision of these estimates is poor.

Recommendation due to Variability

The extremely high variability in per trap savings strongly supports the conclusion that industrial steam traps should not be rebated as a prescriptive measure. Prescriptive measures should be limited to measures that are relatively homogeneous in their application and their per unit savings, industrial steam trap are extremely heterogeneous in their application and their savings. The results from this evaluation lead to the recommendation that industrial steam traps be rebated as a custom measure.

This evaluation found that only 20 percent of pumps in need of repair, go on to be repaired.

5.) Spillover

Forty-seven of the surveyed customers said that they also test pumps at facilities outside of SCE territory. Those customers were then asked if the non-SCE pump tests were also free, and as shown in Table 5-9, 30 percent of the customers who had pump tests outside SCE territory stated that they were free and for 23 percent of the customers none of those tests are free.

Table 5-9: Pump Tests Outside SCE's Territory

Q59. Are those pump tests free also?	Total	Strata 3	Strata 2	Strata 1
Yes All Are Free	30%	31%	30%	25%
None Are Free	23%	28%	20%	13%
Most Are Free	13%	10%	30%	.
Some Are Free	21%	28%	.	25%
Don't Know	13%	3%	20%	38%
N	47	29	10	8

As illustrated in Table 5-10 of the report, the majority of these customers (62 percent) said that their experience with the SCE pump testing program was very important in their decision to have their pumps outside of SCE territory tested (see Table 5-10 of the Evaluation Report). This indicates that SCE's pump testing program is helpful in educating customers on the benefits of pump testing.

6.4 Discussion of Findings and Recommendations

6.4.1 The Evaluation-based Estimates of Overall Program Savings Realized are Significantly Below Those Estimated by SCE

As shown in the Results section of the report, the overall net realization rate for the SCE2509 industrial program covered in the scope of this CPUC evaluation contract group (Section 4) is 0.46, with a gross

realization rate of 0.72 (kWh) and net-of-free-ridership ratio of 0.63 (kWh). Per-kW realization rates are slightly lower, 0.42 overall with 0.65 for gross and 0.65 for net. These quantitative results indicate that the program is significantly overestimating their savings claims. In addition, the results for the 2006-2008 program cycle show little to no improvement as compared to the historic results for industrial sector programs and may, in fact, be worse.

6.4.2 Overall Improvement Needed for the Industrial Program Realization Rates

Previous evaluations have identified many of the same issues that are identified in this evaluation yet these issues and the effects they have on overall program gross and net impact results have not yet been fully addressed. It is recommended that greater efforts are put forth to carefully review evaluation findings and recommendations and to apply corrective actions within the programs that address shortcomings in the accuracy of ex ante methods and results. The question remains regarding how to increase the effectiveness of industrial efficiency programs given the history of the programs and the challenges that the sector presents. We note that, despite these challenges and results, the industrial sector remains an important area for achieving cost effective and significant energy efficiency reductions above those that would otherwise occur due to natural market forces; in addition, programs may remain cost effective even with mediocre realization rates due to the size of the savings opportunities as compared with other sectors.

6.4.3 Problems with Ex Ante Baseline Selection or Modeling of Baseline Parameters

Baseline equipment was incorrectly selected for ex ante analysis in several of the site-specific gross impact (M&V) sample points. In a motor retrofit project it was determined that the existing motor it replaced was near the end of its effective useful life, and so the ex post evaluation selected a standard motor efficiency to represent baseline (after the estimated remaining useful life) rather than the in-situ system, as was the case for the ex ante analysis of impact. These program claims are inconsistent with most of the industrial programs' procedure manual references to "industry standard practice" as the baseline from which savings and incentives are to be estimated. Consequently, in this evaluation we used current industry standard practice to estimate gross savings for applications in which there was strong evidence for use of a replace on burnout or natural turnover baseline (increased and improved use of industry standard practice baselines are discussed further in Section 3). In the motor retrofit noted above, the resulting gross savings were zero after the remaining useful life due to the lack of any alternative to the project implemented by the customer (and the lack of any associated program effect).
Example Site – C026

As in prior SPC evaluations, a number of cases were identified where the assumptions for the program baseline calculations were unverified and undocumented, and ultimately proved to be inappropriate estimates based on ex post measurement and documentation.

Recommendation: Improve Baseline Specification.

Recommendation: Clarify and Enforce the Definition of "industry standard practice".

Recommendation: Empirically Study the Effective Useful Life of Measures in an Industrial Setting

Recommendation: Incorporate Greater Levels of Real-Time Measurement and Pre- and Post-Installations Measurement Based Verification

Recommendation: Require a Greater Level of Technical Documentation for the Largest and Most Complex Projects

Recommendation: Require Better Documentation of Pre-Installation Operating Conditions

Recommendation: Aggregate and Approve Fuel Switching and Distributed Generation-Related Projects in One or More Explicit Programs or Clearly Identified Program Elements

6.4.14 The Programs Need to Continue to Build Upon Market-Driven Efficiency

In some cases, high free ridership can be viewed as a positive indicator of strong market driven efficiency. A challenge for the programs is to influence these customers to go even further in their

efficiency plans than they would otherwise due to their own internal policies and financial criteria. In one sense, this means setting baselines higher – which can be accomplished by using industry standard practice rather than in situ practice – as the basis for program participation and incentives. It can also mean developing customer specific baselines based on the plans the customer had at the initial point of program interaction.

Recommendation: Consider Limiting or Excluding Incentive Payments to Known Free Riders When program administrators are incented and permitted to simply exclude known free riders, scarce program funds can instead be utilized on projects that provide net benefits.

Recommendation: Consider Using Incremental Costs to Benchmark and Limit Payments Limiting payments so that they do not exceed a pre-determined portion of average or customer-specific incremental cost estimates is critical to avoiding grossly overpaying for savings.

Recommendation: Consider Incorporating a Payback Floor The use of a payback floor (minimum payback level based on energy savings alone) helps to ensure that project generates meaningful and significant energy savings. With a payback floor, the program avoids incenting projects that are primarily being done for reasons other than energy savings (modernization, production efficiency, environmental compliance, etc.)

Recommendation: Set Incentive Levels to Maximize Net, not Gross Program Impacts Free riders dilute the market impact of program dollars. Payback floors and increasing incentives with increasing payback levels are one approach. Another is to tie incentive levels to individual measures or types of measures that are known to have extremely high or low naturally occurring adoption levels.

Recommendation: Consider Tying Staff Performance to Independently Verified Net Results Tying performance reviews and bonuses of program staff to verified savings as reported through an independent M&V or impact evaluation process is likely to increase project quality and the accuracy of initial savings estimates. Marketing staff, in particular, should have any financial incentives tied to savings that are independently verified.

8. Final Report 2006–08 Retro-Commissioning Impact Evaluation

SBW Consulting, Inc.

This report encompassed the Savings by Design programs run by the four IOUs.

1. Pacific Gas and Electric did not track its SBD program separately
2. SCE 2512
3. SCG 3542
4. SDGE 3018

Findings and Recommendations are found on the following pages of the report:
p. 26-27, p. 38, p. 80-82

Figure 3 provides a graphical comparison of claimed versus evaluated gross energy savings for each IOU and for the HIM overall. Quantities on the graph are expressed in millions of BTUs saved annually (MMBTU), combining both electrical energy and natural gas energy impacts.

Table 8: Gross Savings Realization Rates

			Gross Savings Realization Rate			90% Relative Precision		
Utility	Population	Sample	kW	kWh	Therms	kW	kWh	Therms
PG&E	135	24	0.31	0.45	0.53	0.51	0.23	0.24
SCE	58	13	2.07	0.94	N/A	0.66	0.17	N/A
SCG	28	10	N/A	N/A	0.93	N/A	N/A	0.23
SDG&E	4	3	2.60	1.23	0.21	0.04	0.06	0.01

Table 9: Gross Ex Post Unit Energy Savings

			Gross Ex Post Unit Energy Savings			90% Relative Precision		
Utility	Population	Sample	kW	kWh	Therms	kW	kWh	Therms
PG&E	135	24	13	178,355	7,334	0.51	0.23	0.24
SCE	58	13	30	383,712	462	0.66	0.17	1.56
SCG	28	10	6	28,781	23,735	0.00	0.00	0.23
SDG&E	4	3	129	606,849	11,454	0.04	0.06	0.01

PG&E projects as a whole had relatively low realization rates for both electric and gas energy savings (0.45 and 0.53), compared to SDG&E, which had realization rates that varied between gas and electric savings; for example, 1.23 for kWh and 0.21 for therms. SCG's single realization rate for therms was 0.93. These differences may reflect the diversity of programs and program delivery models at PG&E. By comparison, the savings claims for SCE and SCG were dominated by two local government partnership programs, UC/CSU/IOU and Los Angeles County.

IOU-level realization rates for peak kW demand vary widely, from 0.31 to 2.60. Two related factors likely explain this— program implementers using different definitions of peak period in their savings calculations, and a tendency by implementers to be conservative and claim zero peak demand reduction for measures where the actual reduction is very uncertain and/or difficult to estimate.

Across the 50 projects in the gross sample, we determined 83 significant reasons for differences, with a relatively even split between customer-driven and program-driven reasons. Over 75% of these reasons worked to reduce savings, a percentage that was fairly uniform across all four IOUs. Critically, nearly half of these savings-reducing reasons were instances where the RCx measure was no longer operational. Put simply, the most common reason why savings fell short of the claim was that measures were not

working anymore. Other common reasons for differences included discrepancies between program calculation assumptions and actual conditions, changes in building operation, and measures being only partially implemented. Detailed tables can be found in Appendix 5.5 of the Contractor's Report.

