Final Evaluation Report: Upstream Lighting Program

Volume 1

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Abstract

This report presents results of an impact evaluation of the 2006-2008 Upstream Lighting Program implemented by PG&E, SCE and SDG&E. Combined, the Upstream Lighting Program accounted for over half (56%) of the expected net kWh savings and 42% of the expected net kW reductions for the total statewide portfolio.

Gross impacts were developed using a combination of methods, including installation rate modeling and analysis, as well as lighting logger and baseline wattage data analysis from over 1,700 sites throughout California. Net savings were developed using multiple methods and data sources ultimately relying on a preponderance of the evidence approach.

Statewide annual net savings for the Upstream Lighting Program are estimated to be about 1,325 GWh and net peak demand reductions were determined to be nearly 134 MW (25% and 20% of the ex-ante estimates respectively).[1] Screw-in CFLs account for the vast majority of net savings, with 92% of net energy savings and 96% of net peak demand reductions achieved through the purchase, installation and usage of these measures.

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

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Executive Summary

In this report we present the results of an impact evaluation conducted by the Residential Retrofit contract group for the California Public Utilities Commission. The prime contractor for this group was The Cadmus Group, Inc., with KEMA, Inc. as the lead for the Upstream Lighting Program. Support was also provided by Itron, Inc., PA Consulting Group and Jai J. Mitchell Analytics.

The evaluation focused on estimating gross and net kWh and kW impacts from the 2006-2008 Upstream Lighting Program as implemented by PG&E (PGE2000 and PGE2080), SCE (SCE2501) and SDG&E (SDGE3016).[2] Combined, the Upstream Lighting Program accounted for over half (56%) of the expected net kWh savings and 42% of the expected net kW reductions for the total statewide portfolio.

There were three types of high-impact measures (HIMs) addressed in this evaluation: screw-in compact fluorescent lamps (CFLs), energy efficient lighting fixtures, and light emitting diode (LED) measures.[3]

Evaluation Approach

The 2006-2008 Upstream Lighting Program evaluation was designed to achieve the following objectives:

- Verify the quantity of lighting measures that were shipped, sold and installed by residential and nonresidential customers within the PG&E, SCE and SDG&E service territories during the 2006-2008 program period,
- Estimate the gross energy and demand impacts from these measures, and
- Determine an appropriate net-to-gross ratio[4] for estimating net energy and demand impacts.

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[2] 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).

[3] Subsequent to the initial allocation of programs to the evaluation contract groups, the overall focus of the CPUC evaluation activities shifted from a program evaluation to a "high impact measure" (HIM) evaluation. During this process, a list of HIMs was developed from the E3 calculators delivered by the Investor-owned utilities (IOUs) covering program savings claims through the end of the second quarter of 2008 (Q2-2008). A single Access database containing E3 measure line items, from the E3 calculator's Input tab, was created. Each of the measures was assigned a measure name using a consistent measure-naming scheme. The savings claims for each IOU were tabulated for each named measure, and each measure's contribution was calculated to the total IOU portfolio savings claim for kWh, kW, and therms. The list of HIMs was developed by identifying all measures that contributed more than 1% to any of the kWh, kW, or therm savings parameters and categorized by IOU. Unlike most other contract groups, this process did not result in any significant changes to the overall evaluation approach for the Upstream Lighting Program since it was already well established that this program had substantially contributed to each IOU's portfolio savings claim for kWh and kW.

There were three primary components to the evaluation approach:

1. **Adjustments to Quantity of Measures Rebated,** which included a verification assessment of a sample of program invoices/applications, an assessment of the percent of IOU-discounted products not sold by the end of 2008, an assessment of the percent of IOU-discounted products purchased by non-IOU customers (i.e., leakage), and an assessment of the percent of IOU-discounted products purchased by residential v. nonresidential customers.
2. **Development of Gross Savings Inputs,** which included an assessment of the percent of IOU-discounted products installed at the end of 2008 (installation rate), estimates of the average daily hours-of-use (HOU), estimates of the average percent operating at peak (coincident factor, CF), estimates of the wattage displaced by IOU-discounted products (delta watts), and calculation of unit energy savings (UES) estimates (kWh/year and peak kW).
3. **Development of Net Savings Inputs,** which included estimates of the net-to-gross ratio (NTGR).

Results

Table 1 presents the final results from the evaluation of the 2006-2008 Upstream Lighting Program. As shown, more than 1,325 GWh in net annual energy savings were achieved as a result of the measures rebated through this program. Net peak demand reductions amounted to nearly 134 MW. Overall, the IOUs realized about 25% of their ex-ante claims for net energy and 20% of their peak demand reduction claim.

Key drivers in these results are summarized below:

- The quantity of all measures rebated was adjusted downward by about 13% to account for measures not verified, not sold through December 31, 2008, and not sold to IOU customers.
- In general, about 95% of the rebated measures were found to have been installed in residential locations as compared to the 90% assumed by PG&E and SCE and 100% assumed by SDG&E.
- 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 ex-post adjustments to the estimates for annual operating hours, peak coincidence factors and delta watts.
- The recommended NTGR estimates were reduced by about half for PG&E, and a little more than one third for SDG&E. SCE's ex-ante NTGR value was lower than the other two IOUs to begin with and the ex-post value was the highest of the three, resulting in only about a 15% reduction.

[4] According to the CPUC Energy Efficiency Policy Manual v4.0, the net-to-gross ratio is the ratio or percentage of net program impacts divided by gross program impacts. Net-to-gross ratios are used to estimate and describe the free ridership that may be occurring within an energy efficiency program.

Table 1: Ex-post Net Annual Energy and Peak Demand Impacts from the 2006-2008 Upstream Lighting Program[5]

All IOUs	**Ex-post Net Annual Energy Impacts (kWh/yr)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	233,553,499	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%	**25%**
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	**607,596,705**	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	**62,159**	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%	**26%**
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%**

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

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.

1. Introduction and Purpose of the Study

This is the evaluation report for the Upstream Lighting Program, a component of the Residential Retrofit contract group. The evaluation project was led by KEMA, Inc., who was in charge of overall project planning, sample design, evaluation implementation, analysis, and reporting. Substantial support was provided by the prime contractor, The Cadmus Group, Inc. as well as PA Consulting Group, Itron, Inc. and Jai J. Mitchell Analytics.

The evaluation focused on the 20006-2008 Upstream Lighting Program as implemented by PG&E (PGE2000 and PGE2080), SCE (SCE2501) and SDG&E (SDGE3016).[6] There were three types of high-impact measures (HIMs) addressed in this evaluation: screw-in compact fluorescent lamps (CFLs), energy efficient lighting fixtures, and light emitting diode (LED) measures.[7] The evaluated program period operated from January 2006 through December 2008.

The Upstream Lighting Program evaluation effort had three primary objectives:

1. Verify the quantity of lighting measures that were shipped, sold and installed by residential and nonresidential customers within the PG&E, SCE and SDG&E service territories during the 2006-2008 program period,
2. Estimate the gross energy and demand impacts from these measures, and
3. Determine an appropriate net-to-gross ratio for estimating net energy and demand impacts.

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[6] 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).

[7] Subsequent to the initial allocation of programs to the evaluation contract groups, the overall focus of the CPUC evaluation activities shifted from a program evaluation to a "high impact measure" (HIM) evaluation. During this process, a list of HIMs was developed from the E3 calculators delivered by the Investor-owned utilities (IOUs) covering program savings claims through the end of the second quarter of 2008 (Q2-2008). A single Access database containing E3 measure line items, from the E3 calculator's Input tab, was created. Each of the measures was assigned a measure name using a consistent measure-naming scheme. The savings claims for each IOU were tabulated for each named measure, and each measure's contribution was calculated to the total IOU portfolio savings claim for kWh, kW, and therms. The list of HIMs was developed by identifying all measures that contributed more than 1% to any of the kWh, kW, or therm savings parameters and categorized by IOU. Unlike most other contract groups, this process did not result in any significant changes to the overall evaluation approach for the Upstream Lighting Program since it was already well established that this program had substantially contributed to each IOU's portfolio savings claim for kWh and kW.

1.1 Program Overview

The Upstream Lighting Program provided manufacturer and distributor buy-downs or retailer instant discounts for eligible lighting products that were then sold through participating retailers. Eligible products included:

- **Screw-in CFLs –** All three IOUs provided rebates for basic bare spiral CFLs, as well as several types of specialty CFLs (e.g., dimmable, three-way wattage, reflector-style, A-lamp shaped, and globe-shaped).
- **Energy Efficient Lighting Fixtures –** All three IOUs provided rebates for hard-wired, compact fluorescent (CF) interior and exterior lighting fixtures. PG&E and SCE also offered rebates for CF torchiere lighting fixtures, and SCE provided rebates for plug-in fluorescent desk, table and non-torchiere floor lamps.
- **Light-emitting diodes (LEDs) –** All three IOUs also offered rebates for various types of LED lighting products:
    - LED night lights – PG&E, SCE and SDG&E
    - LED holiday light strings – PG&E and SDG&E
    - LED open/close signs – SCE and SDG&E
    - LED desk/task lights – SCE and SDG&E

PG&E and SCE assumed that a fraction of these products would be purchased and installed within the nonresidential sector. With the exception of a small number of LED lighting products, SDG&E assumed that 100% would be purchased and installed within the residential sector. Another key difference between the IOU programs is the distribution of rebated products by retail channel, as shown in Table 2. These differences play a key role in the determination of several energy savings parameters as described throughout this report.

Table 2: Distribution of Upstream Lighting Program Rebated Products by Retail Channel (2006-2008)

Screw-in CFLs			
Retail Channel	**PG&E**	**SCE**	**SDG&E**
Discount	10%	25%	14%
Drug	13%	4%	11%
Grocery	30%	44%	32%
Hardware	6%	4%	4%
Home Improvement	8%	8%	13%
Lighting & Electronics	1%	2%	1%
Mass Merchandise	4%	5%	9%
Membership Club	28%	8%	16%
Other	0%	0%	1%
	100%	100%	100%
Energy Efficient Lighting Fixtures			
Retail Channel	**PG&E**	**SCE**	**SDG&E**
Discount	25%	45%	35%
Drug	1%	1%	0%
Grocery	4%	14%	5%
Hardware	24%	14%	37%
Home Improvement	28%	6%	6%
Lighting & Electronics	7%	5%	0%
Mass Merchandise	1%	0%	0%
Membership Club	9%	15%	17%
Other	0%	0%	0%
	100%	100%	100%
LEDs			
Retail Channel	**PG&E**	**SCE**	**SDG&E**
Discount	5%	49%	15%
Drug	3%	1%	1%
Grocery	11%	27%	56%
Hardware	7%	9%	15%
Home Improvement	0%	11%	3%
Lighting & Electronics	3%	1%	4%
Mass Merchandise	0%	3%	0%
Membership Club	70%	0%	0%
Other	1%	0%	6%
	100%	100%	100%

Source: Program tracking records.

The reported number of rebated units is shown in Table 3 by IOU, product type and sector, and Table 4 summarizes the reported savings claims by IOU, product type and sector. As shown, the various components of the Upstream Lighting Program accounted for over half (56%) of the expected net kWh savings and 42% of the expected net kW reductions for the total statewide portfolio. Finally, Table 5 summarizes the ex-ante impact parameter assumptions by IOU, product type and sector.

Table 3: Reported Number of Rebated Units from the Upstream Lighting Program by IOU, Product Type and Sector (2006-2008)[8]

Program ID	Sector	CFLs	Fixtures	LEDs	All Products
PGE2000/ PGE2080	Nonresidential	5,234,370	42,438	987,653	6,264,461
	Residential	47,704,381	410,125	9,101,886	57,216,392
	Total	52,938,751	452,563	10,089,539	63,480,853
SCE2501	Nonresidential	3,518,478	244,677	0	3,763,155
	Residential	31,766,209	512,277	1,812,352	34,090,838
	Total	35,284,687	756,954	1,812,352	37,853,993
SDGE3016	Nonresidential	0	0	1,034	1,034
	Residential	7,611,804	105,977	3,638,976	11,356,757
	Total	7,611,804	105,977	3,640,010	11,357,791
All IOUs	Nonresidential	8,752,848	287,115	988,687	10,028,650
	Residential	87,082,394	1,028,379	14,553,214	102,663,987
	Total	95,835,242	1,315,494	15,541,901	112,692,637
Percentage by Sector					
Program ID	**Sector**	**CFLs**	**Fixtures**	**LEDs**	**All Products**
PGE2000/ PGE2080	Nonresidential	10%	9%	10%	10%
	Residential	90%	91%	90%	90%
SCE2501	Nonresidential	10%	32%	0%	10%
	Residential	90%	68%	100%	90%
SDGE3016	Nonresidential	0%	0%	0%	0%
	Residential	100%	100%	100%	100%
All IOUs	Nonresidential	9%	22%	6%	9%
	Residential	91%	78%	94%	91%

Source: 4Q08 E3

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

Table 4: Ex-Ante Net Energy and Demand Impacts from the Upstream Lighting Program by IOU, Product Type and Sector (2006-2008)[9]

Ex-ante Net Annual kWh						
Program ID	**Sector**	**CFLs**	**Fixtures**	**LEDs**	**All Products**	**Total Portfolio**
PGE2000/ 2080	Nonresidential	1,250,100,941	14,126,385	12,879,616	1,277,106,941	
	Residential	1,715,558,531	45,349,481	30,608,896	1,791,516,908	
	Total	2,965,659,471	59,475,866	43,488,512	3,068,623,850	5,254,423,907
	Percent of Total Portfolio	**56%**	**1%**	**1%**	**58%**	
SCE2501	Nonresidential	529,182,704	32,656,476	0	561,839,180	
	Residential	1,236,987,908	35,688,372	35,022,908	1,307,699,188	
	Total	1,766,170,612	68,344,848	35,022,908	1,869,538,368	3,263,648,649
	Percent of Total Portfolio	**54%**	**2%**	**1%**	**57%**	
SDGE3016	Nonresidential	0	0	45,289	45,289	
	Residential	279,077,392	6,155,341	23,467,063	308,699,796	
	Total	279,077,392	6,155,341	23,512,352	308,745,085	849,277,220
	Percent of Total Portfolio	**33%**	**1%**	**3%**	**36%**	
All IOUs	Nonresidential	1,779,283,644	46,782,861	12,924,905	1,838,991,411	
	Residential	3,231,623,831	87,193,194	89,098,867	3,407,915,892	
	Total	5,010,907,475	133,976,056	102,023,772	5,246,907,303	9,367,349,776
	Percent of Total Portfolio	**53%**	**1%**	**1%**	**56%**	
Ex-ante Net Peak kW						
Program ID	**Sector**	**CFLs**	**Fixtures**	**LEDs**	**All Products**	**Total Portfolio**
PGE2000/ 2080	Nonresidential	226,951	1,409	941	229,301	
	Residential	162,854	1,055	0	163,909	
	Total	389,805	2,464	941	393,209	845,662
	Percent of Total Portfolio	**46%**	**0%**	**0%**	**46%**	
SCE2501	Nonresidential	129,595	0	0	129,595	
	Residential	108,628	2,163	96	110,888	
	Total	238,223	2,163	96	240,483	592,508
	Percent of Total Portfolio	**40%**	**0%**	**0%**	**41%**	
SDGE3016	Nonresidential	0	0	41	41	
	Residential	27,461	295	0	27,756	
	Total	27,461	295	41	27,797	147,360
	Percent of Total Portfolio	**19%**	**0%**	**0%**	**19%**	
All IOUs	Nonresidential	356,546	1,409	982	358,937	
	Residential	298,943	3,513	96	302,552	
	Total	655,489	4,922	1,079	661,489	1,585,530
	Percent of Total Portfolio	**41%**	**0%**	**0%**	**42%**	