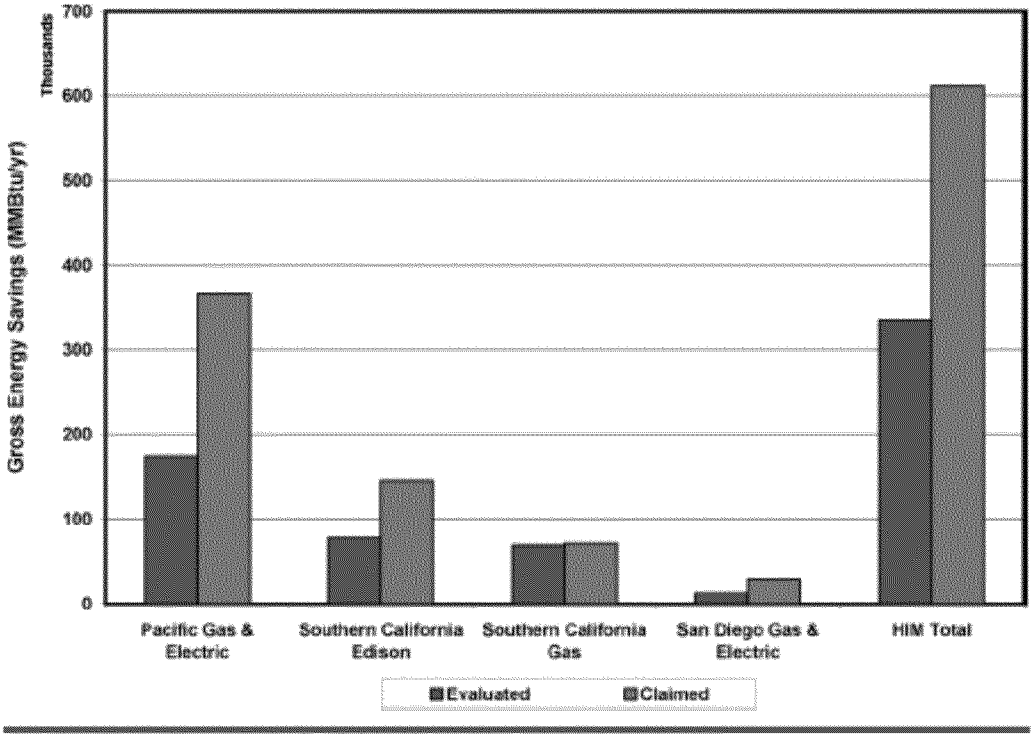

Figure 3: Comparison of evaluated and claimed gross energy savings

Program-Related Recommendations

While this was clearly not a process evaluation, and the focus was on measuring savings rather than assessing the effectiveness of program delivery, there were nevertheless some findings that have implications for the mechanism by which the RCx HIM is delivered. Note that these recommendations also tie into the evaluation-related recommendations presented below.

Provide program participants with adequate follow-up RCx services. Once RCx service providers have identified RCx opportunities, maintaining the value of those findings requires sustaining a long-term relationship with customers to make sure the measures are implemented correctly and maintained properly over time. RCx is an incremental process that needs to be done over a longer period of time, rather than through a one-time process of dropping in, making recommendations and then moving on. This evaluation found frequent examples where measures failed soon after implementation. A particular example is economizer repair measures1, which comprise a significant fraction of all RCx measures. Although these measures had been vetted by program staff, they often had failed, were only partly functional, or had faulty programming that meant they produced no savings a relatively short time after project completion. In many cases, more sustained follow-up from the program might have eliminated these problems.

Overall, NTGR scores for the RCx HIM are consistently high, reflecting the continued influence of a variety of programs on the motivation and ability of organizations to pursue RCx projects. With only a single exception, NTGR scores averaged more than 0.50 for every fuel type in every stratum, and the overall mean was significantly higher for all IOUs.

9. Major Commercial Contract Group Volume I Final Impact Evaluation Report 2006-2008 Program Years

SBW Consulting, Inc.

This Contract Group encompassed five High Impact Measures (HIMs)
(Custom Lighting, Custom HVAC, Custom Other and Audit) within the following five commercial, industrial and agricultural programs that were implemented by SCE, SCG and SDGE.

1. SCE2517 – The Standard Performance Contract and non-residential audit portions of the SCE Business Incentives and Services Program (commercial/industrial retrofit)
2. SCE3513 – The SCG Business Energy Efficiency Program (commercial/industrial retrofit)
3. SDGE3025 - The SDG&E Standard Performance Contract Program (commercial/industrial retrofit)
4. SDGE3010 – The SDG&E Energy Savings Bid Program (commercial/industrial retrofit)
5. SCG3503 – The SCG Education and Training Program (non-residential audit)

Findings and Recommendations are found on the following pages of the report:
p. 5-7, p. 35-56

Summary of Findings

Significant gross energy savings were found for three of the four high impact measures (custom lighting, custom HVAC and custom other) associated with the programs or program components with direct measures. Domain-level realization rate results indicate that the ex post gross savings estimated in this evaluation were less than the ex ante savings in most cases. Significant gross savings were not found for the audit HIM. Domain-level realization rate and unit energy savings results indicate that the ex post savings estimated in this evaluation were very small.

Across the custom HIMs , the realization rates varied from a low of 0.33 for SDGE3025 therms to a high of 1.54 for SDGE3025 kWh. For the audit HIM (programs SCE2517 NRA and SCG3503), the realization rates varied from 0.02 for SCG3503 therms to 0.27 for SCE2517 NRA kW and kWh (see Table 2).

Table 2: Summary Gross Savings Realization Rate

				Gross Savings Realization Rate			90% Relative Precision		
Program	HIM	Population	Sample	kW	kWh	Therms	kW	kWh	Therms
SCE2517 SPC	all custom	1,397	18	0.82	0.80	N/A	0.10	0.15	N/A
SCG3513	custom other	700	19	N/A	N/A	0.72	N/A	N/A	0.74
SDGE3010 kWh	custom HVAC, custom lighting	719	9	0.66	0.67	N/A	0.34	0.34	N/A
SDGE3010 Therm	custom HVAC	14	7	N/A	N/A	0.98	N/A	N/A	0.11
SDGE3025 kWh	custom HVAC, custom lighting	343	8	1.28	1.54	N/A	0.33	0.60	N/A
SDGE3025 Therm	custom HVAC, custom other	24	6	N/A	N/A	0.33	N/A	N/A	0.59
SCE2517 NRA	audit	10,415	58	0.27	0.27	N/A	0.53	0.55	N/A
SCG3503	audit	34	12	N/A	N/A	0.02	N/A	N/A	0.36

Table 3: Summary Gross Ex Post Unit Energy Savings

				Gross Ex Post Unit Energy Savings			90% Relative Precision		
Program	HIM	Population	Sample	kW	kWh	Therms	kW	kWh	Therms
SCE2517 SPC	all custom	1,397	18	41.0	274,897	30	0.10	0.15	0.91
SCG3513	custom other	700	19	0.0	0	14,467	N/A	N/A	0.74
SDGE3010 kWh	custom HVAC, custom lighting	719	9	17.0	112,395	0	0.34	0.34	N/A
SDGE3010 Therm	custom HVAC	14	7	0.0	0	98,072	N/A	N/A	0.11
SDGE3025 kWh	custom HVAC, custom lighting	343	8	21.0	167,423	71	0.33	0.60	1.34
SDGE3025 Therm	custom HVAC, custom other	24	6	0.0	-217	7,679	1.29	1.29	0.59
SCE2517 NRA	audit	10,415	58	0.6	3,070		0.53	0.55	N/A
SCG3503	audit	34	12			4,365	N/A	N/A	0.36

Summary of Recommendations

Important recommendations from this impact evaluation include:

1. **Better inspection and documentation of baseline conditions** –It is recommended that baseline documentation be upgraded (when appropriate) so that an experienced evaluator can understand the energy performance of the baseline equipment.

2. **Improved measure names** –For future program years it is recommended that a statewide standardized measure naming system be put in place that would provide consistency across programs and IOUs.

3. **Improved IOU tracking system data entry** –It is recommended that additional quality control be placed on the IOU tracking database data entry procedures to verify that only measures that were implemented during the program years being evaluated be included in the savings claim.

4. **Do not claim savings for normal replacement measures that are required by Title 20/24 or are standard practice for the facility** - It is recommended for future program cycles that additional care be given to the IOU assessment of savings for normal replacement measures. The application file should provide documentation that discusses the Title 20/24 or standard practice conditions relevant to the affected normal replacement measure and provide proof that the implemented measures exceeded these requirements. The IOU savings claim should be consistent with this logic.

5. **Feedback to ex ante savings estimates** – It is recommended that the IOUs carefully study the differences between the ex ante and ex post savings estimates for the sampled measures in this evaluation and look for opportunities to improve their ability to predict measure performance.

6. **Measure level estimates savings in the indirect IOU tracking system** - It is recommended that for future program cycles all IOUs provide measure level savings estimates in their audit tracking system at a level of detail that is agreed upon with ED.

7. **Definition of peak demand savings** – It is recommended that the IOUs and the CPUC use the same definition of peak demand, if the assessment of peak demand remains an important part of the impact evaluations.

8. **Claimed indirect savings for audit measures** – It is recommended that the CPUC and all IOUs establish a series of rules for inclusion of indirect measures in the savings claim for future program cycles where indirect savings are claimed. It is also recommended that the utilities reconsider whether savings claims should be made at all for indirect measures. The results from this evaluation indicate that the utilities do such a good job of directing audited customers to the

financial incentives offered by the direct programs that there is very little indirect savings to be claimed.

9. **Improve staff capabilities –** It is recommended that the programs improve the capability of their implementation staff to materially influence advance commercial and industrial efficiency improvements. It is also recommended that training of program staff be improved to enhance the capability to review submitted projects for compliance with program objectives, enforcement, rules and policies.

10. **Get involved early –** It is recommended that the programs enhance their capability to get involved with projects at the earliest possible stage.

11. **Early Project NTG and Baseline Screening –** It is recommended that that programs provide early project NTG and baseline screening for the largest customers.

2.6. Detailed Findings for High Impact Measures, excerpts

2.6.2.1 Custom Lighting

The analysis of the custom lighting HIM considered four important energy savings parameters for each sampled measure. They included annual operating hours, fixture (or lamp) quantity, watts/fixture (or lamp) and fixture utilization factor. For measures that required a dual baseline, both early and normal replacement conditions were considered for some parameters. A comparison of the ex ante and ex post gross savings results across sampled measures revealed that differences between the ex ante and ex post values occurred most frequently for two of these parameters; annual operating hours and fixture quantity.

2.6.2.2 Custom HVAC

The important energy savings parameters considered in the analysis of the Custom HVAC HIM varied with the type of HVAC measure analyzed. Four of these parameters were relevant to multiple measures, whose ex ante and ex post values can be compared. They include operating hours, fan kW, fan CFM savings and kW/ton. Significant differences between ex ante and ex post values for annual operating hours occurred for four sampled measures. The evaluation shows that the ex post annual operating hours were less than the corresponding ex ante value in two of the four cases. The ex post operating hours were also greater in two cases. The difference in operating hours across all affected measures ranged from a decrease of 66 percent to an increase of nearly 600 percent. This wide range is due to the fact that the actual operating hours in the post-retrofit period, in some cases, is significantly different than the hours anticipated during the preparation of the ex ante savings estimates.

There were also a significant number of sampled measures with differences between ex ante and ex post values for HVAC system efficiency (kW/Ton); although a smaller number than for operating hours. Significant differences in system efficiency (kW/Ton) were found for four measures, with a least one site in each of the three programs with direct Custom HVAC measures. The ex post kW/ton was greater for two of the four cases. The ex post value was less for the remaining two cases. The difference in kW/ton across these cases ranged from a decrease of 46 percent to an increase of 110 percent.

There were several sampled measures with differences between ex ante and ex post values for HVAC fan CFM (flow volume in cubic feet per minute) savings. Significant differences in fan CFM savings were found for three sampled measures. All three of the cases were for measures in the SDGE3010 program. The ex post fan CFM was less than the ex ante value for all three cases. The difference in fan CFM savings across these cases ranged from a decrease of 12 percent to a decrease of 60 percent.

Table 22: Frequency of Reasons for Realization Rates Not Equal to 1
Direct Measures

HIM	Reason for Discrepancy with ex-ante savings	Frequency
Custom Lighting	Operating hours	14
	Fixture wattage	4
	Fixture count	5
	Utilization factor	3
Custom HVAC	Operating hours	4
	Chiller efficiency	4
	Fan power	2
	Fan flowrate	3
	Other	14
Custom Other	Inappropriate algorithm	10
	Standard practice or code installed	6
	Operating hours	5
	Production changes	9
	Equipment efficiency	6
	Measure not installed	3
	Other	8

For the Custom Lighting HIM differences in ex ante and ex post operating hours were found most frequently. Table 22 shows that operating hours were noted as a reason for 14 of the 15 sampled measures analyzed under this HIM. The table also shows that differences in fixture wattages, fixture counts and lighting utilization factor were found to be a reason in a smaller number of cases.

For the Custom HVAC HIM four significant reasons were found that explained the difference in ex ante and ex post savings. They include operating hours, chiller efficiency, fan power and fan flow rate (CFM). For this HIM a variety of less frequent reasons for the discrepancies were noted. They are combined in the above table into the 14 reasons noted under the "other" category.

For the Custom Other HIM six significant reasons were found that explained the difference in ex ante and ex post savings. They include inappropriate ex ante algorithm, installation of standard practice or code, operating hours, production changes, equipment efficiency and measure not installed. In cases where standard practice or code was implemented zero gross savings were assigned in the evaluation. For this HIM a variety of less frequent reasons for the discrepancies were noted. They are combined in the above table into the eight reasons noted under the "other" category.

2.8. Conclusions and Recommendations

4. **Do not claim savings for normal replacement measures that are required by Title 20/24 or are standard practice for the facility** - Most measures claimed by the IOUs were early replacement, where the IOU influenced the customer to implement the measure before the end of the effective useful life of the existing affected energy system. However, the evaluation determined for some claimed measures that the existing equipment was at the end of its effective useful life. For the IOUs to claim savings for these measures, they had to influence the customer to implement an increment of energy efficiency that was beyond the requirements of Title 20/24, standard practice (if Title 20/24 was not applicable) or any other regulations (e.g., air quality standards)
5. **Major reasons for differences between ex ante and ex post savings–** The analysis performed on each direct measure included an examination of the reasons for discrepancies between the ex

ante and ex post savings estimates. The most common reason for discrepancies was the difference in the annual operating hours of the affected equipment. This reason was observed for all for HIMs. Inappropriate ex ante algorithms and production changes were the other reasons most commonly cited.

10. 2006-2008 Evaluation Report for PG&E Fabrication, Process and Manufacturing Contract Group

Itron, Inc.

The PG&E Fabrication, Process and Manufacturing contract group is comprised of one corePG&E program (PGE2004) and nine third-party programs The PG&E Fab contract group was divided into three measure groupings: Pump-off controllers (POCs), all other electric measures ("Non-POC Electric"), and Gas measures

Findings and Recommendations are found on the following pages of the report:
p. 1-7 – 1-14, p. 5-1 – 5-21

1.3 Summary of Recommendations

Below are several overarching recommendations aimed at improving the accuracy of savings claims and increasing the degree of program influence on rebated projects. The recommendations are suggestions for consideration with the end goal being improved gross realization rates and lower levels of free ridership on a percentage basis, while still maintaining high levels of total net savings. We recognize that the utility has ultimate responsibility for program implementation, and the CPUC has responsibility for energy efficiency policy, and each must weigh a variety of different factors, some of which are competing, in developing program requirements, implementation strategies, and policies.

The recommendations are not meant to be prescriptive and the utility and CPUC may develop and prefer other approaches to achieve the same overarching goals.

- ***Recommendation: Improve Baseline Specification.***
  End the practice of using in situ baselines over the EUL of the measure as the baseline for estimating savings and paying incentives. Identify projects explicitly in program files as replace-on-burnout, natural turnover, or early replacement. For the replace-on-burnout and natural turnover cases, baselines should be based on the efficiency of alternative new equipment, not the existing in situ equipment. In the case of early replacement, provide evidence and documentation of the remaining useful life of the equipment replaced, the estimated time at which the equipment would have been replaced in the future, and the effect of the program in accelerating early replacement.

- ***Recommendation: Clarify and enforce the definition of "industry standard practice".***
  Industry standard practice should used to set baselines for savings estimates and incentives (such that program savings estimates improve as reflected in improved evaluation gross and net realization rates). It is recommended that, for the next EE program cycle (2010-2012), the CPUC and IOUs should ensure that program and policy references to "industry standard practice" are more precisely defined with respect to program participation requirements, incentive level payments, gross versus net savings attribution, and energy efficiency goal attainment.

- ***Recommendation: Be More Conservative in Estimating Savings.***
  We recommend that the programs make more conservative assumptions for calculated (custom) savings projects in the industrial sector in the next program cycle until ex post realization rates increase.

- ***Recommendation: Use a Gross Realization Rate Adjustment in Savings Claims in Program Tracking Systems.***
  Use of a realization rate adjustment in future program cycle ex ante estimates of custom measure claims should be strongly considered until future evaluation results indicate higher gross realization rates. The size of the adjustment to use for the next cycle is closely related to the extent to which the

other recommendations made regarding improving specific aspects of gross savings estimation are addressed.

- ***Recommendation: Aggregate and Approve Fuel Switching and Distributed Generation-Related Projects in One or More Explicit Programs or Clearly Identified Program Elements.***
  If the CPUC approves use of fuel switching, it should require all applications to follow the three-prong test set forth in the CPUC Policy Manual[5]4 and any other CPUC or other regulatory agency requirements (e.g., those related to GHG reduction goals). If the CPUC approves use of fuel switching, it should investigate whether refinements are needed to the three-prong test to address the state's greenhouse gas reduction policies.

- ***Recommendation: Increase the capability of the program to influence industrial efficiency improvements.***
  To move these customers further along the efficiency spectrum takes time and advanced levels of technical expertise, often requiring expertise in specific industry production practices and options for improvement. This is a very difficult challenge in this sector. There is already significant industrial expertise available at the utility and third-party contractors and PG&E should be commended for having developed a large and strong industrial efficiency team for 2006-2008. This expertise should be built upon and further increased. Development of the depth of technical expertise required to increase the net effects of the programs is a long term endeavor that requires both utility and regulatory support.

- ***Recommendation: Influence and provide incremental energy efficiency options directly to end users at the earliest decision-making stages of major equipment or facility modifications.***
  Program involvement at an early stage to identify large equipment and facility changes helps ensure efficiency opportunities are appropriately considered and maximize the chances of program influence. Utilization of sales or related tracking systems helps prevent projects from becoming lost opportunities.

- ***Recommendation: Provide Continuity in Account Representative Assignments, Particularly for the Largest Customers.***
  We found many instances where the utility account reps had been reassigned one or more times during the project lifecycle. In some cases, this is unavoidable due to retirements or job changes. However, it should be noted that the likelihood of utility program influence is weakened in such cases, because the assigned representative lacks the long-term relationship and continuity needed to provide a significant influence on the installed project. The utility likely has an internal incentive to maintain continuity in account representative-customer relationships; utilities should seek to provide continuity in these account rep assignments, particularly for their largest customers.

- ***Recommendation: Consider Using Early Project NTG and Baseline Screening Prior to the Incentive Being Approved for the Largest Projects and those with Significant Policy Issues such as Fuel Switching, Self Generation, and Greenhouse Gas Impacts.***
  For the largest projects and those with significant policy issues, we recommend that the CPUC consider implementing an Early Project NTG and Baseline Screening step. This step would involve having the CPUC evaluation team review the baseline claim and conduct NTG interviews during the participant's project implementation and program participation decision process. The purpose of this screening would be to obtain critical information regarding program influence that could lead to the project being re-defined to increase efficiency levels and program influence or dropped for ratepayer-funded rebates if no influence is evident. This approach would also have the advantage of capturing

[5] The Three Prong Test requires that any fuel switching measures: (1) not increase source-BTU consumption;(2) have a TRC benefit-cost ratio of 1.0 or greater; and (3) not adversely affect the environment. Decision 92-10-020, Conclusion of Law 5.

critical information on program influence early in the decision making process, while the information is still fresh in the mind of the decision maker(s).

- ***Recommendation: Increase enforcement of program eligibility and policy rule requirements.*** Some of the evaluated projects were found to have violated program eligibility and policy rules. The CPUC should develop a process for reviewing projects for program eligibility prior to their being approved for a rebate.

- ***Recommendation: Carefully review the list of qualifying measures for each program and eliminate eligibility for those that are standard practice.***
  Measures that are already extremely likely to be installed by the vast majority of the market should in most cases not qualify for incentives. Although identification of such measures can be difficult in practice in the industrial sector, a number of such measures can be identified through investigation of industry practices (e.g., interviews with manufacturers, distributors, retailers, and designers), analysis of sales data, and review of evaluation results. In determining which measures to retain and which to eliminate, a balance must be struck between reducing free ridership and avoiding significant lost opportunities.

- ***Recommendation: Put measures with inadequate empirical basis for savings estimates in the emerging technologies program until more reliable information is developed.***
  The CPUC and IOUs should develop more explicit criteria for determining whether new measures are included under resource programs or the emerging technologies program. Measures with highly uncertain savings in need of detailed research to establish validity, expected savings, and repeatable algorithms and measurement protocols should be included in emerging technologies.

- ***Recommendation: Improve training of program implementation staff in several key areas.***
  These areas are: proper baseline specification, enforcement of program and policy rules, reasonableness of claims, comprehensive facility systems analysis, and increasing program influence on end user's efficiency-related decisions.

- ***Recommendation: Conduct analysis of customer incentives by customer and industry type. Conduct further research on the use of incentive caps.***
  Customer incentive caps have been utilized in various forms for many years. During times of low budgets and low goals, caps were set low to spread incentives to a broad pool of participants. More recently, as goals and budgets have significantly increased, caps have increased greatly as well. We are not aware of any systematic study of the effect of the incentives caps. Similarly, research is needed to explore how much total incentive dollars have been distributed across or concentrated within certain customers to determine whether these patterns are aligned and supportive of efficiency policy goals.

- ***Recommendation: More information is needed on industrial project costs, nonenergy costs and benefits, net present value analysis, and associated participant cost-effectiveness analysis.***
  There has been very little analysis conducted of the actual incremental costs of industrial energy efficiency projects. Rules of thumb, such as assuming that incentives represent half of incremental costs, appear to have been used instead as proxies. There is inadequate financial analysis conducted on program projects to determine what portion of the customer's financial investment threshold is associated with the energy savings of particular projects versus non-energy factors such as increases in production and reductions in labor, materials, and regulatory compliance costs. Further research is needed on industrial incremental measure costs in general. Increased financial analysis should be included in industrial project applications, especially for the projects with the largest incentives. Increased review of project financials inclusive of non-energy factors can also help to reduce free ridership.