Source: 4Q08 E3

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

Table 5: Ex-Ante Savings Parameters for the Upstream Lighting Program by IOU, Product Type and Sector (2006-2008)[10]

Parameter	CFLs			Fixtures			LEDs		
	PGE2000/ 2080	SCE2501[1]	SDGE3016	PGE2000/ 2080	SCE2501[1]	SDGE3016	PGE2000/ 2080 [2]	SCE2501	SDGE3016
Rebated Units	52,938,751	35,284,687	7,611,804	452,563	756,954	105,977	10,089,539	1,812,352	3,640,010
Percent Residential	90%	90%	100%	91%	68%	100%	90%	100%	100%
Residential									
Installation rate	76%	90%	90%	100%	100%	100%	100%	100%	100%
UES (kWh/yr)	59.15	57.62	50.92	138.22	91.61	72.60	4.18	24.16	8.06
UES (kW)	0.0056	0.0051	0.0050	0.0032	0.0056	0.0035	0.0000	0.0001	0.0000
NTGR	0.80	0.75-0.78	0.80	0.80	0.76-0.80	80%	80%	80%	80%
Nonresidential									
Installation rate	92%	92%	n/a	100%	100%	n/a	100%	n/a	100%
UES (kWh/yr)	327.34	222.55	n/a	346.74	175.62	n/a	14.34	n/a	54.75
UES (kW)	0.0594	0.0545	n/a	0.0346	0.0000	n/a	0.0012	n/a	0.0500
NTGR	0.96	0.75-0.78	n/a	0.96	0.76	n/a	0.80-0.96	n/a	80%

[1] SCE ex-ante NTGR for basic CFLs was 0.75 and for specialty CFLs it was 0.80. For plug-in fluorescent fixtures, ex-ante NTGR was 0.80. For all other fixtures, ex-ante NTGR was 0.76.
[2] PG&E ex-ante NTGR for LEDs varied by product type: holiday lights were 80%, and night lights were 80%, 90% and 96%.
Note: Ex-ante UES values have been adjusted to exclude installation rates.
Source: 4Q08 E3

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

1.2 Evaluation Approach

The methodology used to evaluate the 2006-2008 Upstream Lighting Program involved three primary components:

1. Adjustments to Quantity of Measures Rebated, which included:
    a. Verification assessment of a sample of program invoices/applications;
    b. Assessment of the percent of IOU-discounted products not sold by the end of 2008;
    c. Assessment of the percent of IOU-discounted products purchased by non-IOU customers (i.e., leakage); and
    d. Assessment of the percent of IOU-discounted products purchased by residential v. nonresidential customers.
2. Gross savings inputs, which included:
    a. Assessment of the percent of IOU-discounted products installed at the end of 2008 (installation rate);
    b. Estimate of the average daily hours-of-use (HOU);
    c. Estimate of the average percent operating at peak (coincident factor, CF);
    d. Estimate of the wattage displaced by IOU-discounted products (delta watts);
    e. Unit energy savings (UES) estimates (UES kWh/year and UES kW)
3. Net savings inputs, which included development of final NTGR estimate.

Table 6 presents an overview of each component of the evaluation methodology, along with a summary of the types of analysis completed to produce each of these key evaluation inputs.

Table 6: Summary of Evaluation Elements, Inputs and Analyses

Evaluation Element	Evaluation Input	Type of Analysis Completed	
Quantity of Measures Rebated	Invoice/ Application Verification Adjustment	Verification of completeness, accuracy and quality of program claims (product type, quantity rebated, retailer name/location)	
	Shipment v. Sales Adjustment	Percent of IOU-discounted CFL shipments not sold at end of 2008	
	Leakage Rate	Percent of IOU-discounted CFLs purchased by non-IOU customers	
	Residential/Non-residential Sales Rate	Percent of IOU-discounted CFLs purchased by residential v. nonresidential customers	
Gross Savings Inputs	Installation Rate	Percent of IOU-discounted CFLs installed by end of 2008	
		Program sales as percent of total sales	
		Surviving installation rate, snapshot storage rates, snapshot number of CFLs in use per home, percent of CFLs never installed	
		IOU-discounted CFLs installed as percent of total CFLs installed, snapshot storage rates, snapshot number of CFLs in use per home	
	HOU	Average daily hours-of-use	
	Peak CF	Average percent on during peak	
	Delta Watts	Estimated average wattage displaced by rebated CFL	
Net Savings Inputs	NTGR Estimate[1]	Self Report Analysis	*Suppliers* - Percent of IOU-discounted products sold absent the program by channel *Consumers* – Likelihood of selecting CFLs at twice the price by channel
		Econometric Analysis	*Conjoint elasticity models* – Percent increase in sales resulting from decrease in price *Revealed preference purchase models* – CFL purchase rates with and without program *Stated reference purchaser elasticity model* – Percent change in quantity purchased per percent change in price
		Total Sales (Market-based) Approach	*Multistate regression* - Statewide sales estimates at program and non-program conditions

[1] NTGR estimates were developed using multiple methods which produced a range of results. We considered the validity of each method/estimate, at the channel level where available, and assessed which had the greatest validity in each case. The final recommended NTGR estimates represent the evaluators' best judgment based on a preponderance of evidence.

1.3 Report Organization

This document constitutes Volume 1 of the evaluation report for the Upstream Lighting Program, organized as follows:

- Section 2 presents the gross impact and net impact evaluation methodology
- Section 3 presents and discusses the results of the screw-in CFL HIM evaluation
- Section 4 presents and discusses the results of the energy efficient lighting fixture HIM evaluation
- Section 5 presents and discusses the results of the LED HIM evaluation
- Section 6 summaries findings and recommendations from the overall evaluation
- Appendix A contains a glossary of acronyms
- Appendix B contains further detail on the gross and net impact evaluation methodologies and results
- Appendix C contains changes to the draft report that were submitted in an errata document on December 18, 2010
- Appendix D contains detailed responses to the comments on the draft report submitted by PG&E, SCE, SDG&E, Natural Resources Defense Council (NRDC) and Division of Ratepayer Advocates (DRA) on January 7, 2010.

Volume 2 of the evaluation report contains the remaining three appendices:

- Appendix E provides detailed results tables from the residential household lighting inventory analysis
- Appendix F contains a more detailed description of the Conjoint Survey Methods and Results
- Appendix G contains copies of the research protocols for each of the main data collection elements that supported this evaluation.

2. Methodology

This section presents a discussion of the methodology for each of the three main components of the evaluation

1. Quantity of Measures Adjustments
2. Gross Impacts Analysis
3. Net Impacts Analysis

Additional detail on the evaluation methods is contained in Appendix B.

2.1 Quantity of Measures Adjustments

This section discusses the four adjustments made to the quantity of rebated measures claimed by the IOUs as having been sold to IOU residential and nonresidential customers during 2006-2008. These four adjustments include:

- Quantity of IOU-discounted products shipped by participating manufacturers to retailers as determined through the verification of a sample of program invoices/applications;
- Percent of IOU-discounted products not sold by the end of 2008;
- Percent of IOU-discounted products purchased by non-IOU customers (i.e., leakage); and
- Percent of IOU-discounted products purchased by residential v. nonresidential customers. Invoice/Application Verification

2.1.1 Invoice/Application Verification

The objective of this task was to verify the quantity of IOU-discounted products shipped by participating manufacturers to retailers. This was determined through the verification of a sample of program invoices/applications against information contained in program tracking databases.

We analyzed shipment trends by IOU in order to select the appropriate sample of invoices/applications. Total as well as average shipments were analyzed by distribution channel (e.g., discount, drug store, etc.) and by store type (e.g., chain v. independent). We allocated the sample by IOU based on the proportion of shipments by IOU, channel and store type and then made adjustments to ensure that we had at least two invoices/applications per channel and store type, as shown in Table 7. We ultimately verified 764 of the 800 invoices/applications sampled. This is because PG&E provided fewer invoices/applications than requested.

Table 7: Invoice/Application Verification Sample Design and Final Sample Size

	Percent of Total ULP* Shipments (2006-2008)	Proportional Sample Size	Adjusted Sample Size	Final Sample Size
PG&E	56%	445	475	439
SCE	34%	269	224	224
SDG&E	10%	86	101	101
		800	800	764

* ULP = Upstream Lighting Program
Note: Proportional sample targets were adjusted to ensure a minimum of two invoices/applications per channel per IOU. Final sample was lower than adjusted sample because PG&E provided fewer applications than requested.

For each invoice/application, we compared program tracking data to what was provided in either paper or electronic form. In addition to quantity of IOU-discounted products shipped, we attempted to verify the following key metrics:

- Manufacturer name
- Measure name
- Product type
- Retailer name and location
- Per unit rebate
- Total rebate paid
- Shipment and sales dates

We also documented and assessed the quality of the various sources of information used to verify each metric.

For the ex-post energy savings and peak demand impact calculations, the quantity claimed was compared to the quantity that could be verified in the invoice/application documentation provided. Additional adjustments were not made based on verification of product type, retailer location and overall document quality. Section 8.3 in Appendix B presents additional detail on the methodology used to verify invoice/applications and adjust the quantity of IOU-discounted products shipped.

2.1.2 Shipments v. Sales

Program tracking data included information on the quantity of lighting products rebated by the IOUs and then shipped from participating manufacturers to retailers, but it does not provide information on the actual sales of these products. Sales of the products rebated through the Upstream Lighting Program may continue to occur well after the products were shipped. Of particular interest in the 2006-2008 evaluation are IOU-discounted products that were shipped in 2006-2008, which were claimed by the IOUs as resulting in energy savings during 2006-2008, but which did not actually sell until 2009.

The approach used to adjust for shipments v. sales relied on interviews with participating manufacturers, high-level retail buyers and retail store managers. Specifically, manufacturers and retail buyers were asked:

- Have all the IOU-discounted CFL products been sold through? If not, what percentage of your 2008 IOU-discounted CFL products were sold through by the end of 2008?

Retail store managers were asked the question slightly differently:

- What percentage of IOU-discounted CFLs were sold as of Dec. 31, 2008? If not 100%, do you still have 2006-2008 IOU-discounted CFLs available at your store? If yes, what percentage of IOU-discounted CFLs are still available at your store?

Sample sizes by source are provided in Table 8.

Table 8: Sample Sizes for Shipments v. Sales Analysis

Channel	Manufacturer Interviews [1]	Retail Buyer Interviews [2]	Retail Store Manager Surveys
Mass Merchandiser	12	0	21
Discount		2	20
Home Improvement		1	21
Hardware		3	44
Grocery		2	101
Drug		1	9
Membership Club		1	7
All Channels	12	10	223

[1] Information from 12 manufacturers represented 92% of 2008 ULP shipments.

[2] Information from 10 retail buyers represented 45% of 2008 ULP shipments.

Based on the results of the questions, adjustments were made to the quantity of IOU-discounted products shipped in 2008 to better reflect actual sales through December 31, 2008. Even though market actors were only asked these questions about screw-in CFLs, the same adjustments were applied for IOU-discounted energy efficient fixtures and LEDs based on the assumption that similar channels would sell through these products with similar patterns.

2.1.3 Leakage

Leakage is defined as the purchase and installation of IOU-discounted lighting products by non-IOU customers.[11] Data from the in-store consumer intercept research was analyzed to estimate the percentage of IOU-discounted lighting products that were sold to non-IOU customers. Sample sizes from the in-store consumer intercept research are shown in Table 9.

Table 9: Revealed Preference Intercept Survey Sample Size

Channel	Number of Revealed Preference Intercept Surveys Completed	Number of Stores Surveyed
Discount	115	68
Drug	21	41
Grocery	146	98
Hardware	84	45
Home Improvement	188	51
Lighting & Electronics	0	0
Mass Merchandise	270	55
Membership Club	43	20
Total	867	378

As part of the revealed preference intercept survey, all respondents were asked whether they received electric service from PG&E, SCE or SDG&E (depending on the store location). For those respondents who reported that they did not receive electric service from PG&E, SCE or SDG&E, the zip code information they provided at the end of the survey was used to determine whether or not they received electric service from a different IOU, from a non-IOU, or if they resided outside of the US (i.e., Mexico).

Using this information, CFL purchasers were split into two groups: IOU customers and non-IOU customers, and the CFLs purchased by non-IOU customers were determined to be "leaked" CFL purchases.[12] Leakage rates were then determined for each store.

Next, all participating retail store locations (including the stores visited as part of the in-store consumer intercept research) were mapped to determine whether or not the stores were located near non-IOU service territories. Stores located within 10 miles of non-IOU service territories (e.g., SMUD, LADWP, Mexico) were considered to be more vulnerable to leakage than other stores.

[11] Leakage can also occur prior to the sale and/or installation of IOU-discounted products (e.g., IOU-discounted products re-routed at distribution centers to retailers located outside of IOU service territories, re-sale of IOU-discounted products on eBay or through other means, etc.). This evaluation was unable to determine quantitative estimates of this type of leakage; qualitative evidence from manufacturers and retail buyers indicates that leakage prior to sales is not significant.

[12] All CFL purchasers were used as the basis for leakage estimates because the sample size for IOU-discounted CFL purchasers was too small.

Leakage rates based on the intercept data were determined for vulnerable and non-vulnerable locations. These rates were then applied to the total shipments through vulnerable and non-vulnerable locations and an overall leakage rate was determined for each IOU.