Recommendations to reduce free ridership. The following are overarching free ridership related recommendations that are also relevant to this contract group:

- ***Recommendation: Consider Limiting or Excluding Incentive Payments to Known Free Riders***[6]
  One obvious and simple approach to reducing free ridership is for program administrators to simply exclude projects from the program that they (or possibly the Energy Division) believe have a high probability of being free riders. Administrators in several other jurisdictions have used this approach.[7] In these cases, the administrator has the flexibility to determine total incentive amounts on a case-by-case basis, including zero incentives. We believe consideration should be given to implementation of a process by which projects considered to be very high likelihood free riders are excluded from participation (or, conversely, must go to higher efficiency levels than initially planned in order to participate).[8] Alternatively, or in conjunction with this type of approach, rules could be developed that exclude incentive payments for projects that are driven exclusively by non-energy factors that produce energy savings as a by-product, such as some naturally-occurring improvements in certain industrial processes.

- ***Recommendation: Consider Incorporating a Payback Floor***
  The use of a payback floor (minimum payback level based on energy savings alone) can help to reduce free ridership be eliminating projects that have extremely quick paybacks and thus little need for ratepayer-funded incentives. With a payback floor, the program may also avoid incenting projects that are primarily being done for reasons other than energy savings (modernization, production efficiency, environmental compliance, etc.).

- ***Recommendation: Set Incentive Levels to Maximize Net (Not Gross) Program Impacts***
  Free riders dilute the market impact of program dollars. Payback floors and increasing incentives with increasing payback levels are one approach. Another is to tie incentive levels to individual measures or types of measures that are known to have extremely high or low naturally occurring adoption levels.

- ***Recommendation: Consider Tying Staff Performance to Independently Verified Net Results***
  Tying performance reviews of program staff to verified net savings as reported through an independent M&V or impact evaluation process is likely to increase project quality and the accuracy of initial savings estimates. Marketing staff, in particular, should have any financial incentives tied to savings that are independently verified.

Evaluation Related Recommendations. There are also a number of recommendations related to improving the evaluation process.

- ***Recommendation: Involve impact evaluators in large projects and a sample of projects on a real-time basis throughout the program cycle***
  The timing of evaluation processes should be accelerated. Moving the evaluation process forward in time to occur just after the project is installed would ensure the decision maker is still available, and that their memory of the basis for the project is still fresh. This can be accomplished through earlier contracting and implementation of the evaluation, combined with improved utility tracking and early reporting of installations (as well as projects in the pipeline), more frequent sampling and evaluation of projects throughout the program plan period.
- ***Recommendation: Evaluation participation requirements should be strengthened***
  In the course of conducting the evaluation, we experienced 'pushback' from many participants who either refused to participate in evaluation surveys and on-sites or declined to provide required data

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[6] From the California Public Utilities Commission Energy Efficiency Policy Manual, v. 4.0: "Free riders (Free Ridership) are program participants who would have installed the program measure or equipment in the absence of the program.

[7] Itron, 2005. National Energy Efficiency Best Practices Study. Volume NR5 – Nonresidential Large Comprehensive Incentive Programs. www.eebestpractices.com

[8] If necessary, such a process could involve an advisory group that includes staff from the Energy Division (to address any customer concerns). This would offer IOUs appropriate protection from claims that such exclusions were unfounded or unfair.

and documentation. This made it difficult to conduct the evaluation efficiently and can lead to systematic bias. Requirements for participating in evaluations need to be clearly explained to participants; both at the time they are paid incentives, and later, when evaluation activities commence. Evaluation participation should be clearly and obviously written into program participation and incentive payment agreements.

- ***Recommendation: Conduct a full complement of impact, process, and market evaluations***
  Large customer programs and markets are very dynamic and require regular assessment in order that they may be continuously improved by program managers and policymakers. Most of the effort for the 2006-2008 industrial evaluation focused on impact evaluation, in accordance with Energy Division's evaluation priorities. Future evaluations should consider more integration of process evaluation and market assessment to capture research economies and reduce customer and vendor interview burdens.

- ***Recommendation: Stagger the timing of process and ex post impact tasks so that process evaluations can be conducted and results communicated on a relatively real-time basis***
  If process and impact evaluations are more integrated in future evaluations, care must be taken to schedule activities and deliverables appropriately. Because of the sometimes long project installation lag after commitment in these programs, it is important to schedule process evaluation tasks to be conducted during or just after each program year so that results can be utilized to improve program processes for the subsequent program year (rather than producing results only late in the three year program cycle for use in the next program cycle).

- ***Recommendation: Conduct baseline research to establish standard industry practices for key measures in important industries***
  Significant research is needed to establish meaningful and defensible data, especially market share, for establishing industry standard practices for measures that are not completely site specific. Improved information on industry standard practices can then inform decisions about which measures to provide incentives for, which could in turn lead to reductions in free ridership.

- ***Recommendation: Conduct a persistence study of industrial sector savings***
  Few studies of the persistence of program savings in the industrial sector have been conducted, particularly within the last decade. As noted previously in this section, there were a number of participants who closed facilities or shut down processes associated with program measures due to economic factors. In addition, in some program years and cycles industrial production levels will be higher or lower depending on economic conditions. Some facilities that do close may stay closed while others may reopen and reutilize efficiency measures. Research is needed to measure the persistence of savings over time under a range of economic conditions. Sufficient time needs to pass in order to maximize the information provided from such persistence studies. We recommend waiting until the recession is completely over and the economy is in full recovery. To accelerate the time at which meaningful results would be obtained, studies can be conducted using earlier program cohorts, for example, going back to the 2002-2003 or 2004-2005 program cycles (or earlier), rather than simple waiting for the 2006-2008 cohort to age.

5.1 Summary of 2006-2008 PG&E Industrial Findings

The overall net realization rate for all projects implemented by all of the industrial programs covered in the scope of this CPUC evaluation contract group is 0.33, with a gross realization rate of 0.49 and net-to-gross ratio of 0.53. For Gas projects, the gross realization rate is somewhat higher, (0.68), but the net-to-gross ratio is much lower (0.31), resulting in an overall net realization rate of 0.27. These quantitative results indicate that the programs are significantly overestimating their savings claims. In addition, the results for the 2006-2008 program cycle show little to no improvement as compared to the historic results for industrial sector programs and may in fact be worse.

These results would be of concern in their own right but are made more significant by several policy considerations. Previous evaluations have identified many of the same issues as identified in this evaluation yet these key problem areas do not seem to have been adequately addressed. This raises a concern as to whether previous evaluation results have been seriously considered or simply cannot be successfully addressed. The question remains as to how to increase the effectiveness of industrial efficiency programs given the history of the programs and the challenges that the sector presents. We note that, despite these challenges and results, the industrial sector remains an important area for achieving cost effective and significant energy efficiency reductions above those that would otherwise occur due to natural market forces. In addition, programs may remain cost effective even with mediocre realization rates due to the size of the savings opportunities as compared with other sectors. There are a number of specific findings that help to explain why the ex-post savings estimates are significantly below the ex-ante.

5.4.3 Market-Driven Efficiency is Strong in this Sector

In some cases, high free ridership can be viewed as a positive indicator of strong market driven efficiency. Some companies' internal CO2 reduction policies may be increasing this (e.g., B123). A challenge for the programs is to influence these customers to go even further in their efficiency plans than they would otherwise due to their own internal policies and financial criteria. In one sense, this means setting baselines higher – which can be accomplished by using industry standard practice rather than in situ practice – as the basis for program participation and incentives. It can also mean developing customer specific baselines based on the plans the customer had at the initial point of program interaction.

11. Non-Residential New Construction (NRNC) Programs Impact Evaluation Volume II

KEMA, Inc., The Cadmus Group, Inc., Itron, Inc., Nexus Market Research, Inc.

This Evaluation encompassed the Savings by Design (SBD) programs which PG&E did not track separately.

1. PGE Multiple
2. SCE 2512
3. SDGE 3542
4. SCG 3018

Findings and Recommendations are found on the following pages of the report:
p. 26-27, p. 38, p. 79-82

1.3.1 NRNC Key Findings

The non residential new construction population consisted of 712 projects of which the evaluation team sampled 191 projects or approximately 27% of the population. The detailed findings for energy, demand, and therm savings can be found in Chapter 3 of the report. The following represents an overview of the ex-post gross and ex-post net evaluated savings. For all program participants, the combined total annual ex-post gross energy savings were estimated in this evaluation to be 186,211 MWh. The gross energy realization rates ranged from 82.2% to 107.1% with an overall gross realization rate of 96.0% for the program statewide. For all program participants, the combined total peak ex-post gross demand reduction is estimated to be 35.5 MW. The gross demand realization rates varied by utility from low of 56.6% to high of 111.6% with an overall gross realization rate of 80.2% for the programs statewide. The combined total annual ex-post gross gas savings for the program is 5,885,378 therms. The gross gas realization rate ranged from 66.5% to 120% with an overall realization rate of 73.6%.

The ex-post net evaluated energy savings for all program participants is 118,920 MWh yielding a statewide realization rate for energy of 77.8%. The net energy savings realization rate varied by utility from a low of 60.9% to a high of 93.1%. The ex-post net evaluated peak demand savings for all program participants is 22.1 MW yielding a statewide realization rate for peak demand of 62.4%. The ex-post peak demand savings realization rate varied by utility from a low of 38.7% to a high of 98.9%. The ex-post net evaluated gas savings for all program participants is 4,270,380 therms yielding a statewide realization rate of 57.4%. The ex-post net gas savings realization rate varied by utility from a low of 51.6% to a high of 113.4%.

1.3.2 NRNC Key Recommendations

This evaluation has shown that the IOUs non-residential new construction programs continue to provide large gross savings, with a substantial fraction being net savings despite changing codes and baselines. The positive performance was especially true for SBD applied to whole buildings. However, when the program was provided to industrial sites, which offer significant opportunities for gross savings, the program seemed to present opportunities for significant free-ridership. This evaluation illustrated that the net-to-gross ratios for industrial site participants were low. From our decision maker surveys, it appeared that in their enthusiasm to identify opportunities for improved energy efficiency, the program implementers may be pushing into areas that the industry already viewed as standard practice. However, the statewide NTG ratio for SBD, which was dominated by commercial new construction, showed NTG rates quite close to the IOU's ex-ante assumptions. For specific projects, gross savings realization rates can vary widely, especially if they involve gas measures, but on average many shortfalls were off-set by overachievements in other projects which resulted in overall positive results. We sampled a significant fraction of the program participants, and relatively high precision statistics give us confidence in these findings.

Gross savings can vary widely due to many issues, but several of them were within control of the utilities: baselines can be set erroneously and many assumptions and calculations are undocumented in the IOUs' files, leaving unexplainable differences with ex-post results. For instance, some measures were listed in

the tracking system with significant savings but were never installed; and some measures were installed but did not perform properly. This evaluation has also illustrated that for gas measures, the ex-ante estimation were either difficult to estimate or not estimated correctly.

In this evaluation we had a particular challenge in dealing with the "virtual" PG&E SBD program in a manner consistent with the SBD programs in the other utilities. As a result of this work, we fundamentally believe that virtual programs cannot be evaluated in a consistent fashion with real programs.

We recommend that the Utilities continue the SBD program since it is providing value to customers and providing significant energy savings. We believe the utilities need to improve the tools they are using to determine natural gas savings estimates. We also recommend that the utility implementers exercise more care and due diligence in assuring that they are really pushing the standard practice efficiency envelope when SBD is applied to industrial facilities. Finally, we recommend that all four utilities implement similar SBD programs.

3.4 SBD Statewide Detailed Findings

Projects that were incented under the Whole Building approach are reported under the measure group labeled "Whole Building." The combined total energy savings and demand reduction are defined to be the difference between the energy use or demand for the entire building under the T-24 baseline and as-built simulations.

Table 3-15 : 2006-2008 SBD Ex-Ante and Ex-Post Gross Electric Energy Savings (MWh)

Utility	Ex-Ante Gross Energy Savings (MWh)	Sampled Energy Savings (MWh)	% Sampled Energy Savings	Ex-Post Gross Energy Savings (MWh)	Error Bound	Relative Precision	Gross Realization Rate
PG&E	68,376	29,312	42.9%	56,174	5,594	10.0%	82.2%
SCE	107,601	41,284	38.4%	115,259	9,673	8.4%	107.1%
SCG	-	-	-	-	-	-	-
SDG&E	17,918	14,693	82.0%	14,779	612	4.1%	82.5%
Total	193,895	85,288	44.0%	186,211	11,191	6.0%	96.0%

5. Discussion of Findings and Recommendations: SBD

5.1 Judging Continuing Need for the Savings by Design Program

Many findings from this evaluation substantiate continuing need for the Savings By Design Program. It continues to produce important gross savings, with a substantial portion of those savings being attributable to the program. The great majority of the measures promoted by the program were long-life, lost-opportunity measures that should continue to deliver energy savings for a long time to come. At the same time, many of the program's measures continue to be innovative and push the energy efficiency envelope, effectively preparing the NRNC market for future code changes. Nevertheless, there are measures that are now becoming standard practice, and the Evaluation Team would suggest that the utilities continue to refine the measures receiving incentives.

12. Volume III Codes & Standards (C&S) Programs Impact Evaluation

KEMA, Inc., The Cadmus Group, Inc., Itron, Inc., Nexus Market Research, Inc.

This Evaluation encompassed four programs all of which dealt with Codes and Standards

1. PGE 2011
2. SCE 2516
3. SDGE 3004
4. SCG 3501

Findings and Recommendations are found on the following pages of the report:
p. 3, p. 14, p. 93-99, p. 137-38

Recommendations

Our major programmatic recommendations include the following:

- Continue to identify and target both appliance and building standards with large potential energy savings that address needs identified in the California Strategic Energy Plan and the CPUC energy goals.
- Continue coordination of Program among the utilities to leverage resources and expertise.
- Articulate, communicate, and implement a comprehensive strategy linking DSM programs and activities to the C&S Program and long-term strategic goals.
- Fully integrate a process of increasing codes and standards compliance and enforcement into the overall C&S Program approach.
- Encourage the California Energy Commission to increase attention to areas such as appliance and building standard compliance to guarantee that anticipated savings are achieved.
- Document and clarify the role of activities less targeted and focused than the preparation of CASE reports to establish the linkage to the adoption of other standards.
- If codes are to remain an important element in the California Strategic Energy Plan, the CEC, the IOUs, associations of local governments, and the legislature need to collaborate to ensure that the enforcing entities work together with evaluators to allow reliable measurement of energy savings due to compliance. In particular, policies need to be implemented to ensure local code jurisdictions retain essential code compliance documentation.

6.1 Major Findings

The C&S Program through its activities prior to 2006 produced significant verified energy savings during the period 2006 through 2008. The net savings after accounting for all the adjustments to the potential savings are shown in Table 44 along with the savings claimed by the utilities The savings shown are those achieved in the IOU service areas only and adjusted by the 50% factor required by the CPUC during this cycle.

In general, the verified electricity savings are slightly more than the claimed savings, while the verified demand and natural gas savings are less than the claimed amounts. In the aggregate, the realization rates were 117%, 85%, and 77% for electricity, demand, and natural gas savings, respectively. Overall, the Program has made a significant contribution toward energy savings in both buildings and appliances.

Table 44. Final Verified and Claimed Savings*

	Electricity (GWh)		Demand (MW)		Natural Gas (MTherms)	
	Verified	Claimed	Verified	Claimed	Verified	Claimed
PG&E						
Period						
2006	50.6	42.9	10	12.1	0.7	0.9
2007	59.6	42.7	11.6	11.8	0.7	0.8
2008	54.6	54.6	10.8	14.2	0.6	0.8
2006-08	164.7	140.3	32.3	38.1	1.9	2.4
SDG&E						
2006	11.9	10.1	2.3	2.8	0.1	0.1
2007	14	10	2.7	2.8	0.1	0.1
2008	12.8	12.8	2.6	3.3	0.1	0.1
2006-08	38.6	32.8	7.6	8.9	0.2	0.3
SCE						
2006	52.2	44.3	10.3	12.4	N/A	N/A
2007	61.5	44.1	12.0.7	12.2	N/A	N/A
2008	56.3	56.3	11.2	14.7	N/A	N/A
2006-08	169.9	144.7	33.4	39.3	N/A	N/A
SCG						
2006	N/A	N/A	N/A	N/A	1	1.4
2007	N/A	N/A	N/A	N/A	1.1	1.3
2008	N/A	N/A	N/A	N/A	1	1.2
2006-08	N/A	N/A	N/A	N/A	3	3.9
Total (all IOUs) for 2006-08	373.2	317.8	73.2	86.3	5.1	6.6
Statewide Realization Rates for 2006-08	117%		85%		77%	
*Note that claimed savings are based on 50% of amounts in the SES and verified savings are also 50% of the ex post evaluated quantity.						

13. Evaluation Report: PG&E Agricultural and Food Processing Program: Greenhouse Heat Curtain and Infrared Film Measures

KEMA, Inc. ERS, Inc., ADM Associates, California AgQuest Consulting, Robert Thomas Brown Company, Itron, Inc.

Besides the Agricultural and Food Processing program, this Contract Group encompassed two High Impact greenhouse Measures: heat curtains and infrared film. These two HIMs were installed through programs run by PG&E, SDG&E, and SCG.

PGE2001 (Agricultural and Food Processing)

Findings and Recommendations are found on the following pages of the report: p. 77-81

5.4.1 Program-Related Findings and Recommendations

Following are the key program-related findings and recommendations:

Baseline. Baseline definitions affected realization rates more than any other factor. It was both the most common "primary" reason (32% of evaluated projects) for ex-post impacts to deviate from ex-ante impacts by more than 10% and also was commonly cited in projects with low realization rates. For example, the simple average electric-energy realization rate was 35% for the seven projects that used an inappropriate industry-standard baseline definition in the ex-ante savings calculations. The simple average gas realization rate for the 15 projects that used inappropriate baseline parameters was 29%. Most often, the discrepancy was due to the IOU program administrators having used or allowed use of existing conditions to define the baseline when the evaluators used other project-specific circumstances at the time of decision-making to define baseline. Examples of projects with differing baseline definitions included:

- Boiler replacement. Engineers evaluated multiple projects associated with boiler replacement. Some of them turned out to be driven by the need to comply with increasingly stringent California emissions standards. In one case, while the pre-existing boiler theoretically could have been retrofitted through installation of a new low NOx burner or a selective catalytic reduction (SCR) device, evaluators concluded that circumstances at the site—boiler age, alternative retrofit cost, other related projects happening at the same time—meant that retrofit was not a viable economic alternative for the customer. It was improbable that the pre-existing boiler would have been retained. Thus evaluators used the characteristics of an industry-standard new boiler instead of the less efficient pre-existing boiler as the baseline.

- Wine-tank insulation. The IOU used no insulation as the baseline for a new tank installed at a large winery. Evaluators cited an IOU-funded report that concluded that one inch of insulation was standard practice for large winery tanks and was particularly common for outside tanks. The measure was for installation of two inches of insulation. The change in baseline from no insulation to one inch of insulation reduced measure savings by over 90%.

- Air compressor controls. In a project where the applicant bought an oil-free compressor controlled with a variable speed drive, the IOU defined the baseline compressor as an otherwise identical one controlled with less efficient throttle modulation. Evaluators researched the market and found that no such equipment exists in the oil-free market at this size and pressure class and, in fact, could not find any compressor with less efficient part load cfm/kW than the one purchased, thus all savings were negated.

Peak Demand Definition. Evaluators did not review a single project in which the applicant computed demand savings on the same basis as that defined by the evaluation protocols. Unsurprisingly, the peak demand realization rates varied tremendously. The unweighted coefficient of variation for demand

savings realization rate was 115%. We recommend that program staff be educated regarding the definition upon which their projects will be evaluated and that custom projects have demand savings calculated using a basis that reflects this definition, or something that reflects the same effect.

Remaining Useful Life Definition. Evaluators judged 10% of the projects as early retirements. These seven projects are likely to realize a higher level of savings during an early period and lesser savings in later years. To our knowledge, none of the IOU projects claimed savings on this two-tiered basis; all reported the first-year savings for the duration of the measure life. This methodological discrepancy regarding the remaining useful life (RUL) systematically inflates the IOU savings estimates compared to evaluators' judgment and depresses the evaluated lifetime savings realization rate. The evaluation team recommends that the IOUs incorporate RUL into custom-project savings calculations in order to be able to properly assess lifetime savings for incentives and reporting.

Three-prong test integration into SPC software. Ag-Food's sample included two fuel switching projects that do not appear to have been subjected to the requisite "three-prong" test to ensure that the measures resulted in net energy savings, net emissions reduction, and passed cost-effectiveness tests. The IOUs may want to consider integrating such an assessment into the Standard Performance Contract (SPC) software.

Third-party review team independence. Many evaluated projects had been subject to prior review and/or management by IOU-funded third-party contractors. There was evidence in program materials of relationships that may have been allowed to get too familiar. For example, one controls developer asked that a particular third-party review firm work with them on a project due to prior satisfactory experience. That firm's subsequent reviews largely affirmed the adequacy of the developer's approach and projections rather than independently developing their own. Evaluators found that particular set of calculations to markedly overestimate savings. In another project associated with a centrifugal air compressor, pre-implementation approval was appropriately based on a more efficient compressor than the theoretical baseline and thus the compressor was to be eligible for incentive. However, the post-implementation site visit by the IOU-funded third party consultant found a different, less-efficient compressor installed. Due to a sequence of events untraceable by evaluation staff, the post-implementation verification savings calculations changed in a fashion favorable to the applicant without apparent change in baseline equipment, presumed circumstances, or computational method. Evaluators found the initial pre-implementation estimates to be much closer to the evaluated savings, and the IOU suffered in this evaluation by having a low realization rate for the sampled project applied to both that project and others it represented in the population. We recommend that the IOU redouble its efforts to keep third parties vigorously and independently scrutinizing projects, especially in instances where there is deviation in the installed and proposed equipment.