Leakage rates for CFLs were applied for energy efficient fixtures and LEDs based on the assumption that products distributed through similar channels would be purchased by IOU and non-IOU customers with similar patterns.

2.1.4 Residential v. Nonresidential

As mentioned above, PG&E and SCE assumed that a portion of the lighting products rebated through the Upstream Lighting Program would be installed in nonresidential locations, whereas SDG&E assumed that 100% would be installed in residential locations (with the exception of a small number of LED products). This residential v. nonresidential "split" was verified through this evaluation through several methods.

First, the CFL User Survey[13] results were analyzed to determine the proportion of IOU-discounted CFLs that were purchased by residential customers for installation in nonresidential locations. Second, the in-store consumer intercept survey[14] data was analyzed to determine the proportion of IOU-discounted CFLs that were purchased for installation in nonresidential locations. Intercepts were conducted with consumers shopping for their home, their business or both.

Finally, onsite data was used to estimate the quantity of IOU-discounted CFLs installed in residential v. nonresidential locations. Both the Residential Lighting Metering Study[15] and the Nonresidential Customer Upstream CFL site visits[16] collected manufacturer and model numbers for a sample of the CFLs observed onsite and this was compared to the manufacturer/model information contained in the program tracking data. Extrapolation techniques were used to estimate the total number of IOU-discounted CFLs installed in residential and nonresidential locations. These estimates were adjusted to represent the total number of IOU-discounted CFLs purchased (dividing by installation rates) and the ratio of residential to nonresidential purchases was computed.

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[13] See Section 8.1.1 for additional information about the CFL User Survey, which was conducted as part of this evaluation to support various analyses, including leakage rates, the residential/nonresidential "split," installation rates, and NTGR estimates.

[14] See Section 8.1.3 for additional information about the in-store consumer intercept survey, which was conducted as part of this evaluation to support various analyses, including leakage rates, the residential/nonresidential "split," installation rates, and NTGR estimates.

[15] See Section 8.1.2 for additional information about the Residential Lighting Metering Study, which was conducted as part of this evaluation to support the various analyses, including the residential/nonresidential "split," installation rates, and the development of gross savings inputs (i.e., average HOU, peak CF, and delta watts).

[16] See Itron's Small Commercial contract group evaluation report for additional information about the data collection conducted to support the various analyses targeting nonresidential sector Upstream Lighting Program measures.

For the calculation of ex-post energy savings and peak demand impacts, the residential v. nonresidential estimate was based on the onsite verification results since these were based on observed IOU-discounted CFL installations.

The residential v. nonresidential estimate was also applied for energy efficient fixtures and LEDs based on the assumption that products distributed through these channels would be sold to residential and nonresidential customers with similar patterns.

2.2 Gross Impacts Analysis

This section describes the methodology employed for conducting the gross impacts analysis. There were five primary analysis elements:

1. Installation rate
2. Average daily hours-of-use (HOU)
3. Average percent operating at peak (coincidence factor, or CF)
4. Wattage displaced by IOU-discounted products (delta watts)
5. Unit energy savings (UES) estimates (kWh/year and peak kW)

2.2.1 Installation Rate

For the Upstream Lighting Program, the installation rate was defined as the proportion of IOU-discounted lighting products that were installed by December 31, 2008. Installation rates have been estimated for IOU-discounted products installed in both residential and nonresidential locations. Several methods were used to determine installation rates, as described below.

For energy efficient fixtures and LEDs, it was not possible to identify purchasers and assess installation rates due to the upstream nature of the program and the relatively low penetration of the IOU-discounted products in the general residential and/or nonresidential populations. Consequently, the ex-ante installation rate value of 100% was retained for fixtures and LEDs.

2.2.1.1 Residential Screw-in CFL Installation Rate

The evaluation plan proposed to estimate a set of three inter-related models from the CFL User Survey data:

1. User type diffusion model. Shows the effect of the program over time moving customers from non-users to partial users to committed users.
2. Purchase model. Relates purchases to current use and storage levels as well as program activity.

3. Installation model. Relates installations to current use and storage levels as well as program activity.

We did not obtain meaningful results for the attempted models. This is likely attributable to several reasons:

- Customers' descriptions of their use of CFLs were not always accurate.
- Program activity levels could not be directly mapped to purchase timing.
- The reported changes in numbers of CFLs in use within a given survey wave were inconsistent with the changes between waves in numbers reported to be currently in use.

The approach we pursued instead combined some elements of the planned modeling with some simpler estimation steps. Essentially, we constructed a trajectory from the observed CFL use and storage rates in the 2004-2005 period to those observed in 2008 and 2009 through this evaluation. This trajectory accounts for the flow of CFLs shipped and purchased, as well as rates of installation and replacement. The analysis relies on several sources of data and attempts to reconcile and corroborate them.

Section 8.4 of Appendix B provides a much more detailed discussion of the sources of data and method used to determine residential CFL installation rates.

2.2.1.2 Nonresidential Screw-in CFL Installation Rate

Initial estimates of the number of IOU-discounted, nonresidential CFL purchases were based on customer self-reports collected through telephone surveys. Site visits were used to adjust the telephone survey self-report responses, and to verify the number installed, stored, burned out, located elsewhere, etc. As mentioned above, these site visits also collected CFL manufacturer and model numbers, which were compared to similar information contained in the program tracking data. This analysis produced installation rates for IOU-discounted CFLs purchased and installed in nonresidential locations. See Section 3 and Appendix I of Itron's Small Commercial Contract Group Evaluation Report for a detailed discussion of the Nonresidential Customer Upstream CFL telephone survey and site visit methodology.

2.2.2 Average Daily Hours-of-Use (HOU)

Estimates of the average daily hours-of-use (HOU) for residential lighting were derived from the analysis of logger data collected through the Residential Lighting Metering Study. Nonresidential HOU were determined using the method described in Section 3 and Appendix G of Itron's Small Commercial Contract Group Evaluation Report.

Residential lighting HOU estimation consisted of the following steps:

1. Annualization. Because each logger collected data for only a portion of the year, a procedure was required to annualize the logger data. Annualization allows the seasonality and level of use indicated by each logger to be applied to the full year, rather than having different logger

samples represent different parts of the year. Annual average HOU per day was estimated for each logger, by fitting a sinusoid curve to the daily hours of use data.

2. Weighting. Sample expansion weights were calculated for each metered home and each logger.

3. Analysis of Covariance (ANCOVA). A model was fit across the annualized loggers to calculate annual hours of use as a function of dwelling unit characteristics, room type, fixture type, lamp type, and IOU.

4. Projection to Full Inventory Sample. The estimated model was applied to each lamp observed in the full inventory of each metered home, providing an estimate of annual hours of use for each lamp in the inventory.

5. Calculation of averages. Applying the premise weights to the inventory estimates, average annual hours of use were calculated for CFLs and non-CFLs by various breakdowns, including IOU, room type, dwelling unit type, and heating/cooling type.

Each of these steps is described in further detail in Section 8.5 of Appendix B. Data for the Residential Lighting Metering Study was gathered in three waves. Table 10 illustrates the numbers of sites visited and the number of meters installed/removed in each month for each wave.

2.2.3 Peak Coincidence Factor (CF)

Estimates of residential usage of lighting during peak periods were derived from the analysis of logger data collected through the Residential Lighting Metering Study. Nonresidential peak usage estimates were determined using the method described in Section 3 and Appendix G of the Small Commercial Contract Group Evaluation Report.

Modeling of residential peak use was similar to that for annual hours of use, and built on the HOU analysis. Only loggers with data during the summer peak hours were used for this analysis. Essentially, this was the third wave of loggers indicated in Table 10.

Steps in the process were:

1. CF calculation for each logger:

   a. Peak period fraction. For each logger, determine the fraction of daily use that falls during the peak hours 2:00 to 5:00 pm for peak weekdays.

   b. Daily Use. For each logger, use the sinusoid model from the HOU analysis to calculate the daily use for each of the three days that define the DEER 2008 peak day period (which is the CPUC definition of peak for purposes of this evaluation), for each climate zone.

Table 10: Residential Lighting Metering Study Sample Sizes by Month/Year

	2008						2009											
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wave 1																		
# Sites	26	191	92				-26	-191	-92									
# Meters	174	1280	622				-174	-1280	-622									
Wave 2																		
# Sites				118	181	15					-118	-181	-15					
# Meters				814	1249	104					-814	-1249	-104					
Wave 3																		
# Sites									188	76	213	133		-24	-231		-155	-200
# Meters									1297	524	1470	918				-524	-1470	-2570
# Downloads														291	64			
Total # Sites	**26**	**217**	**309**	**427**	**608**	**623**	**597**	**406**	**502**	**578**	**673**	**625**	**610**	**586**	**355**	**355**	**200**	**0**
Total # Meters	**174**	**1454**	**2076**	**2890**	**4139**	**4243**	**4069**	**2789**	**3464**	**3988**	**4644**	**4313**	**4209**	**4500**	**4564**	**4040**	**2570**	**0**

   c. CF calculation. For each logger, calculate the coincidence factor or percent on at peak for each climate zone by multiplying the peak period fraction by the total hours of use for the three-day period, and dividing by nine hours.

2. Population Expansion. As for the HOU analysis, peak results are expanded to the full population by direct expansion, applying the adjusted expansion weights to the metering sample, as well as via ANCOVA modeling and leveraging of the full inventory sample. The leveraged expansion involves the same steps as for the HOU analysis.

   a. Analysis of Covariance (ANCOVA). A model was fit across the loggers to calculate percent on at peak as a function of dwelling unit characteristics, room type, fixture type, lamp type, and IOU, for each climate zone.

   b. ANCOVA Projection to Full Inventory Sample. For each lamp in the full inventory of each metered home, the ANCOVA peak model for that home's climate zone was applied, yielding an estimate of percent on at peak for each lamp in the inventory.

   c. Leveraged calculation of averages. Applying the premise weights to the inventory estimates, percent on at peak was calculated for each lamp in the inventory by various breakdowns, including IOU, room type, dwelling unit type, and heating/cooling type.

Each of these steps is described in further detail in Section 8.6 of Appendix B.

2.2.4 Delta Watts

Residential-sector estimates of the wattage displaced by IOU-discounted products were derived from the analysis of lighting inventory data collected as part of the Residential Lighting Metering Study. Nonresidential estimates were determined using the method described in Section 3 and Appendix C of the Small Commercial Contract Group Evaluation Report.

Given the upstream nature of the program, there was no reliable method for collecting wattage data for lighting products replaced by the rebated measures. Instead, we relied on the residential lighting inventory data and the nonresidential site visits as bases for estimating delta watts:

- Base case wattage:
    - For residential CFLs, we calculated the average wattage of non-CFL equivalents by lamp shape and room type. We then averaged the room-type non-CFL wattages, weighting by the room-type distribution of CFLs of that shape[17].

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[17] For example, for each rebated CFL product type, the average wattage of corresponding non-CFLs was weighted by the distribution across room types for that particular CFL product type or lamp shape. For example, MSB incandescent A-line shaped lamps were weighted by the room type distribution of observed MSB twister/a-line shaped CFLs, and MSB incandescent globes were weighted by the room type distribution of observed MSB CFL globes.

- For nonresidential CFLs, self-report data was collected onsite to estimate the wattage of pre-existing equipment. Pre-existing wattages were estimated using regression techniques for various post-retrofit wattage categories.
- The wattage of base case fixtures was estimated for each of the applicable fixture categories rebated through the program (taking into account room type and fixture type). The base case for fixtures was assumed to be the same for both residential and nonresidential applications since the types of fixtures rebated implied a similar relationship between base case and installed wattage/application.

- Installed wattage:
  - For CFLs, we computed the population-weighted average wattage for IOU-discounted CFLs observed onsite. This approach was consistent for both residential and nonresidential CFLs.
  - For fixtures, we computed the shipment-weighted average wattage since data was not collected onsite for either residential or nonresidential IOU-discounted fixtures.

See Section 8.7 for additional discussion of the methodology used to estimate delta watts for IOU-discounted screw-in CFLs and energy efficient fixtures. Section 8.16 provides a summary of the assumptions used to estimate delta watts for IOU-discounted LED measures.

2.2.5 Unit Energy Savings (UES)

Unit energy savings (UES) estimates are the average gross energy (kWh per year) and peak demand (kW) impacts per measure. UES calculations were computed as follows for measures rebated through the Upstream Lighting Program:

- UES (kWh/year): IR_p x HOU_p x $\Delta W_p/1000$, where:
  - IR_p = installation rate for IOU-discounted product *p*
  - HOU_p = annual average hours of use for IOU-discounted product *p*
  - ΔW_p = average displaced wattage for IOU-discounted product *p*
- UES (peak kW): IR_p x CF_p x $\Delta W_p/1000$, where:
  - IR_p = installation rate for IOU-discounted product *p*
  - CF_p = average percent on at peak for IOU-discounted product *p*
  - ΔW_p = average displaced wattage for IOU-discounted product *p*

2.3 Net Savings Analysis

This section describes the methods used to assess the net impacts attributable to the 2006-2008 Upstream Lighting Program. Specifically, these methods were designed to produce NTGR estimates, or the fraction of IOU-discounted lighting products that would not have been sold, purchased or installed had it not been for the program. NTGR estimates were developed using multiple methods which produced a range of results. We considered the validity of each method/estimate, at the channel level where available, and assessed which had the greatest validity in each case.[18] Ultimately, the final recommended NTGR estimates represent the evaluators' best judgment based on a preponderance of evidence. The following sections present a discussion of each method, with a more detailed discussion of the final NTGR estimates provided in Sections 3.3 and 6.1.3.

There were three primary types of methods at the core of the net savings analysis:

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

Each of these types of methods is described below.

2.3.1 Self-Report Methods

There were two different self-report methods employed to produce NTGR estimates for the Upstream Lighting Program. The first involved interviews and surveys with suppliers (e.g., manufacturers, retail buyers, retail store managers), and the second involved interviews with consumers. Each self-report method is described below.

2.3.1.1 Supplier Self-Report

The supplier self-report NTGR estimation method relied primarily on information collected from in-depth interviews and surveys with participating manufacturers, retail buyers, and retail store managers. Generally, these market actors were asked a series of questions designed to estimate the percentage of IOU-discounted lighting products that would have been sold in the absence of the program (i.e., free ridership). These results were analyzed to determine NTGR estimates by channel (or, one minus free ridership).

[18] A comparison of the relative strengths and weaknesses of each method is presented in Table 23.

This method offered several advantages over others used in this evaluation. First, the approach was identical to that used in the 2004-2005 program evaluation.[19] Similar questions were asked of similar respondents by the same senior members of the evaluation team. Thus, the approach provides direct comparability to the prior results from one evaluation period to the next.