Demand more measurement on large projects. There were several projects with very large savings and large incentives under consideration for which there also was great uncertainty in savings projections due to their almost entirely theoretical basis. The basis may have included a few spot measurements but little logging of performance over time. This was more likely to happen with gas savings projects. The evaluation team was able to substantially improve on estimates with equipment measurement. It would seem that more measurements would be warranted in these multi-million dollar projects and be beneficial to the customers paying for them for the IOU to insist on more logging to substantiate savings projections.

Custom pump-retrofit projects. The agricultural pump-retrofit program basis of estimating incentives and savings generally appears to work very well, particularly for pumping applications that deliver water to a static situation (permanent crop, same acreage, and no other water sources). Applications that involve other irrigation water sources and loads that vary (i.e., availability of surface water from an irrigation district, annual changes in cropping, or winter rainfall) result in much more complex evaluations, and the levels of uncertainty increase significantly. While the IOU may not deem it worthwhile to complicate the incentive determination process, it is worth considering custom savings' analysis for the purpose of energy-savings reporting to the CPUC. Specifically, evaluation of long-term energy savings would benefit by not simply accepting the prior twelve months' electricity usage as representative of long-term future flow requirements and instead rigorously interview on prospects, use 24- or 36-month histories, or both.

Good methodology. While there were exceptions as noted above, overall the engineering evaluation team found the computational approaches used by the IOU, their third party contractors, and applicants to be both appropriate and defensible. Differences in savings estimates tended to be due to baseline issues or different input values due to measurement, judgment, or changes in production. The underlying methodologies were sound and executed calculations were relatively error-free.

ATTACHMENT 3:

Electricity Consumption Trends: California and the Rest of the U.S.

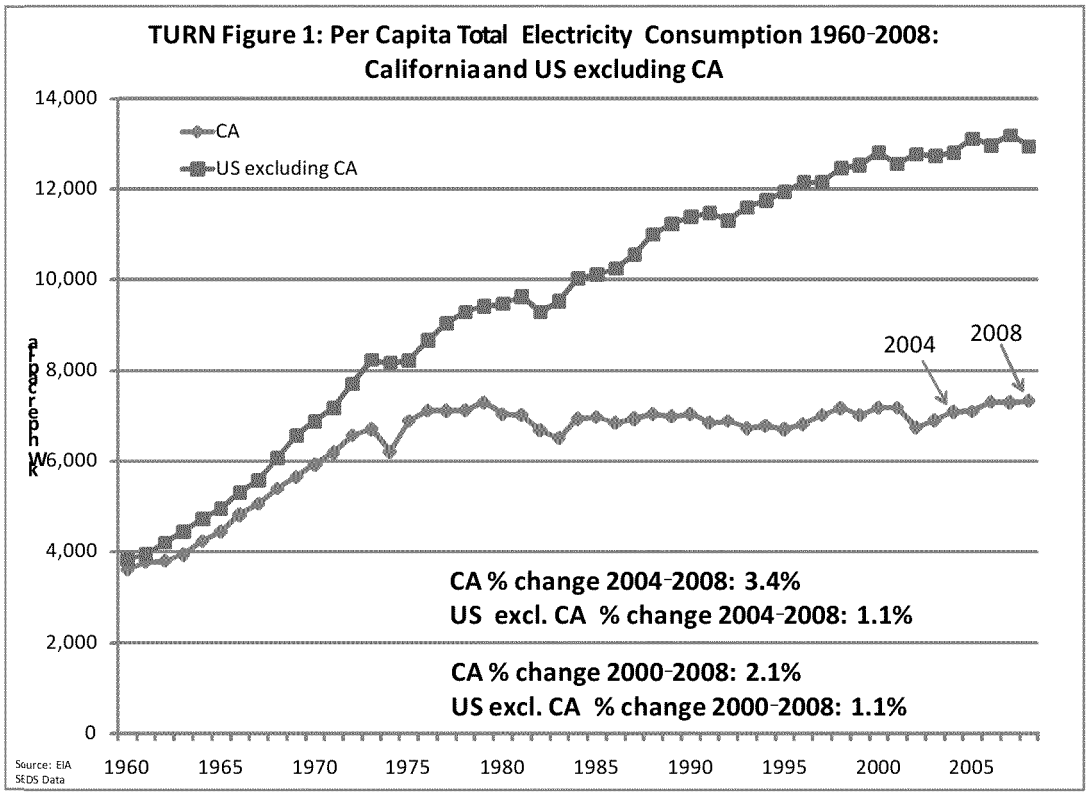
Figures 1 to 4 below show the per capita and absolute change in residential and total electricity consumption between 1960 and 2008 (California and the rest of the U.S.), as well as the reductions in consumption that are consistent with meeting AB32 targets.

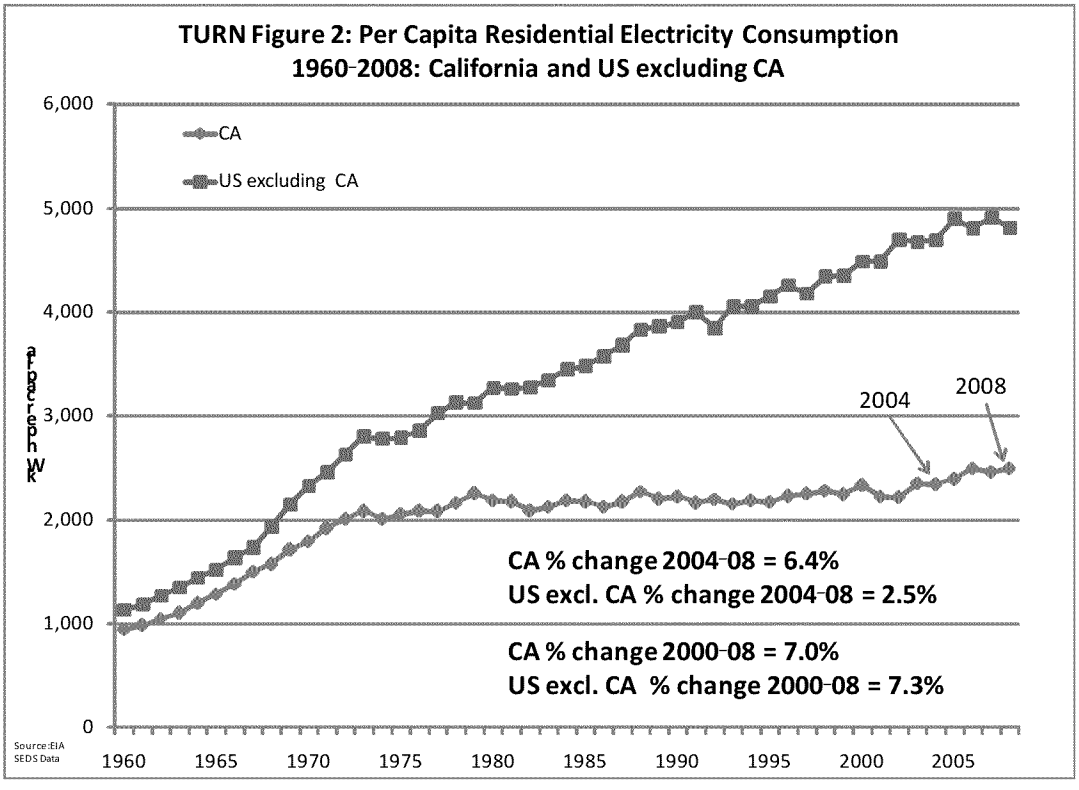
Figure 1 shows total electricity consumption per capita. California and the rest of the U.S. followed divergent paths from the 1970s to the beginning of the twentieth century, with California consumption leveling off while the rest of the U.S. continued to increase its per capita electricity use. More recently, however, the rest of the U.S. has slowed its rate of increase in consumption. A similar pattern is evident in Figure 2, which focuses on trends in the residential sector only. In both cases the rest of the U.S. has actually experienced less of an increase in per capita electricity use over the last several years than California:

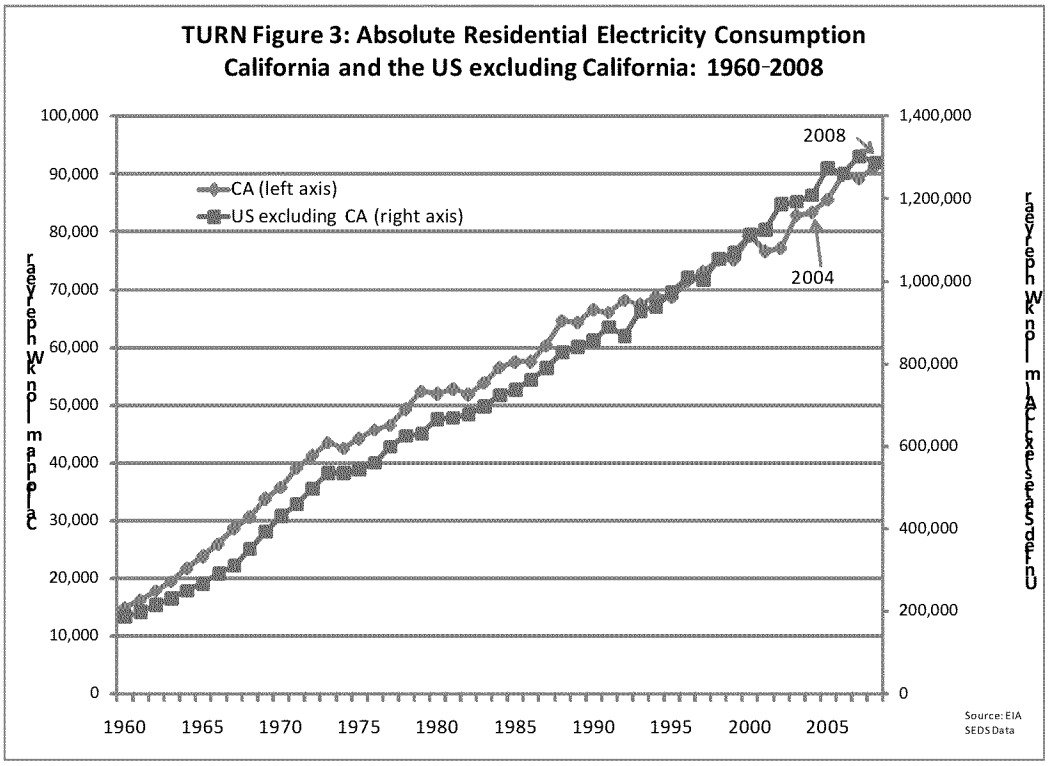
- For total electricity, per capita consumption increased by 3.4 per cent in California between 2004 and 2008, compared with 1.1 per cent in the rest of the U.S. A similar pattern is evident for the 2000-2008 period, during which California recorded an increase of 2.1 per cent compared to 1.1 per cent in the rest of the U.S.
- For the residential sector, per capita consumption grew by 6.4 per cent in California between 2004 and 2008 and 2.5 per cent in the rest of the U.S. Over the longer 2000-2008 period, both California and the rest of the U.S experienced a similar rate of increase (7 per cent).

There has been considerable debate about the causes of California's relatively flat per capita electricity consumption curve in the context of steadily increasing usage in the rest of the U.S. While it is tempting to assume that the difference is due to California's history of energy efficiency, closer inspection reveals a number of other factors that have contributed to the trends in Figures 1 and 2. The issue was addressed in a study conducted by Energy Economics Inc. and published in Public Utilities Fortnightly March 2009, "Stabilizing California's Demand: The Real Reasons Behind the State's Energy Savings". The article illustrates the difficulty of establishing a strong direct "cause and effect" between energy (utility EE programs and building and appliance standards) and energy consumption, and points to a number of other factors that both distinguish California from the rest of the U.S. and which act to reduce the demand for electricity in the state. One of these is the price of electricity; the Energy Economics, Inc. study found a strong correlation between changes in California per capita residential electricity consumption and changes in the price of residential electricity in the state. The study also identified a number of other differences between California and the rest of the U.S. that could help explain the state's history of relatively low per capita electricity use, including climate, the rising share of multi-family housing, increasing household size, behavior suggestive of a "conservation ethic" and, beyond the residential sector, the structure of the economy and trends in energy usage within dominant industries.

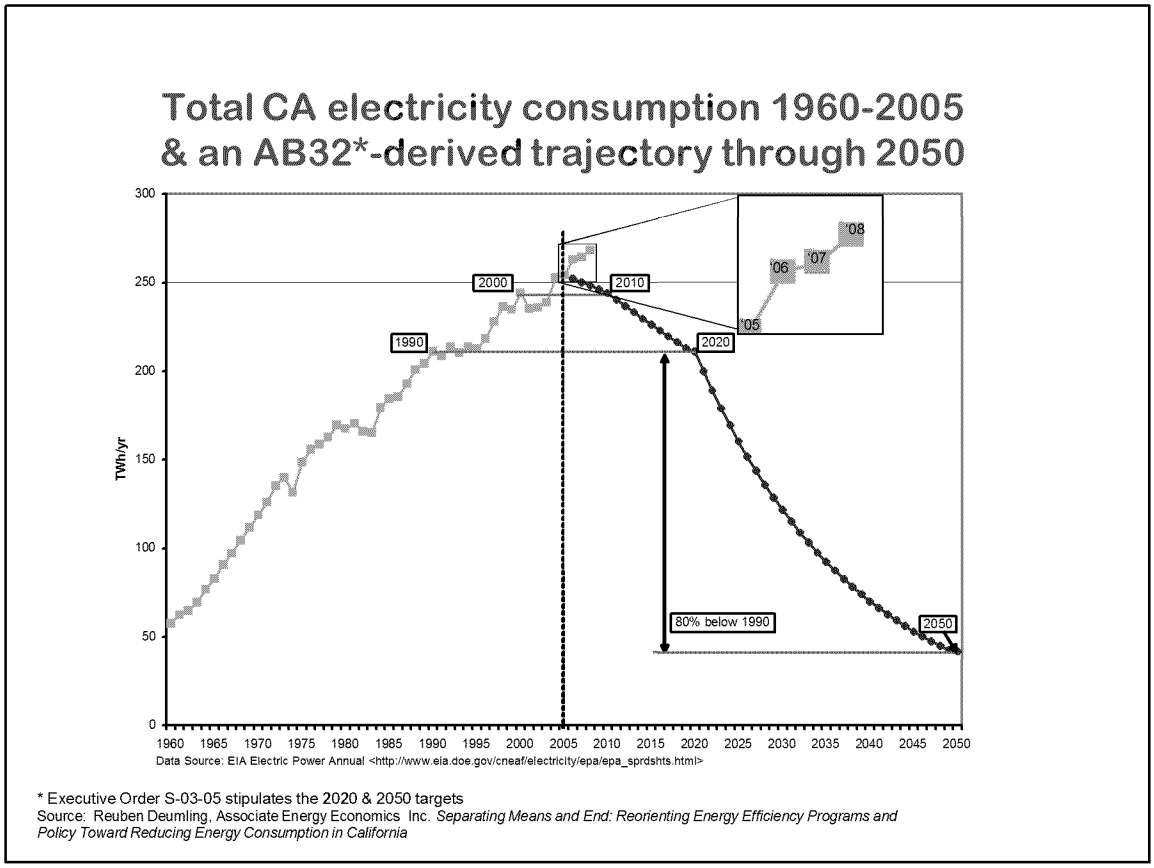
Turning now to absolute consumption, rather than usage per capita, Figure 3 shows that both California and the rest of the U.S. have seen steady increases in residential electricity consumption. Although California has kept per capita consumption relatively stable over the past 40 years, population growth has meant that absolute electricity use has continued to rise. Figure 3 also shows that the EE programs of the 2004-2008 period did little to address the steady increase in residential electricity consumption within California. Figure 4 shows that if the state is to meet its AB32 GHG reduction targets, this upward trend will have to reverse direction: California will have to reduce electricity usage in absolute terms and bend down the consumption curve.


TURN Figure 1: Per Capita Total Electricity Consumption 1960-2008:
California and US excluding CA
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
CA
US excluding CA
2004
2008
CA % change 2004-2008: 3.4%
US excl. CA % change 2004-2008: 1.1%
CA % change 2000-2008: 2.1%
US excl. CA % change 2000-2008: 1.1%
Source: EIA SEDS Data
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005


TURN Figure 2: Per Capita Residential Electricity Consumption
1960-2008: California and US excluding CA
6,000
5,000
4,000
3,000
2,000
1,000
0
CA
US excluding CA
2004
2008
CA % change 2004-08 = 6.4%
US excl. CA % change 2004-08 = 2.5%
CA % change 2000-08 = 7.0%
US excl. CA % change 2000-08 = 7.3%
Source:EIA SEDS Data
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

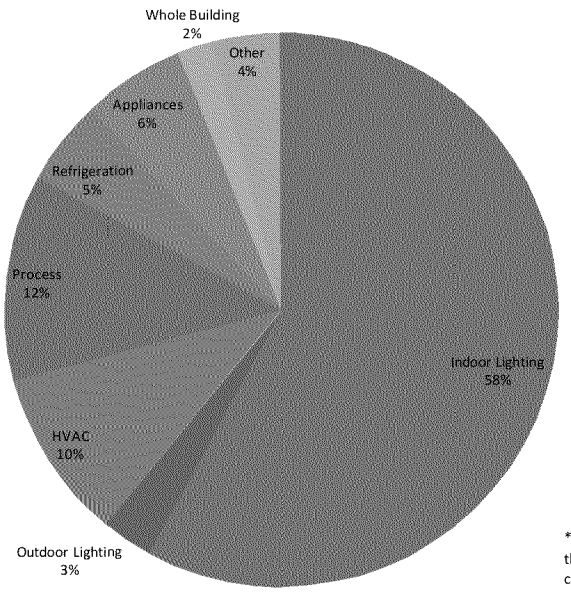


TURN Figure 4



ATTACHMENT 4: Comparison 2006-08 Energy Division ex post Adjusted and 2010-12 IOUs Projected EE Savings: End Uses and Lighting Measure Groupings

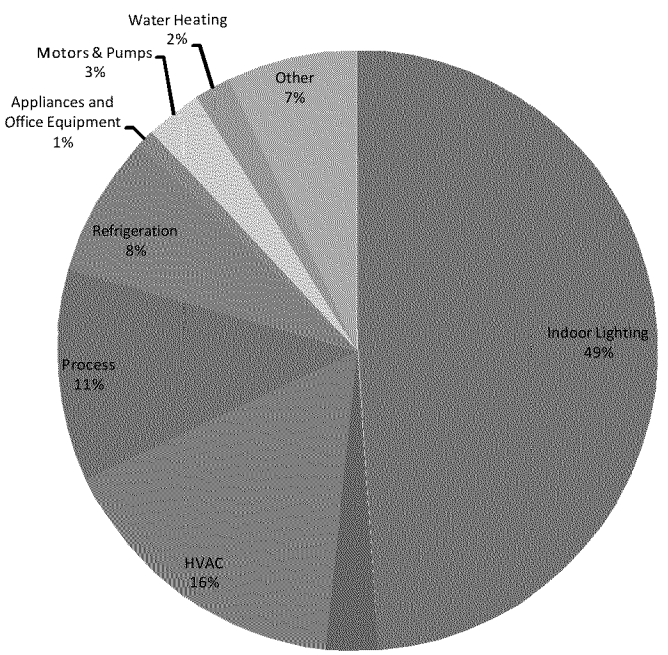
Figure 1: Net GWh Savings by End Use* 2006-2008
ED Ex-post M&V



Source: 2006-2008 Energy Efficiency Evaluation Report, July 2010, Figure 37

* For the purposes of this graph, the End Use categories used correspond to the Measure Group categories in the 2006-2008 EE Evaluation Report.