In addition, the supplier self-report method is the only approach that attempted to account for the full effects of Upstream Lighting Program during 2006-2008 (as discussed below, all other methods rely on data representative of the program in 2008 only and/or market conditions in 2008-2009 only).

However, despite internal consistency and quality control steps, this method suffers from several threats to validity as discussed below.

2.3.1.1.1 Questionnaire

The main question asked of manufacturers to inform the NTGR calculation was worded as follows:

- You received manufacturer buy-down discounts of $X per bulb for sale of [CFL TYPE X] through [RETAIL CHANNEL X] such as [RETAILER X]. ULP also provides promotional material. If these discounts and promotional materials hadn't been available during 2006-2008, do you think sales of [CFL PRODUCT TYPE X] through [RETAIL CATEGORY X] would have been same, higher, or lower?
  - [IF LOWER] By what percentage do you estimate your sales of [CFL PRODUCT TYPE X] through [RETAILER CHANNEL X] stores would have been lower during 2006-2008 if these manufacturer buydowns and program promotional materials for [CFL PRODUCT TYPE X] had not been available?

Retail buyers were asked a similar question without the channel-level distinction.

Retail store managers were asked the following question:

- By what percentage do you estimate your store's sale of [CFL PRODUCT TYPE X] would be higher or lower during the 2006-2008 time period if the discounted items were not available?

2.3.1.1.2 Sample Sizes

The final sample sizes achieved from these in-depth interviews and surveys are as follows:

- Manufacturers – A total of 18 participating manufacturers were surveyed as part of this evaluation, 16 of which were able to provide data used in the NTGR calculation. These 16 manufacturers represented 91% of total 2006-2008 CFL shipments.

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[19] Itron and KEMA Inc., 2007. 2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation. Prepared for The California Public Utilities Commission, Pacific Gas & Electric, San Diego Gas & Electric, Southern California Edison, and Southern California Gas Company. Submitted to California Public Utilities Commission Energy Division. September 26, 2007.

- Retail buyers – A total of 18 participating retail buyers were surveyed and 18 provided data used in the NTGR calculation, representing 61% of total 2006-2008 CFL shipments.
- Retail store manager surveys – Two retail store manager surveys were completed and used for the NTGR calculation:
  - Process evaluation: In May 2008, 141 participating retail store managers in the PG&E and SCE service territories were surveyed as part of a process evaluation completed for these IOUs. Input for NTGR calculations were obtained from 114 of these store managers.
  - Impact evaluation: Using essentially the same questionnaire, a second survey of retail store managers was conducted in 2009 as part of the impact evaluation. Participating retail store managers from all IOUs were included in this effort. A total of participating 242 retail store managers were surveyed but only 127 were able to provide data used in the NTGR calculation.

2.3.1.1.3 Consistency Checks and Quality Control

A number of steps were taken to ensure the responses from manufacturers and retail buyers were internally consistent and reliable. Responses to the relevant questions were checked against responses to questions asked earlier in the survey. For example, earlier in the survey we asked them whether they sold any non-IOU-discounted CFL products in California and the types and sales volumes of these products. If their NTGR estimates seemed inconsistent with responses to these earlier questions, we probed to provide clarity. We also asked confirmation questions to make sure that we understood what they meant by their NTGR responses, for example:

- "So to make sure I understand you, you're saying you would have sold [insert appropriate NTGR response] in CA through [RETAIL CHANNEL X] during the 2006-2008 period without the program? Is this correct?"

Consistency checks were also conducted after the interviews were completed. Specifically, we analyzed how NTGR estimates compared among different market actors for same channel and product. We also assessed whether manufacturers and retailers were telling a similar story as their peers for the same channel and product. We also considered cases where it might be appropriate for manufacturers to be telling a different story than the retailers in a given channel or product category.

In addition, we analyzed how NTGR estimates compared to responses from the 2004-2005 evaluation. In cases where estimates were lower, we considered the possibility of self-report bias (in favor of maintaining IOU program subsidies) versus the possibility of real changes in the underlying market economics.

See Section 8.8.3 in Appendix B for a more in-depth discussion of the quality control steps taken to ensure responses from suppliers were internally consistent.

2.3.1.1.4 Threats to Validity

The supplier self-report NTGR estimates suffer from two types of threats to validity: potential bias and lack of market knowledge.

- **Potential bias.** Two types of potential bias in the supply-side research present potential threats to validity:
    - *The gaming or "don't kill the golden goose" bias:* This potential bias occurs when market actors purposely overestimate the negative impact that the removal of the rebates would have on their product sales. This is done to make the rebates seem more effective than they actually are and therefore ensure that the rebates they receive continue to be funded.
    - *The green retailer bias:* This potential bias occurs when market actors underestimate the negative impact that the removal of the rebates would have on their product sales because they have exaggerated confidence in their company's ability to market environmentally-friendly products. In some respects this bias might be considered a variation of the "social desirability bias" well known in program evaluation literature. This green retailer bias was described in the 2008 DEER update study and was actually used to justify an adjustment of the NTGR estimates upwards.

  The gaming bias and the green retailer bias work in opposite directions – with the former tending to overestimate program attribution and the later tending to underestimate it. However, it is not clear what the relative strengths of these biases are and to what degree they offset each other.

  In the case of the Upstream Lighting Program, lighting manufacturers are the market actors with the strongest motives to engage in the gaming bias because the vast majority of the program incentives are buydown payments that go directly to manufacturers rather than point-of-sale rebates that go to retailers. In-depth interviews with lighting manufacturers also revealed that some were aware that in 2006-2008 incentive allocations were shifted away from "big box" retailer channels as a direct result of channel-specific NTGR estimates from the evaluation of the 2004-2005 program.[20] This knowledge might tempt manufacturers who ship CFL products to these "big box" channels to purposely overestimate the sales impacts of removing or reducing the IOU allocations of incentives going to these channels.

  By definition, retailers would be the market actors most likely to engage in the green retailer bias. Of the two types of retailer representatives that we interviewed – retail buyers and retail store managers – we would theorize that the retail buyers were the ones who would be most likely to engage in the green retailer bias. One reason for this is that retail buyers would likely be more knowledgeable of corporate environmental campaigns than store managers even if they both

[20] Itron and KEMA, Inc., 2007.

worked for the same company. Another reason is that many store managers represented independent stores or small chains that did not have corporate green policies.

If these theories of potential biases are correct, then the NTGR estimates of the manufacturer representatives should be higher than those of the retailer representatives. As discussed later in this report, this indeed was almost always the case.

Since these gaming and green retailer biases move in opposite directions, one way to try to adjust for these potential biases is to simply average the manufacturer and retail buyer estimates. Since retail store managers are less likely to be aware of any gaming opportunities, averaging in their NTGR estimates can also help dilute any potential gaming. For some channels, this was the approach used to determine the supplier self-report NTGR estimate.

- **Lack of Market Knowledge.** Another threat to validity is the possibility that some market actors may simply lack the broader market knowledge to competently assess what would happen to product sales in the absence of the rebate. Lighting manufacturers have the greatest potential to accurately predict what would happen to their sales in the absence of the Upstream Lighting Program. This is because for them this is not an academic exercise, they have good practical reasons for making such predictions accurately. Every year, and in some cases multiple times per year, lighting manufacturers submit proposals to the Upstream Lighting Program managers indicating how many CFL products they think they can sell of what product type and through which retail channels. If they overestimate the sales effects of these rebates, they must deal with unhappy retail partners and Upstream Lighting Program managers. Retailers in general do not like allocating limited store space to products that do not sell and overstocks can be particularly burdensome for smaller retailers, as the evaluation of the 2004-2005 Upstream Lighting Program indicated. Upstream Lighting Program managers dislike overstocks because it increases the chances that store managers might ship their excess CFLs outside the program, resulting in CFL "leakage."

  A good example of how a lack of broader market knowledge can threaten the validity of net-to-gross estimates occurs in the discount channel. In the in-depth interviews a number of manufacturers provided estimates of their costs for producing a typical Energy Star CFL and none of these estimates were less than $1.20 per bulb. Since many discount stores operate with $1 or 99 cent price caps it is likely that these stores would not be able to sell Energy Star CFLs without the manufacturer buydowns. All the manufacturers who supplied these $1/99 cent stores confirmed this was the case. Retail buyers with two largest chains of $1/99 cent stores also said that they would not be able to sell Energy Star CFLs without the Upstream Lighting Program incentives and that they stop selling them when the Upstream Lighting Program rebates run out. And yet when we interviewed store managers with some of these $1/99 cent stores, they estimated that their sales of basic Energy Star CFLs would only go down 60 – 86 percent if the Upstream Lighting Program discounts went away. Because of limited market knowledge they did not know what the manufacturers and retail buyers knew – that is, if these Upstream Lighting

Program incentives disappeared they would no longer receive shipments of these products. In cases like these, the manufacturer and retail buyer responses were considered more reliable and the retail store manager responses were ignored in the calculation of the supplier self-report NTGR estimates.

2.3.1.1.5 Calculation of Supplier Self Report NTGR Estimates

We calculated the supplier self-report NTGR at the retail channel level for each type of market actor and by IOU-discounted CFLs and energy efficient fixtures.[21] These ratios were based on the shipment-weighted averages of their component NTGR estimates. For example, if five lighting manufacturers had each provided estimates of the decline in their sales of specialty CFLs through the grocery channel in the absence of the program, the overall NTGR estimate would be the sum-product of each estimate and the underlying volume of specialty CFLs shipped through the 2006-2008 Upstream Lighting Program that each estimate represented.

2.3.1.2 Consumer Self-Report

As part of the in-store consumer intercept research, brief interviews were conducted with shoppers who had just made a lighting purchase (revealed preference) as well as "stated preference" surveys with other consumers recruited randomly. Sample sizes are shown in Table 11.

Table 11: Stated Preference Intercept Survey Sample Size

Channel	Number of Stated Preference Intercept Surveys Completed	Number of Stores Surveyed
Discount	277	68
Drug	173	41
Grocery	481	98
Hardware	137	45
Home Improvement	154	51
Lighting & Electronics	0	0
Mass Merchandise	186	55
Membership Club	55	20
Total	1,463	378

As part of the stated preference survey, consumers were asked to make a hypothetical purchase decision and then asked a brief series of questions about that decision. Specifically, stated preference respondents who had selected CFLs in their hypothetical purchase decision were asked whether or not they would have selected CFLs had they cost twice as much. Respondents who indicated that they would have selected CFLs at twice the price were considered free riders (NTGR=0) and respondents who indicated that they would not have selected CFLs at twice the price were assigned NTGR estimates of 1. Average

[21] Only qualitative evidence was collected for LEDs.

NTGR estimates were generated by retail channel and then shipment-distribution weighted averages were generated by IOU.

Similar to any self-report method, the stated preference surveys may have been influenced by biases and other threats to validity. In this case, it appears that stated preference respondents may have over-stated both their preference for CFLs as well as their price insensitivity, which combined has the effect of biasing NTGR estimates downward.

For example, when comparing CFL selection/purchase decisions between stated and revealed preference respondents, we found that in some channels stated preference respondents tended to over-state their preference for CFLs when compared to actual, revealed preference CFL purchases. In addition, in these hypothetical purchase decisions, stated preference respondents selected IOU-discounted CFLs (over higher-priced, non-IOU discounted CFLs) far less likely than revealed preference respondents, providing evidence that stated preference respondents may have been under-stating their price sensitivity. Finally, as discussed later in this report, these results are consistent with the modeled conjoint analysis results which suggest that hypothetical, out-of-context purchase decisions may not be reliable predictors for actual price elasticity (especially when compared to actual, observed purchase decisions).

In addition, like many of the consumer survey-based methods employed in this evaluation, the timing of the consumer stated preference surveys was such that the full effect of the 2006-2008 Upstream Lighting Program may not have been captured in the results. These surveys were conducted throughout 2008 and early 2009 and, therefore, may not adequately represent program years 2006-2007. As discussed in Section 6 and at length in the CPUC's CFL Market Effects Study, the global market for CFLs underwent substantial changes in late 2007 and into early 2008.

2.3.2 Econometric Models

There were four primary econometric models developed for this evaluation:

- Pricing
- Conjoint Elasticity
- Revealed Preference Purchase
- Stated Preference Purchaser Elasticity

The results from each model contributed to the overall preponderance of evidence used to estimate the final net impacts attributable to the 2006-2008 Upstream Lighting Program. In addition, we have completed an assessment of the effects of "channel shift" (i.e., absent the program, sales that would have occurred in different channels). Brief descriptions of the methods are provided below, with detailed results provided in Appendix B.

2.3.2.1 Pricing Model[22]

Using information collected from retailer shelf surveys in California and comparison areas,[23] a statistical (hedonic) pricing model was estimated in which the price of a product is regressed on the product's characteristics. Through the pricing model, the variation in a product's price can be explained by the observable attributes. In the model, the coefficient corresponding to an attribute represents the "implicit price" of the attribute. The CFL pricing model used in this study followed the basic formulation:[24]

$$\text{Register price per CFL} = \beta_0 + \beta_1\text{IOU Discount} + \beta_2\text{Other Discount} + \beta_3\text{Product Characteristics} + \beta_4\text{Retail Channel} + \beta_5\text{MetroArea} + \beta_6\text{MonthYear} + \varepsilon$$

The dependent variable in the regression model was the price per CFL in a package. The independent variables were the CFL characteristics, including: watts, ENERGY STAR Label, the number of bulbs in the package, manufacturer, metropolitan statistical area, and year-month of data collection. We allowed the impact of the number of CFLs in the package on price per CFL to vary non-parametrically (i.e., without making functional form assumptions) with the number of bulbs in the package. This was done by including separate indicator variables for the number of CFLs in the package. In addition, we included indicator variables for whether the package was discounted by an IOU or discounted by another entity such as the retailer. We expected both variables to have negative and statistically significant effects on register price, but the magnitudes of the coefficients were a priori unclear.

To test several of our research questions, it was necessary to augment the main regression equation with additional independent variables. For example, to test the hypothesis about variation between retail sales channels in the upstream incentive's impact on register price, we introduced interaction terms between "IOU Discount" and the "Retail Channel" variables into the model.

While the pricing model provides a robust methodology for estimating the percent reduction in CFL prices that resulted from the IOU-discounts, on its own it does not provide an estimate of the net impacts attributable to the program. As discussed below, the results were combined with the findings from the conjoint and stated preference purchaser elasticity models to produce NTGR estimates.

In addition, since data from retailer shelf surveys upon which the pricing regression models were based were conducted in California during 2008 and 2009 (and the comparison area surveys were conducted in 2009 only), the results may not adequately capture the full effect of the 2006-2008 Upstream Lighting Program.

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[22] The pricing model was developed collaboratively, led by The Cadmus Group with substantial support provided by Andy Goett (independent consultant) and KEMA.

[23] Comparison areas included Pennsylvania, Georgia and Kansas. There areas were selected to represent regions where CFL programs were believed to be relatively inactive.

[24] See the CPUC's CFL Market Effects Report for a more detailed methodology and discussion of findings from the regression analysis.

2.3.2.2 Conjoint Elasticity Model[25]

The conjoint analysis survey was designed with the following objectives in mind:

- Understanding why consumers choose to buy (or not to buy) CFLs (e.g., environmental concerns, saving money, appearance, light quality, product quality, previous satisfaction with CFLs, value of specialty features in both incandescent and CFLs, lifetime, etc.), and determining the role of price in the mix of these qualitative considerations.
- Measuring the price sensitivity (elasticity) of demand for CFL bulbs in selected California markets to determine price points that trigger and optimize consumers' conversions from incandescent to CFLs.

A conjoint survey was chosen for this evaluation because it provides an objective methodology to trade-off price and non-price attributes without directly asking the question "what are you willing to pay?" Conjoint analysis surveys provide respondents with descriptions of different goods, characterized by a consistent set of six or less distinct attributes (the levels of which vary across questions).

NTGR estimates are derived by combining the findings from the pricing study (which estimates the percent reduction in CFL prices that resulted from program incentives) with the demand elasticity results from the conjoint analysis (which estimates the corresponding percent increase in sales that result from the price decrease). The combination of these results provides an estimate of program-induced sales which, when compared to the program-claimed sales, yields the NTGR result. Additional detail on the methodology and results from the conjoint elasticity analysis is provided in Section 8.10 of Appendix B.

Despite the robustness of the overall modeling framework, the results from the conjoint analysis have the following threats to validity:

- The research was conducted in a controlled study environment, providing complete disclosure of product information, which is unlikely to reflect the typical consumer's actual purchase decision.
- Although the attributes were selected to reflect actual conditions as accurately as possible, the experiments assumes that the selected product will be available with the desired attributes at the specific locations where consumers actually purchase lighting, which may not be the case.
- The method does not adequately account for non-price program effects, such as promotions, increased shelf space and/or increased visibility within the store.
- The method does not account for impulse purchases – i.e., assumes some type of lighting will be purchased.
- The results cannot be disaggregated to provide retail channel-specific estimates.

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[25] The conjoint study was designed collaboratively, with analysis led by The Cadmus Group. Substantial support was provided by independent consultants, Carol Kauder and Linda Fergusson, and KEMA. For a more detailed discussion of the conjoint study methodology, see Appendix F.

While price is obviously a key driver, these factors also need to be accounted for when predicting purchasing behavior, as indicated below in the revealed preference modeling methods discussion.

Finally, as mentioned above, the timing of the conjoint-based research (July 2009) was such that the full effect of the 2006-2008 Upstream Lighting Program may not have been captured in the results.

The steps undertaken to conduct the conjoint elasticity analysis are provided in Section 8.10 of Appendix B. Additional detail on the conjoint study methodology is provided in Appendix F.

2.3.2.3 Revealed Preference Purchase Models

This approach utilized revealed preference survey data collected through the in-store consumer intercepts to model CFL purchase rates with and without the effects of the program.

Steps in calculating the NTGR estimates using revealed preference data are as follows:

1. Data Coding. For use in the modeling, the retail shelf survey and revealed preference survey data had to be coded into analysis variables. Coding included:

   a. Defining equivalence groups of non-CFLs and CFL substitutes at each store

   b. Characterizing CFL displays in terms of prominence and size

   c. Calculating shelf volumes for CFLs and non-CFLs

   Variables developed included store-level information, including sets of CFL/non-CFL equivalents, average and minimum prices for each CFL and non-CFL group of equivalents, promotional index, display shelf space index, and presence or absence of IOU-discounted CFLs. In addition, package-level information was also coded (e.g., average and minimum price for CFL or non-CFL equivalent as compared to what was purchased).

2. Logistic Regressions. We modeled the probability of buying a CFLs rather than an "equivalent" non-CFL as a function of price, displays, customer characteristics, and bulb characteristics, by channel. Models were fit separately for those who planned to buy lighting and those who did not. NTGR results were weighted according to the proportions of customers in each channel who made planned and unplanned purchases. For cases where intent to purchase CFLs dominated the determination of CFL purchase, we took the next step of modeling the factors that affected intent to purchase CFLs. We included store characteristics in this model, on the assumption that price, display, and discount characteristics of the store affected the decision to come to the store for CFLs, or are correlated with outside marketing that affected that decision.

3. Regression Application. The fitted models were evaluated under "program" and "non-program" conditions. The program condition was the average of the actual observed conditions. The non-program condition was determined by substituting non-program average prices, displays, etc.

4. Calculation of Program Attribution and NTGR Estimate. For each channel, the difference between the probability of purchasing CFLs under the program condition (p_{pgm}) and that under the non-program condition (p_{nonpgm}) is the program-attributable CFL sales share. The ratio of this difference to the with-program probability is the proportion of program sales attributable to the program, that is, the NTGR estimate. Thus, the NTGR estimate is calculated from the modeled purchase probabilities as:

   $$NTGR = (p_{pgm} - p_{nopgm})/p_{pgm}$$

5. Weight to Total Sales. NTGR estimates were produced for each IOU and for each of the channels included in the analysis. Thus, the final overall NTGR estimate reflects the different distribution of IOU-specific shipments through retailer channels.

An alternative NTGR estimate is provided by a simple contrast from the sales data themselves. The contrast estimate is:

$$NTGR = (f_{pgm}T_{pgm} - f_{no\text{-}pgm}\, T_{no\text{-}pgm})/(f_{pgm}T_{pgm})$$

Where,

f = CFL sales share

T = total bulb sales (including CFLs and non-CFLs, program and non-program)

If total CFL sales are not affected by the program, the totals T drop out of the equation and it reduces to:

$$NTGR = (f_{pgm} - f_{no\text{-}pgm})/f_{pgm}$$

Alternatively, if we are able to estimate the relative change in total sales due to the program, we calculate:

$$NTGR = (f_{pgm} - f_{no\text{-}pgm}\, T_{no\text{-}pgm}/\, T_{pgm})/f_{pgm}$$

Calculating the NTGR estimate assuming that total CFLs sales is not substantially changed by the program provides a conservative estimate of NTGR estimate. This is the approach taken in the contrast model analysis.

The methodology and results from both the revealed preference logistic regression and contrast models are described in more detail in Section 8.11 of Appendix B.

The revealed preference purchase models have several advantages over the other methods discussed thus far. First, the revealed preference models account for actual, observed IOU-discounted product purchases unlike the other methods. In addition, in contrast to the conjoint modeling effort, the revealed preference model attempts to control for price plus other factors (e.g., planned v. unplanned purchases, consumer characteristics, available product characteristics, promotional/display characteristics, etc.) that have been shown to drive purchase decisions.

However, there were several important limitations to the revealed preference regression models:

- There was little variation of pricing, store characteristics, product characteristics, etc. within channels.
- Only channels observed to be stocking IOU-discounted products could be included in the models; thus, results are not available for some key channels including discount stores and small, independent grocery stores.
- Regression models fit for customers who intended to buy lighting were unable to account for program effect on intent to buy CFLs.
- The contrast model consider stores with no IOU-discounted CFLs at the time of the survey as baseline, which may not accurately reflect the program's effect on these stores when discounted products are temporarily unavailable.

In addition, the shelf surveys and revealed preference surveys were conducted beginning in February 2008 (and concluding in May 2009), suggesting that the results may not be representative of the full effect of the 2006-2008 Upstream Lighting Program.

2.3.2.4 Stated Preference Purchaser Elasticity Model

Revealed preference survey respondents were asked to indicate how many CFLs they would have bought compared to their actual purchases at double the price they actually paid. Response categories were the same amount, fewer, or none. While still based on hypothetical, self-reported responses, revealed preference respondents may be a more reliable sample because they just made an active purchase decision (as compared to stated preference respondents). Revealed preference respondents, however, may be somewhat unlikely to indicate they would have paid more for what they just purchased. We do not know the magnitude of the potential bias in either the revealed preference or stated preference responses but it is likely that NTGR estimates from stated preference respondents are biased downward and from revealed preference respondents are biased upward.

To model elasticity from the revealed preference survey responses, we first define the relative quantity purchased Q_r/Q_1 as the ratio of hypothetical purchases Q_r at a price *r* times the actual price to the amount Q_1 actually purchased. The relative quantity that would be bought at double the price is 0 for response category "none," ($Q_2 = 0$, $Q_2/Q_1 = 0$) and 1.0 for response category "same" ($Q_2 = Q_1$, $Q_2/Q_1 = 1$). We assume the relative quantity that would be bought is 0.8 for response category "fewer."

This assumption that those who say they would buy fewer would buy only 20% fewer is somewhat conservative. On the other hand, as mentioned above, respondents who have just made a purchase are likely to overstate their price sensitivity somewhat. We use this conservative assumption to counterbalance this potential overstatement.

To calculate NTGR estimates by this method, we need the change in quantity if the purchasers had faced the non-program price rather than the price they did with the IOU discounts in place. This estimate requires extrapolation from the available price points. We use a logarithmic relationship which has a qualitatively natural relationship between price and quantity, and does not produce unreasonable NTGR values at higher prices.

Similar to the other revealed preference models described above, the stated preference purchaser elasticity model has several key advantages and disadvantages. Since it was based on all revealed preference survey responses (and weighted to reflect the quantity of IOU-discounted CFLs actually purchased), it provides fairly robust estimates at both the IOU and channel-specific levels. There are significant difference by IOU as well as across channels.

While this method relies on survey responses from consumers who have just made actual observed IOU-discounted product purchase decision, their responses to the elasticity questions still represent hypothetical scenarios and ("stated preferences," as discussed above) there could be a bias toward higher price sensitivity given they just made a purchase at a particular price. In addition, the NTGR calculations require extrapolation beyond the range of prices respondents were asked about (i.e., beyond two times the price paid for the products purchased that day).

Section 8.12 in Appendix B provides additional detail on the methodology and results from the stated preference purchaser elasticity models.

2.3.2.5 Channel Shift

Channel shift refers to sales through one channel that, absent the program, would have occurred through another channel. That is, while the program may induce sales that would not have otherwise occurred in a particular channel, it does so at the expense of another channel, at least in part.

For example, discount and small grocery stores accounted for about 34 million IOU-discounted CFLs (or nearly 37% of total shipments) and preliminary results indicate that these types of stores may not have sold program measures in the absence of the program. However, some portion of these sales may have occurred through other mainstream, "big box" distribution channels (i.e., Wal-mart, Costco, Home Depot, etc.).

To assess the potential for channel shift between the discount chains and the mainstream distribution channels, we mapped the relevant stores to determine how close to each other these potentially competing stores were located. While we cannot say with certainty whether channel shift happened between stores, we can at least rule out stores where it was unlikely to happen due to stores not being located within reasonable driving distances.

The channel shift analysis consisted of the following steps:

- For each channel or group of channels, determine the subset of stores that are likely to gain or lose sales as a result of channel shift. Determine the total residential program sales in each of these subgroups.

- Determine non-program residential sales in each group by applying the ratio of total to program sales.
- Apply initial NTGR estimates to each channel group to determine program-attributable sales.
- Calculate sales absent the program, excluding channel shift, as the non-program sales plus the non-attributable program sales.
- For the likely gainers or recipients (i.e., discount stores), determine what fraction of stores are within a reasonable distance of a likely channel shift victim or source (i.e., big box stores). Assume that a portion of the sales from these stores have been pulled from a source store.
- Assume that these shifted sales were distributed among source stores in proportion to their estimated total sales absent the program.
- Re-calculate total sales absent the program by adding back the estimated amounts shifted from or to each channel.
- Calculate final NTGR estimates as the difference between total sales with the program and the recalculated total sales absent the program, divided by program sales.

The result provides an estimate of the impacts of the program net any indirect effects from channel shift. Section 8.13 in Appendix B provides an illustrative example of this method.

2.3.3 Total Sales (Market-Based) Approach[26]

The total sales (or market-based) approach nets out program-influenced sales by comparing CFL sales within the California IOU service territories to an estimate of baseline sales or sales that would have happened in absence of the upstream programs. This approach was implemented as part of the CFL Market Effects Study, the results of which have helped to inform the NTGR estimates for the Upstream Lighting Program evaluation.

The primary methodology for the total sales (market-based) approach was a regression model to predict CFL sales of a function of program activity, while controlling for demographic, household, and economic factors that can also influence sales. The analysis was based on data from 1,034 onsite lighting inventories conducted in 11 areas in the U.S.[27] Some of these areas have no CFL programs, some have modest or newer CFL programs, and some have longstanding aggressive CFL programs.

[26] The total sales (market-based) approach was completed as part of the CPUC's CFL Market Effects Study. The work described in this section and later in the Section 3 was led by NMR, with support provided by The Cadmus Group, Inc. and KEMA.

[27] The full multistate modeling effort incorporates data from 16 states—including California; in total over 9,300 households took part in telephone surveys and 1,400 households in onsite saturation studies.

Note that this approach in principle includes both free ridership and spillover (including both participant and non-participant spillover), as well as cumulative market effects (i.e., impacts from the cumulative history of program activity). As a result, it does not provide a direct measure of the program effect net of free riders as is necessary for the Residential Retrofit Evaluation. The method is primarily focused on 2008 impacts rather than addressing all program years, as is true of several of the other NTGR methods. Another limitation is that the final analysis, as described below, does not include any California data, making the application to California of uncertain validity. Finally, the results currently available are from a draft version of the CPUC CFL Market Effects Study, and may change before becoming final.

This method is used, therefore, only as a benchmark for assessing the reasonableness of the results from the other NTGR estimates. At a minimum, it can provide a view of program-induced total effects, inclusive of all market effects. The relationship between the total sales (market-based) approach, the gross savings analysis, and the net of free ridership analysis should bare reasonable ordering and comparative magnitudes. It can be used to help verify the primary estimation approach for the NTGR estimates.

3. Upstream Screw-in CFL HIM Evaluation Results

3.1 Adjustments to Quantity of Measures Rebated

3.1.1 Summary of Results

Table 12 presents the final adjustments to quantity of measures rebated.