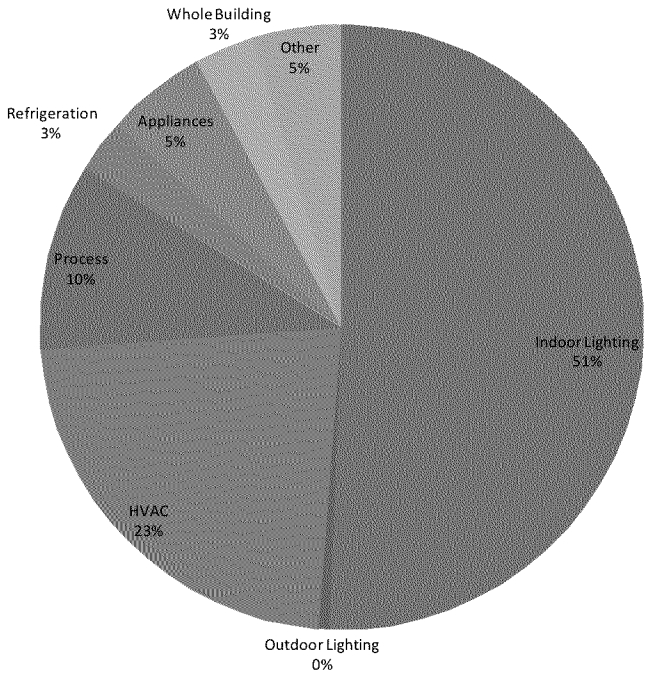
Figure 2: Net GWh Savings by End Use 2010-2012
IOUs' Forecast Savings



Source: Output tabs: SDG&E and SCE November 2009 Compliance Filing E3s; PG&E June 2010 Compliance Filing E3

Indoor lighting = E 3Interior Lighting
Outdoor Lighting = E3 Exterior Lighting

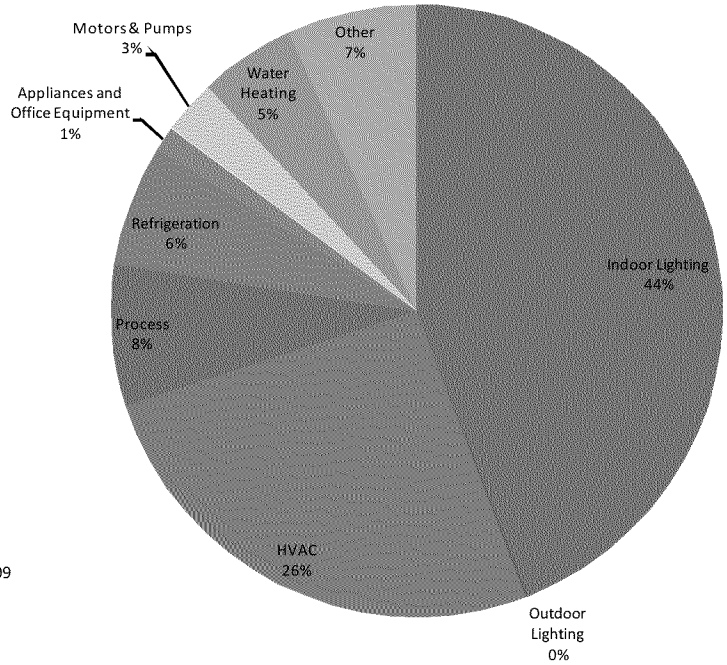
Figure 3: Net MW Savings by End Use* 2006-2008
ED Ex-post M&V



Source: 2006-2008 Energy Efficiency Evaluation Report, July 2010, Table 21

* For the purposes of this graph, the End Use categories used correspond to the Measure Group categories in the 2006-2008 EE Evaluation Report.

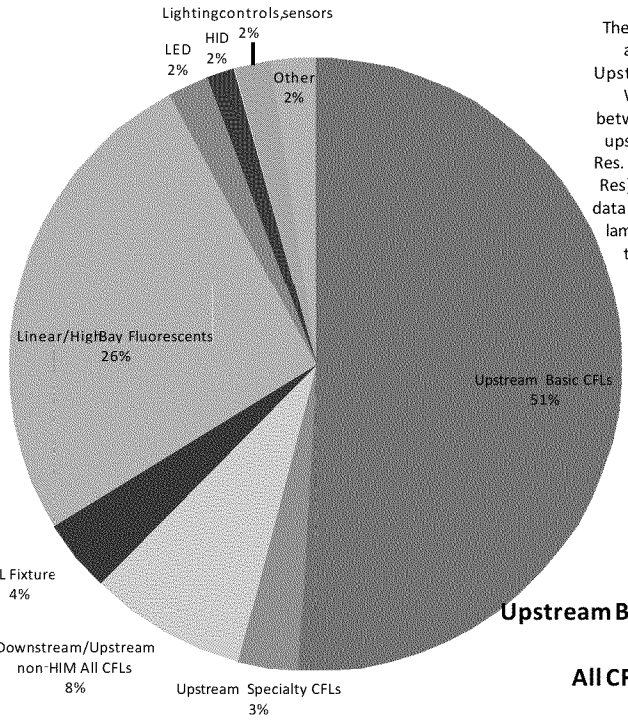
Figure 4: Net MW Savings by End Use 2010-2012
IOUs' Forecast Savings



Source: Output tabs: SDG&E and SCE November 2009 Compliance Filing E3s; PG&E June 2010 Compliance Filing E3

Indoor lighting = E 3Interior Lighting
Outdoor Lighting = E3 Exterior Lighting

Figure 5: Net GWh Savings from Lighting by Measure Group 2006-2008 ED Ex-post M&V



Note: Excludes 118.7 GWh of "unknown" lighting

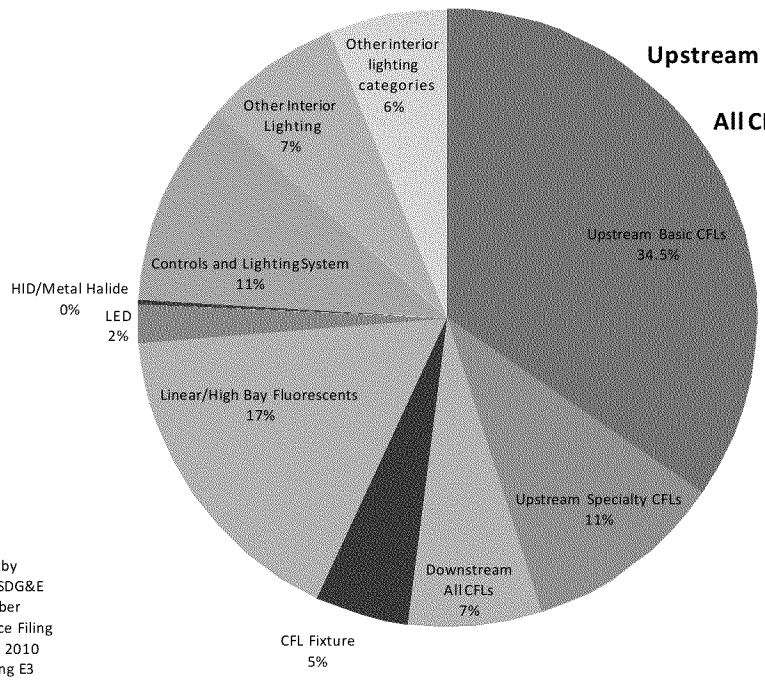
The Upstream Basic CFL category is an estimate derived from the Upstream Lighting Evaluation Report. We applied the 94% - 6% split between Twister/A-lamps and other upstream CFLs documented in the Res. sector to the total (Res and Non-Res) upstream CFL savings. Ex-ante data for SCE show that the Twister/A-lamp - Other CFL split is similar for the Res and Non-Res sectors.

Upstream Basic CFLs = 1,152 GWh

All CFLs = 1,498 GWh

Source: ERT Measure Level Summary; Final Upstream Lighting Evaluation Report, Vol. 1, Table 27

Figure 6: Net GWh Savings from Lighting by Measure Group 2010-2012 IOUs' Forecast Savings

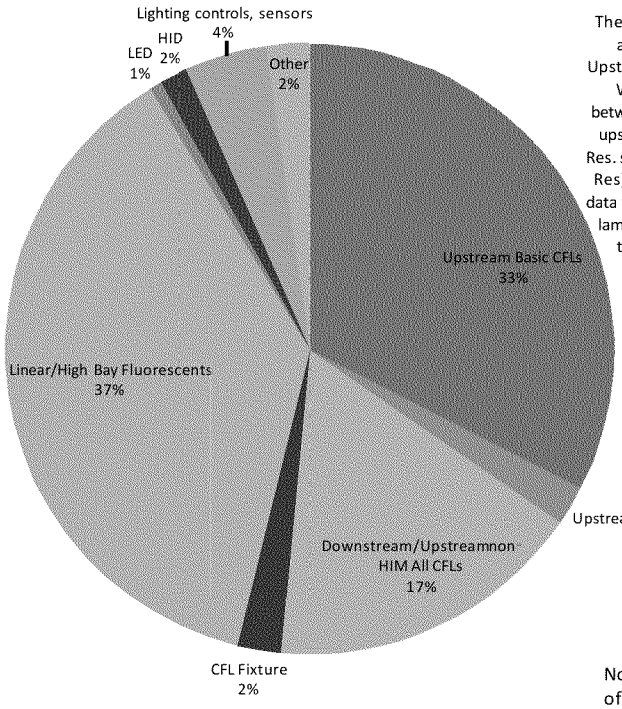


Upstream Basic CFLs = 947 GWh

All CFLs = 1,560 GWh

Source: Output by Measure tabs: SDG&E and SCE November 2009 Compliance Filing E3s; PG&E June 2010 Compliance Filing E3

Figure 7: Net MW Savings from Lighting by Measure Group 2006-2008 ED Ex-post M&V

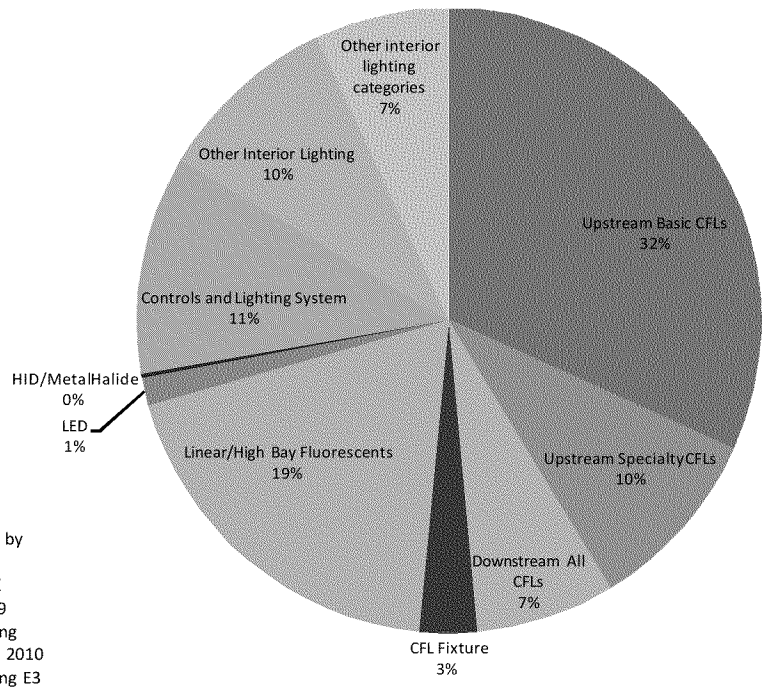


The Upstream Basic CFL category is an estimate derived from the Upstream Lighting Evaluation Report. We applied the 94% - 6% split between Twister/A-lamps and other upstream CFLs documented in the Res. sector to the total (Res and Non-Res) upstream CFL savings. Ex-ante data for SCE show that the Twister/A-lamp - Other CFL split is similar for the Res and Non-Res sectors.

Source: ERT MeasureLevel Summary; Final Upstream Lighting Evaluation Report, Vol. 1, Table 27

Note: Excludes 19.901 MW of "unknown" lighting

Figure 8: Net MW Savings from Lighting by Measure Group 2010-2012 IOUs' Forecast Savings



Source: Output by Measure tabs: SDG&E and SCE November 2009 Compliance Filing E3s; PG&E June 2010 Compliance Filing E3