Table 12: Final Adjustments to Quantity of Measures Rebated[28]

Adjustment	PG&E	SCE	SDG&E
Invoice/Application Verification	96%	99%	96%
2008 Shipments Sold in 2008	88%	87%	87%
Leakage	99%	96%	93%
Final Adjustment	**86%**	**90%**	**85%**
Percent Residential	94%	94%	95%

3.1.2 Invoice Verification

The recommended adjustment based on the verification of invoices/applications is based on the results for the quantity metric alone. This takes into account the quantity of measures claimed as a percent of the quantity of measures verified. Overall, 96% of the measures claimed by PG&E were verified based on quantity, 99% for SCE and 96% for SDG&E.

The results from this adjustment are well aligned with the results from the installation rate analysis (see discussion below). Therefore, we feel this adjustment result reflects the most reliable estimate of IOU-discounted CFL shipments that resulted in sales to residential and nonresidential IOU customers. However, as discussed in Section 8.3 of Appendix B, had additional adjustments been made based on metrics other than quantity, the resulting verification rates would have been much lower.

3.1.3 Shipments v. Sales

The approach used to adjust for the portion of rebated products that were shipped during the program but not sold by December 31, 2008 relied on interviews with participating manufacturers, high-level retail buyers and retail store managers. Manufacturers and retail buyers were asked to estimate the percentage of 2008 shipments that were not sold by the end of 2008, whereas retail store managers were asked to estimate the percentage of 2006-2008 shipments that were not sold by the end of 2008.

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

It should be noted that manufacturers were asked to estimate the percentage of the IOU-discounted CFLs shipped in 2008 that were sold by the end of 2008, but were not asked to differentiate this percentage by the various channels that they might deliver to. Therefore, we applied the same "2008 sell-through estimates" to all the channels they delivered to. For example, if a manufacturer delivered to the grocery, drug, and discount channels and said 95% of their 2008 IOU-discounted CFLs were sold through, than this 95% was applied to the 2008 shipment data for all three of these channels.

Results are shown in Table 13. These results have been weighted by shipment volume for each of the sources reporting the results. As shown, the overall results by source are:

- Manufacturers – 97% of 2008 shipments were sold by the end of 2008
- High-level retail buyers – 87% of 2008 shipments were sold by the end of 2008
- Retail store managers – 81% of 2006-2008 shipments were sold by the end of 2008

Results from all sources were fairly well aligned such that taking the average of all three sources is an appropriate method for estimating this adjustment. Therefore, the average of these three sets of results yields 88% for PG&E, 87% for SCE and 87% for SDG&E. These results were applied to shipments in 2008 only, as shown in Table 14.

3.1.4 Leakage

Leakage is defined as the purchase and installation of IOU-discounted lighting products by non-IOU customers. Data from the in-store consumer intercepts was analyzed to estimate the percentage of IOU-discounted lighting products that were sold to non-IOU customers. Results are shown in Table 15. As shown, leakage rates 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 the latter IOUs to highly populated, non-IOU service territories (i.e., LADWP, US-Mexico border).

Table 13: Shipments v. Sales Assessment

Channel	Manufacturer			
	N [1]	2008 ULP Products		Percent Sold
		Received	Sold	
Discount	9	5,717,903	5,544,017	97%
Drug	5	2,088,585	2,086,799	100%
Grocery	11	11,313,976	11,022,476	97%
Hardware	8	1,498,689	1,434,974	96%
Home Improvement	5	2,036,067	1,927,632	95%
Mass Merchandiser	1	1,588,200	1,429,380	90%
Membership Club	2	4,879,898	4,879,898	100%
All Channels	**12**	**29,123,318**	**28,325,177**	**97%**
	Retail Buyer			
Channel	N	2008 ULP Products		**Percent Sold**
		Received	Sold	
Discount	2	4,788,085	3,741,131	78%
Drug	1	1,758,956	1,143,321	65%
Grocery	2	1,183,159	986,256	83%
Hardware	3	984,870	920,204	93%
Home Improvement	1	1,287,445	1,287,445	100%
Mass Merchandiser	0			
Membership Club	1	5,074782	5,074782	100%
All Channels	**10**	**15,077,267**	**13,153,139**	**87%**
	Retail Store Manager			
Channel	N	2006-2008 ULP Products		**Percent Sold**
		Received	Sold	
Discount	20	219,028	181,460	83%
Drug	9	151,236	145,227	96%
Grocery	101	742,709	600,158	81%
Hardware	44	390,572	274,717	70%
Home Improvement	21	774,208	655,344	85%
Mass Merchandiser	21	789,938	611,486	77%
Membership Club	7	477,084	401,320	84%
All Channels	**223**	**3,544,775**	**2,869,711**	**81%**

[1] The sample size for a given manufacturer channel is the total number of manufacturers who shipped IOU-discounted CFLs through this channel in 2008 and who provided an estimate of percentage of their 2008 IOU-discounted CFLs that were sold through by the end of 2008. The total sample size represents the total number of manufacturers who provided an estimate of percentage of their 2008 IOU-discounted CFLs that were sold through by the end of 2008. This total sample size is smaller than the sum of the individual channel sample sizes because the sell-through estimate of a single manufacturer could be applied to multiple channels

Table 14: Shipments v. Sales Adjustments – Screw-in CFLs

IOU	Number of Rebated Units by E3 Program Year			2008 Shipment v. Sales Adjustment	Total 2008 Shipments Sold in 2008	Total 2006-2008 Shipments Sold in 2006-2008	Percent of 2006-2008 Shipments Sold in 2006-2008
	2006	2007	2008				
PGE	7,577,726	19,189,062	26,171,963	88.0%	23,031,327	49,798,115	94.1%
SCE	6,254,156	15,432,231	13,598,300	87.0%	11,830,521	33,516,908	95.0%
SDGE	953,605	3,827,638	2,830,561	87.0%	2,462,588	7,243,831	95.2%
Overall	14,785,487	38,448,931	42,600,824	87.6%	37,324,437	90,558,855	94.5%

Table 15: Leakage Adjustment Results

IOU	Vulnerability	Leakage Rate from Intercept Surveys	Total Shipments	Shipments Not Leaked	Shipment-Weighted Leakage Rate
PGE	Not Vulnerable	0.00%	26,013,863	26,013,863	**0.45%**
	Vulnerable 5-10 miles	0.00%	6,214,849	6,214,849	
	Vulnerable 0-5 miles	2.51%	7,100,045	6,921,652	
	Total		39,328,757	39,150,364	
SCE	Not Vulnerable	1.78%	12,275,842	12,057,928	**4.10%**
	Vulnerable 5-10 miles	4.33%	9,614,063	9,198,070	
	Vulnerable 0-5 miles	7.81%	7,148,539	6,590,475	
	Total		29,038,444	27,846,472	
SDGE	Not Vulnerable	0.40%	5,265,175	5,244,030	**7.41%**
	Vulnerable 0-10 miles [1]	31.71%	1,518,279	1,036,774	
	Total		6,783,454	6,280,804	

[1] Due to the relatively small sample size of stores visited and intercepts survey conducted in SDG&E's service territory, the categories of 0-5 and 5-10 miles were collapsed.

3.1.5 Residential v. Nonresidential

As mentioned above, PG&E and SCE assumed that a portion of the lighting products rebated through the Upstream Lighting Program would be installed in nonresidential locations, whereas SDG&E assumed that 100% would be installed in residential locations. This residential v. nonresidential "split" was verified through this evaluation through several methods. Results from each method are discussed below.

- **Intercept Survey and CFL Survey results:** As shown in Table 16, the intercept survey results indicate that 6% of all IOU-discounted CFL purchases were planned for installation in nonresidential locations. The CFL User Survey results indicate that 13% of all CFLs purchased during 2006-2008 were installed in nonresidential locations. Note that the intercept survey results reflect actual purchases of IOU-discounted CFLs in 2008-2009, whereas the CFL User Survey results are self-reported purchases of all CFLs during 2006-2008.

Table 16: Intercept Survey and CFL User Survey Results for Residential/Nonresidential CFL Purchases

Intercept Survey			
IOU	Number of IOU-Discounted CFLs Purchased and Installed (2008-2009)		
	Residential	Nonresidential	Percent Residential
PG&E	400	28	93%
SCE	502	32	94%
SDG&E	113	0	100%
All IOUs	1,015	60	94%
CFL User Survey			
IOU	Number of CFLs Purchased and Installed (2006-2008)		
	Residential	Nonresidential	Percent Residential
PG&E	24,311,938	2,225,211	92%
SCE	23,285,935	5,350,556	81%
SDG&E	6,717,842	606,291	92%
All IOUs	54,315,715	8,182,058	87%

- **Residential and Nonresidential Onsite Surveys:** Approximately 48.5 million IOU-discounted CFLs are estimated to be installed in residential locations. This compares to 3.2 million IOU-discounted CFLs installed in nonresidential locations. Adjusting these numbers to represent the total number of IOU-discounted CFLs purchased (dividing by installation rates of 65% for residential and 76% for nonresidential, respectively), we find that about 68 million were initially purchased by residential customers and about four million were initially purchased by nonresidential customers. This implies that 94% of all IOU-discounted CFLs were purchased by residential customers, and 6% were purchased by nonresidential customers. These results are shown in Table 17 by IOU. Since these adjustments are based on actual, observed onsite information, they are believed to be the most reliable and therefore recommended as the final evaluation estimates.

Table 17: Residential and Nonresidential Onsite Survey Results for Residential/Nonresidential CFL Purchases

Residential				
IOU	**IOU-Discounted CFLs Installed**	**Installation Rate[1]**	**IOU-Discounted CFL Purchases**	**Percent Residential**
PG&E	25,085,329	67%	37,440,790	94%
SCE	17,891,495	77%	23,235,708	94%
SDG&E	5,485,241	67%	8,186,927	95%
All IOUs	48,462,064	71%	68,256,428	94%
Nonresidential				
IOU	**IOU-Discounted CFLs Installed**	**Installation Rate[1]**	**IOU-Discounted CFL Purchases**	**Percent Nonresidential**
PG&E	1,794,855	73%	2,446,567	6%
SCE	1,136,114	81%	1,396,420	6%
SDG&E	310,850	76%	408,830	5%
All IOUs	3,241,820	76%	4,251,817	6%

[1] Installation rates are discussed below in Section 3.2.2.

3.2 Gross Savings Inputs

3.2.1 Summary of Results

Table 18 presents the final residential gross savings inputs derived from this evaluation, and Table 19 presents similar results for the nonresidential sector. In general, ex-post results differed from ex-ante as follows:

- 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.

Table 18: Final Gross Savings Inputs – Residential

Gross Savings Input	Source	PG&E	SCE	SDG&E	Overall
Installation Rate	Installation rate analysis, cumulative installation rate 2006-2008	67%	77%	67%	71%
Average Daily HOU					
Overall	Metering sample direct expansion, all bulbs	1.8	2.1	1.5	1.9
	Metering sample direct expansion, program bulbs	1.9	1.9	1.3	1.8
CFL Twister/A-Line	Metering sample direct expansion, program bulbs	2.0	1.9	1.4	1.9
CFL Globe	ANCOVA leveraged expansion estimate	1.4	1.7	1.3	1.5
CFL Reflector		1.7	2.2	1.4	1.9
Recommended for ex-post, all CFL types	**Metering sample direct expansion, program bulbs: PG&E, SCE, all bulbs: SDG&E**	**1.9**	**1.9**	**1.5**	**1.8**
Peak Coincidence Factor					
Overall	Metering sample direct expansion, all bulbs	5.7%	7.5%	5.4%	6.4%
	Metering sample direct expansion, program bulbs	5.8%	6.3%	3.0%	5.6%
CFL Twister/A-Line	Metering sample direct expansion, program bulbs	6.6%	6.4%	3.4%	6.2%
CFL Globe	ANCOVA leveraged expansion estimate	5.9%	7.4%	5.0%	6.3%
CFL Reflector		6.5%	7.6%	3.2%	6.5%
Recommended for ex- post, all CFL types	**Metering sample direct expansion, all bulbs, all IOUs**	**6.4%**	**6.4%**	**6.4%**	**6.4%**
Delta Watts					
Overall	Inventory sample avg non-CFL W minus inventory sample avg rebated CFL W	44.3	44.8	44.4	44.5
CFL Twister/A-line		47.2	47.8	48.9	47.7
CFL Globe		33.3	35.4	34.8	34.2
CFL Reflector		53.1	52.3	52.9	52.7

Table 19: Final Gross Savings Inputs – Nonresidential[29]

Gross Savings Input	Source[1]	PG&E	SCE	SDG&E	Overall
Installation Rate	Nonresidential Customer Upstream CFL telephone surveys and site visits	73%	81%	76%	76%
Annual HOU	Metered sample	2,710	2,517	2,191	n/a
Peak CF	Metered sample	44%	39%	36%	n/a
Delta Watts	Pre-program avg non-CFL W estimates minus observed avg rebated CFL W	44.6	41.9	45.1	n/a

[1] For more detail on the methods and sources used to generate these results, see Itron's Small Commercial Contract Group Evaluation Report.

3.2.2 Installation Rates

For the Upstream Lighting Program, the installation rate is defined as the proportion of lighting products rebated through the program that were installed by December 31, 2008. Installation rates have been estimated for products installed in both residential and nonresidential locations, as presented below.

3.2.2.1 Residential

The residential installation rate analysis produces installation rates from several perspectives:

- 1st-year installation rate: Of all CFLs purchased or acquired in a particular program year, the fraction that were installed within that program year.
- Cumulative installation rate: Of all CFLs purchased or acquired up to a particular point in the program, the fraction that have *ever* been installed.
- Cumulative surviving installation rate: Of all CFLs purchased or acquired up to a particular point in the program, the fraction in use at that point.

Table 20 provides the results from the residential installation rate analysis by IOU.

Table 20: Residential CFL Installation Rate Analysis Results by IOU

Installation Rate	PG&E			SCE			SDG&E		
	2006	2007	2008	2006	2007	2008	2006	2007	2008
1st year installation rate 2006-2008 CFLs	47%	60%	78%	55%	78%	87%	34%	63%	82%
Cumulative installation rate 2006-2008 CFLs	47%	56%	**67%**	55%	71%	**77%**	34%	56%	**67%**
Surviving installation rate	47%	54%	62%	55%	68%	69%	34%	55%	61%

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

We recommend the cumulative installation rate as the most appropriate for calculating lifetime savings from the program. While some of these bulbs were installed in 2006 or 2007 and burned out or broke by 2008, the average measure life accounts for some early losses. If the program had been evaluated on an annual rather than 3-year cycle basis, all 1st-year installations would have been counted.

3.2.2.2 Nonresidential

Installation rates derived from nonresidential customer telephone and onsite surveys are shown in Table 21. As shown, 76% of all IOU-discounted CFLs purchased by nonresidential customers were installed, 15% were in storage and 8% had burned out.

Table 21: Nonresidential IOU-Discounted CFL Installation Rates

IOU	Total CFLs Purchased in Retail Stores	Total IOU-Discounted CFLs Purchased	Total IOU-Discounted CFLs Installed	Installation Rate	Storage Rate	Burn Out Rate
PG&E	4,460,339	2,446,567	1,794,855	**73%**	19%	7%
SCE	3,522,212	1,396,420	1,136,114	**81%**	9%	9%
SDG&E	1,120,395	408,830	310,850	**76%**	14%	10%
All IOUs	9,102,946	4,251,817	3,241,820	**76%**	15%	8%

3.2.3 Hours of Use

Average annual hours of use have been estimated for both the residential and nonresidential sector, as discussed below.

3.2.3.1 Residential HOU

This study produced residential average daily hours of use from the Residential Lighting Metering Study, the largest and most comprehensive study of its kind to date. Separate estimates were produced for program and non-program bulbs, and by lamp shape, as indicated in Table 18 above.

The recommended average HOU estimates are as follows:

- For PG&E and SCE, the metering sample direct expansion, IOU-discounted bulbs, by IOU
- For SDG&E, the metering sample direct expansion, all bulbs by IOU

In selecting which values to recommend for ex-post savings calculation, we considered several criteria that should be met as far as possible:

- Estimates should be provided at 90/10 confidence/precision.
- Estimates should be specific to each IOU.

- If usage is different for program bulbs than for non-program bulbs, estimates should be provided specifically for program bulbs.

For each IOU, HOU estimates were found to be statistically significantly different between program and non-program bulbs. For PG&E and SCE, the 90/10 criterion is met for program bulb HOU (See Table 83 in Appendix B.) For SDG&E, the 90/10 criterion is not met for program bulbs. We therefore use the SDG&E all-bulbs estimate, which meets the 90/10 criterion.

The 90/10 criterion is also not met for CFL types other than twisters/A-line, which constitute the bulk of the program. We therefore do not use estimates by CFL type for ex-post calculations. The more disaggregated estimates are useful for future program planning. For calculation of ex-post achievement at the overall IOU level, we rely on the overall estimates that are well determined at that level.

3.2.3.2 Nonresidential HOU

The HOU results for the nonresidential sector are described in greater detail in Section 3 and Appendix G of Itron's Small Commercial Contract Group Evaluation Report. The results presented above in Table 19 have been used to develop the UES (kWh/year) for nonresidential measures.

3.2.4 Peak Coincidence Factor (CF)

Average peak coincidence factors (CF) have been estimated for both the residential and nonresidential sector, as discussed below.

3.2.4.1 Residential CF

Similarly, peak usage coincidence factors (CF) were derived from the Residential Lighting Metering Study. Separate estimates were produced for program and non-program bulbs, and by lamp shape, as indicated in Table 18 above.

We recommend for ex-post savings estimation, for all program bulbs and for all IOUs, the direct expansion estimate of average CF across all bulbs (all CFL types, program and non-program, all IOUs). This estimate is recommended based on the same criteria as noted above for HOU.

The only CF estimates that met the 90/10 criterion were the overall estimate across program and non-program bulbs combined, across all IOUs, for all CFL types combined, and for twisters/A-lines alone. (See Table 88 in Appendix B.) Since we cannot provide accurate estimates for other CFL types, we use the single value across all CFL types.

3.2.4.2 Nonresidential CF

The CF results for the nonresidential sector are described in greater detail in Section 3 and Appendix G of Itron's Small Commercial Contract Group Evaluation Report. The results presented above in

Table 19 have been used to develop the UES (kWh/year) for nonresidential measures.

3.2.5 Delta Watts

The wattage of bulbs displaced by IOU-discounted CFLs was estimated for both residential and nonresidential applications, as discussed below.

3.2.5.1 Residential Delta Watts

This study produced average watts for non-CFL substitutes from direct observations on all lamps in the Residential Lighting Metering Study. Based on data from over 1,000 premises, the non-CFL averages were weighted by the observed distribution of CFLs by lamp shape and room type. Other factors that would potentially affect the baseline wattage, including lamp type, fixture type and existing CFL saturation, were explored and found not to have identifiable effects on average non-CFL wattage. The average wattage of IOU-discounted CFLs (observed in the lighting inventory database) – by IOU and by lamp type – were subtracted from comparable average non-CFL wattages to determine delta watts.

3.2.5.2 Nonresidential Delta Watts

Nonresidential estimates were determined as described in Section 3 and Appendix C of Itron’s Small Commercial Contract Group Evaluation Report.

3.2.6 CFLs Replacing CFLs

As discussed above, the savings in watts (delta watts) associated with a CFL depends on the baseline wattage, that is, the wattage that would otherwise have been in place. A natural question for the calculation of delta watts is what fraction of CFL installations are replacements of existing CFLs, i.e., CFL to CFL replacements, for which there may be minimal change in watts.

While this question appears to be important for the delta watts calculation, in fact it is not necessary to account for CFL to CFL replacement explicitly in determining gross or net savings . The reason is that the baseline for calculating delta watts is not the prior condition, but what would otherwise have been in place. We cannot assume that what would otherwise have been in place after a CFL burns out is another CFL. CFLs are replaced with non-CFLs and vice versa .

The proportion of existing CFLs that would be replaced by a CFL on burnout without the program is implicitly accounted for in the net-to-gross adjustment. If we reduced the delta watts by this proportion, we would be penalizing the programs twice for the same effect.

There are two general ways to determine net savings:

1. Calculate the average condition that would have existed in the absence of the program, and calculate savings relative to that.

2. Specify a standard efficiency baseline against which gross savings are calculated, then determine the fraction of the time the higher efficiency version would have been adopted in the absence of the program.

With the first method, “gross” and “net” savings distinctions become arbitrary. The net savings is the difference between the average energy or demand usage in the absence of the program and the average with the program measure in place. If this approach is taken, it is necessary to determine what the saturation of CFLs would be in the absence of the program. However, this is still not the same as determining what fraction of recently installed CFLs replaced existing CFLs. Some of the CFL-CFL replacements would have occurred without the program, and some would not.

With the second method, gross savings is always defined as the difference between an installed CFL and its non-CFL alternative. The net-to-gross ratio is the fraction of IOU-discounted CFL purchases for which a CFL would have been purchased absent the program. This second approach is taken in this study.

With this approach, “free ridership” in the Upstream Lighting Programs is the purchase of a program-discounted CFL in place of a non-program CFL that would otherwise have been purchased. In the absence of the program, there are no “program” bulbs. The CFL purchases and installations that would occur in the absence of the program are all non-program CFLs.

Each of the NTGR methods discussed below estimates the fraction of program-discounted bulbs purchased for which a (non-program) CFL would have been purchased without the program, and the complementary NTGR fraction. The NTGR fraction represents CFL purchases that would not have occurred without the program. CFL to CFL replacements that would have occurred without the program from bulbs purchased in 2006-2008 are included in the “free rider” purchases (and installations), just as the conversions from incandescent to CFL that would have occurred without the program are included.

For example, suppose we determine that a total of 60 million program-attributable IOU-discounted CFLs were acquired and installed by residential customers during 2006-08, that 36 million of these were program-attributable, and another 15 million non-program bulbs were purchased and installed. Suppose also that over this same period a total of 25 million CFLs burned out. These and other assumptions in the discussion that follows are summarized in Table 22.

Table 22: Illustration of CFL to CFL Replacement Effects in Relation to NTGR Estimate

	Units	Case 1: All CFLs replaced by CFLs on burnout	Case 2: CFLs and non-CFLs equally likely to be replaced by CFL on burnout
Assumptions			
Total program bulbs acquired and installed	million	60	60
Program-attributable program bulbs acquired and installed	million	36	36
Non-program-attributable program bulbs acquired and installed	million	24	24
Non-program CFLs acquired and installed	million	15	15
Burned out CFLs	million	25	25
Fraction of burned out CFLs replaced by CFLs without program	%	100%	20%
Fraction of burned out CFLs replaced by CFLs with program	%	100%	32%
Implications			
Program-attributable CFL-CFL replacements	million	0	3
Non-program-attributable CFL-CFL replacements	million	25	5
Program-attributable non-CFL-CFL conversions	million	36	33

At the most extreme, consider the case where every CFL that burned out would be replaced by another CFL with or without the program. In this case, the 25 million replacement CFLs would all come from the 24 million non-attributable program bulbs together with the 15 million non-program bulbs. All 36 million program-attributable bulbs would be non-CFL to CFL conversions.

At the other, extreme consider the case where a CFL has the same chance as a non-CFL of being replaced by a CFL on burnout. For illustration, suppose that fraction is 20% without the program and 32% with the program. Then 20% of the burned out CFLs or 5 million would have been replaced by CFLs without the program. These 5 million replacement bulbs are included in the 39 million non-attributable plus non-program bulbs. Another 12% or 3 million of the burned out CFLs are replaced by CFLs rather than non-CFLs because of the program. These additional 3 million replacement CFLs are included in the total of 36 million program-attributable installations. Since these CFLs would otherwise have been replaced with non-CFLs, the appropriate baseline for them is a non-CFL. The remaining 33 million program-attributable installations would all be non-CFL to CFL conversions. The baseline for these conversions is a non-CFL. (The remaining burned out CFLs would be replaced by non-CFLs with or without the program. These non-CFL installations aren't counted in either program-attributable or non-attributable installations.)

Thus, whether we assume burned out CFLs are always replaced by CFLs with or without the program, or at the other extreme assume CFL and non-CFLs burnouts are equally likely to be replaced by CFLs, the baseline for both replacements and conversions is a non-CFL. The CFL to CFL replacements that would occur without the program are included in the non-program-attributable sales.

In summary, this evaluation determines what fraction of IOU-discounted CFLs are installed during the program period, and what fraction of these correspond to CFL sales and installations that would not have been occurred in the absence of the program. Every CFL installation that would not have occurred absent the program is a socket that would otherwise have been filled with a non-CFL, whether or not it was replacing a CFL. Thus, the baseline is the average non-CFL wattage, regardless of prior CFL use.

3.3 Net Savings Inputs

NTGR estimates were developed using multiple methods which produced a range of results, as shown in Table 23. We considered the validity of each method/estimate, at the channel level where available, and assessed which had the greatest validity in each case. We present arguments for the relative strengths and weaknesses of each in Table 24. The methods highlighted with the darkest shades of grey represent those that produced results with the strongest validity/reliability; those highlighted with lighter shades of grey represent those that produced results with relatively weak validity/reliability.

Table 23: NTGR Estimates by Evaluation Method

<table>
<tr><th rowspan="3">Channel</th><th rowspan="3">% ULP Shipments</th><th colspan="6">NTGR Estimates by Evaluation Method</th></tr>
<tr><th colspan="2">Self-Report</th><th colspan="3">Econometric Models</th><th rowspan="2">Total Sales (Market-Based) Approach</th></tr>
<tr><th>Supplier</th><th>Consumer Stated Preference</th><th>Conjoint Model</th><th>Revealed Preference Purchase Model</th><th>Stated Preference Purchaser Elasticity Model</th></tr>
<tr><td>Discount</td><td>16%</td><td>1.00</td><td>0.18</td><td rowspan="9">n/a</td><td>n/a</td><td>0.52</td><td rowspan="9">n/a</td></tr>
<tr><td>Drug</td><td>9%</td><td>0.73</td><td>0.36</td><td>0.33</td><td>0.31</td></tr>
<tr><td>Grocery - chain</td><td>15%</td><td rowspan="2">0.81</td><td>0.14</td><td>0.33</td><td>0.29</td></tr>
<tr><td>Grocery - small</td><td>21%</td><td>0.11</td><td>n/a</td><td>0.51</td></tr>
<tr><td>Hardware</td><td>5%</td><td>0.60</td><td>0.06</td><td>0.20</td><td>0.50</td></tr>
<tr><td>Home Improvement</td><td>8%</td><td>0.46</td><td>0.20</td><td>0.20</td><td>0.52</td></tr>
<tr><td>Ltg & Electronics</td><td>1%</td><td>0.83</td><td>n/a</td><td>n/a</td><td>n/a</td></tr>
<tr><td>Mass Merchandise</td><td>5%</td><td>0.37</td><td>0.10</td><td>0.33</td><td>0.48</td></tr>
<tr><td>Membership Club</td><td>19%</td><td>0.63</td><td>0.12</td><td>0.33</td><td>0.32</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>**All IOUs**</td><td rowspan="4"></td><td>0.74</td><td>0.15</td><td>0.06</td><td rowspan="4">n/a</td><td>0.42</td><td>0.23 (low) – 0.65 (high)[1]</td></tr>
<tr><td>**PG&E**</td><td>0.71</td><td>0.18</td><td>0.06</td><td>0.40</td><td rowspan="3">n/a</td></tr>
<tr><td>**SCE**</td><td>0.80</td><td>0.14</td><td>0.06</td><td>0.44</td></tr>
<tr><td>**SDG&E**</td><td>0.71</td><td>0.30</td><td>0.08</td><td>0.41</td></tr>
<tr><td colspan="8">[1] The previous range of estimates of 0.18 – 0.64 was preliminary and was expected to change.</td></tr>
</table>

Table 24: Summary of NTGR Methods, Results, Validity/Reliability and Relative Strengths and Weaknesses

Type of Method	Approach	Evidence	Validity/ Reliability	Strengths (+) / Weaknesses (-)
Self-Report Approach	Supplier Self-Report	Percent of IOU-discounted Products Sold Absent the Program by Channel	Moderate	+ Only method that can attempt to account for the full effects of program during 2006-2008 (all other methods rely on 2008-2009 data) + Large fraction of market directly accounted for by respondents + Provides IOU and retail channel-specific estimates +/- Suppliers may be biased (in both directions) - Suppliers are not ultimate purchase/installation decision-makers
	Consumer Stated Preference Self-Report	Likelihood of Selecting CFLs at Twice the Price by Retail Channel	Weak-to-Moderate	+ Direct exposure to IOU-discounted product options, actual store environment + Provides IOU and retail channel-specific estimates - Based on hypothetical purchase decisions by customers not focused on actual purchases - Purchase rates differ from actual in key retail channels - Price sensitivity under-stated when compared to actual - Based on 2008-2009 market data

Type of Method	Approach	Evidence	Validity/ Reliability	Strengths (+) / Weaknesses (-)
Econometric Models	Pricing Analysis	Percent reduction in CFL prices that resulted from program incentives	Strong	+ Robust method accounting for variations in product prices by observable characteristics + Provides retail channel-specific estimates - Based on 2008-2009 market data - Does not yield estimate of NTGR on its own (needs to be combined with elasticity results)
	Conjoint Elasticity Analysis	Percent increase in sales that result from decreases in price	Weak-to-Moderate	+ Robust method when combined with pricing results can provide estimate of program-induced sales - Controlled study environment, providing complete disclosure of product information - Does not account for non-price program effects - Does not account for impulse purchases--assumes lighting will be purchased - Does not provide IOU or retail channel-specific estimates - Assumes product will be available with attributes described - Based on 2008-2009 market data
	Consumer Revealed Preference Purchase Models	CFL purchase rates with and without program	Moderate-to-Strong	+ Method accounts for actual observed IOU-discounted product purchases + Provides IOU and retail channel-specific estimates + Attempts to control for price plus other factors (e.g., planned v. unplanned purchases, consumer characteristics, available product characteristics, promotional/display characteristics, etc.) - Limited variation within channels - Channels with limited program activity during the time of visit could not be modeled - models for customers who intended to buy lighting

Type of Method	Approach	Evidence	Validity/ Reliability	Strengths (+) / Weaknesses (-)
				unable to account for program effect on intent to buy CFLs - contrast models use stores observed during non-program periods as baseline, which doesn't reflect program effect on these stores - Based on 2008-2009 market data
	Consumer Stated Preference Purchaser Elasticity Models	Percent change in quantity purchased per percent change in price	Strong	+ Method accounts for actual observed IOU-discounted product purchases +/- Based on hypothetical purchase decisions at alternate prices by customers who are making actual purchases in stores + Provides IOU and retail channel-specific estimates - NTGR calculation requires extrapolation beyond range of prices customers were asked about - Based on 2008-2009 market data
Total Sales (Market Based) Approach	Multistate Regression Models	Estimated statewide sales at program and non-program conditions	Moderate	+ Method provides both low and high NTGR estimates - Does not provide IOU or channel-specific estimates - Applies model developed without California data to estimate California non-program condition - Results include cumulative effects from previous programs - Based on 2008 market data

3.3.1 Final Recommended NTGR Estimates

As presented above, NTGR estimates were developed using multiple methods which produced a range of results and, in determining the final recommended NTGR estimates, we considered the validity of each method/estimate, at the channel level where available, and assessed which had the greatest validity in each case. The final recommended NTGR estimates represent the our best judgment based on a preponderance of evidence.

In general, the revealed preference results were favored over the other approaches mainly because these were the only methods that used data derived from actual observations of participating retail store environments, average prices for all available, comparable products, and average prices for actual purchased products. In addition, the revealed preference surveys provide the only source of data for actual observations of IOU-discounted CFL purchases as a percent of all CFL purchases. Therefore, the recommended NTGR estimate for most channels was taken as the average of the two revealed preference model results.

There were two important channels for which the revealed preference models did not produce direct NTGR estimates – that is, discount stores and small, independent grocery stores. For discount stores we observed mostly IOU-discounted CFLs on the retail shelves and, as a result, the revealed preference models could not be run. In addition, manufacturer, retail buyer and retail store manager survey responses were in agreement that nearly 100% of the CFLs sold through this channel are discounted by the program (i.e., close to zero non-program sales), which was confirmed through the revealed preference surveys (i.e., we observed near 100% stocking of IOU-discounted CFLs and near 100% sales of IOU-discounted CFLs in this channel), and manufacturers and retail buyers were in agreement in terms of their independently-generated estimates of 100% program attribution. Therefore, for this important channel (it accounts for 16% of all CFLs rebated through the program), we recommend a NTGR estimate of 0.90.

For similar reasons, we also recommend a 0.90 NTGR estimate for small, independent grocery stores. Interviews with manufacturers and retailers attribute a high percentage of the sales through these channels to the program, and the revealed preference surveys indicated that 100% of all CFL purchases were IOU-discounted CFLs. According to program tracking records, nearly 20 million IOU-discounted CFLs were distributed by less than ten manufacturers to more than 700 small, independent grocery stores located in hard-to-reach segments throughout the state. These suppliers indicated that had it not been for the program incentives, they would not have been able to sell CFL products through these stores in any where near the volume they experienced during 2006-2008.

Table 25 present the final recommended ex-post NTGR estimates for the 2006-2008 Upstream Lighting Program. These estimates represent the most robust, well-constructed estimates available for attributing net impacts to the 2006-2008 Upstream Lighting Program. The main reason for the difference between the IOUs 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 NTGR results suggest the Upstream Lighting 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 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.

Table 25: Final Recommended NTGR Estimates by Channel, IOU and Overall

Channel	% of ULP Shipments	**Final Recommended NTGR Estimate**	NTGR Estimate Including Channel Shift Assessment[1]
Discount	16%	**0.90**	0.90
Drug	9%	**0.32**	0.31
Grocery - chain	15%	**0.31**	0.31
Grocery - small	21%	**0.90**	0.90
Hardware	5%	**0.35**	0.18
Home Improvement	8%	**0.36**	0.18
Ltg & Electronics	1%	**0.36**	0.18
Mass Merchandise	5%	**0.41**	0.01
Membership Club	19%	**0.33**	0.01
All IOUs		**0.54**	0.43
PG&E		**0.49**	0.35
SCE		**0.64**	0.57
SDG&E		**0.48**	0.36

[1] The NTGR estimates including channel shift assessment are shown for illustrative purposes only. These results were not used in the impact evaluation.

3.3.2 Effects from Channel Shift

As illustrated in Table 25, if the effects from the channel shift assessment were taken into account, the NTGR estimates for all IOUs would be reduced from 0.54 to 0.43. However, there were a significant number of assumptions made in determining the extent of channel shift. In addition, it may not be appropriate to adjust for this type of effect given that other types of market effects (e.g., non-participant spillover, cumulative market effects) have not be accounted for as part of this evaluation. For this reason, in addition to the number of assumptions we made (without much data upon which to base these assumptions), we are not recommending any adjustment to the final NTGR estimate to account for the effects of channel shift.

3.3.3 Discussion of Other NTGR Estimates

We have not incorporated the other NTGR estimates into our recommended results. The supplier self-report NTGR estimates, with the exception of a few channels, are most likely over-estimating program attribution given the potential biases discussed above (e.g., gaming bias). Despite attempts to neutralize these biases (e.g., taking the average of all sources), for some channels, the resulting NTGR estimates still appear to be biased high.

The conjoint-based NTGR estimates are most likely under-estimating program attribution given the potential biases discussed above (e.g., controlled environment, potential self-selection bias, ignores non-price effects of program, etc.). In addition, neither the conjoint nor the multistate regression based NTGR estimates provide channel-level estimates which, as described above, are key drivers for the differences in NTGR estimates by IOU.

In addition, the multistate regression based NTGR estimates are problematic for a number of reasons – for example, the models are capturing both cumulative program effects and non-participant spillover, the effects from which might influence the result in both directions. In addition, the multistate model uses a regression-based estimate of the California market conditions, which may not adequately capture unique characteristics of the state. In addition, while the multistate NTGR estimate of 23% is based entirely on modeled data, the validity of this model to the California situation is tenuous because California was not used in the development of the model because 2008 purchase data were not collected as part of the in-home lighting inventories.

3.3.4 Low and High NTGR Estimates from Multistate Regression

In order to provide a NTGR estimate based on observed 2008 residential CFL sales that also excludes spillover, we relied on the following equation:

NTGR = [(with-program sales) – (no program sales)]/(with-program sales)

In this equation, sales are total 2008 residential CFL sales, with or without the program. With-program sales include both program and non-program sales that occur when there is a program. The numerator of this equation is the total volume of program-attributable CFL sales in 2008, including program and non-program sales attributable to the program. If we divided by the sales through the program only, the ratio would be a net-to-gross ratio including spillover and market effects. We divide instead by the total sales, including program and non-program sales. The result is the fraction of all CFL sales that are attributable to the program.

That is, we cannot identify "free rider" bulbs and "spillover" bulbs with the market-based approach. We can just say that of all the CFLs that were bought, a certain fraction of them were attributable to the program. We apply this fraction to the program bulbs sold, and we do not try to credit the program for the corresponding fraction of non-program bulbs that are also attributable. We might speculate that attribution is higher for program bulbs than for non-program bulbs but this method does not isolate that. In that sense, this is a conservative NTGR estimate at least conceptually.

The estimate of total 2008 sales derived through the installation rate analysis (52.1 million CFLs, see Appendix B) served as a proxy for "total residential CFL sales with the program". However, we lacked an alternative estimate of the number of CFLs that would have been purchased in the absence of the program, so we relied on the modeled "no program" estimate of 1.86 CFLs per household and extrapolated to all households in the IOU service territories (9.9 million). This yielded an estimated 18.4 million "total residential CFL sales in 2008 without the program." Finally, we used the "total residential

CFL sales in 2008 with the program" in the denominator of the equation, as opposed to the total number of incented CFLs per household. Using the former provides an estimate of NTGR that excludes spillover, while the latter would have been inclusive of spillover.

Applying these estimates, yields the following equation:

$$\text{NTGR} = (52.1 \text{ million} - 18.4 \text{ million}) \div (52.1 \text{ million}) = 65\%$$

The estimated NTGR of 65% is among the higher ones calculated for this evaluation. Therefore, 23% to 65% may represent a possible range of for the actual NTGR estimate for the program in 2008.

Finally, we can only speculate on the how well the modeled data used in both the low (23%) and high (65%) estimates of NTGR adhere to the California situation. Given the positive relationship between program activity and prior CFL use, it is likely that the total net impacts for 2006 and 2007 were higher, although the model does not allow us to estimate how much higher.

3.4 Ex-ante v. Ex-post Savings Parameters: Upstream Screw-in CFLs

Table 26: Ex-ante v. Ex-post Savings Parameters – Upstream Screw-in CFLs[30]

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE UNITS SOLD 06-08							
CFL	Globe	n/a	n/a	54,711	494,582	0	277,168
	Reflector	n/a	n/a	100,575	916,689	0	375,491
	Twister/A-lamp	n/a	n/a	3,363,192	30,354,938	0	6,959,145
	All CFLs	5,234,370	47,704,381	3,518,478	31,766,209	0	7,611,804
EX-POST UNITS SOLD 06-08							
CFL	Globe	163,216	2,557,053	29,111	456,079	11,724	222,764
	Reflector	81,608	1,278,527	54,836	859,095	15,642	297,190
	Twister/A-lamp	2,475,445	38,781,972	1,825,330	28,596,836	294,608	5,597,549
	All CFLs	2,720,269	42,617,551	1,909,277	29,912,010	321,974	6,117,502

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE RES/NONRES							
	All CFLs	10%	90%	10%	90%	0%	100%
EX-POST RES/NONRES							
	All CFLs	6%	94%	6%	94%	5%	95%

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE INSTALLATION RATES							
	All CFLs	92%	76%	92%	90%	n/a	90%
EX-POST INSTALLATION RATES							
	All CFLs	73%	67%	81%	77%	76%	67%

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE UES KWH/YR							
CFL	Globe	n/a	n/a	75.29	13.96	n/a	15.16
	Reflector	n/a	n/a	127.16	35.96	n/a	44.53
	Twister/A-lamp	n/a	n/a	227.80	58.99	n/a	52.69
	All CFLs	270.41	59.15	217.71	57.62	n/a	50.92
EX-POST UES KWH/YR							
CFL	Globe	n/a	23.09	n/a	24.55	n/a	19.05
	Reflector	n/a	36.82	n/a	36.27	n/a	28.96
	Twister/A-lamp	n/a	32.73	n/a	33.15	n/a	26.77
	All CFLs	121.00	30.72	105.30	31.07	98.70	24.31

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential

[30] Revisions to the ex-post values shown in this table were submitted as part of the errata document posted on December 18, 2010.

EX-ANTE UES PEAK KW							
CFL	Globe	n/a	n/a	0.0185	0.0017	n/a	0.0036
	Reflector	n/a	n/a	0.0312	0.0029	n/a	0.0042
	Twister/A-lamp	n/a	n/a	0.0558	0.0052	n/a	0.0051
	All CFLs	0.0491	0.0056	0.0533	0.0051	n/a	0.0050
EX-POST UES PEAK KW							
CFL	Globe	n/a	0.0021	n/a	0.0023	n/a	0.0022
	Reflector	n/a	0.0034	n/a	0.0033	n/a	0.0034
	Twister/A-lamp	n/a	0.0030	n/a	0.0031	n/a	0.0031
	All CFLs	0.0196	0.0028	0.0161	0.0029	0.0163	0.0028

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NTGR							
CFL	Globe	n/a	n/a	78%	78%	n/a	80%
	Reflector	n/a	n/a	78%	78%	n/a	80%
	Twister/A-lamp	n/a	n/a	75%	75%	n/a	80%
	All CFLs	96%	80%	75%	75%		80
EX-POST NTGR							
CFL	Globe	n/a	49%	n/a	64%	n/a	48%
	Reflector	n/a	49%	n/a	64%	n/a	48%
	Twister/A-lamp	n/a	49%	n/a	64%	n/a	48%
	All CFLs	49%	49%	64%	64%	48%	48%

3.5 Realization Rates: Upstream Screw-in CFLs

Table 27: Realization Rates – Upstream Screw-in CFLs[31]

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NET KWH/YR							
CFL	Globe	n/a	n/a	2,891,651	4,847,171	n/a	3,024,562
	Reflector	n/a	n/a	8,978,220	23,138,575	n/a	12,038,664
	Twister/A-lamp	n/a	n/a	517,140,345	1,208,595,759	n/a	264,014,166
	All CFLs	1,250,100,941	1,715,558,531	529,010,216	1,236,581,505	n/a	279,077,392
EX-POST NET KWH/YR							
CFL	Globe	n/a	19,386,585	n/a	5,517,732	n/a	1,364,972
	Reflector	n/a	15,456,872	n/a	15,355,366	n/a	2,768,152
	Twister/A-lamp	n/a	416,763,073	n/a	467,157,199	n/a	48,195,545
	All CFLs	117,737,877	451,606,531	104,222,710	488,030,297	11,592,911	52,328,670

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NET PEAK KW							
CFL	Globe	n/a	n/a	709	596	n/a	710
	Reflector	n/a	n/a	2,203	1,867	n/a	1,142
	Twister/A-lamp	n/a	n/a	126,641	106,129	n/a	25,610
	All CFLs	226,951	162,854	129,553	108,592	n/a	27,461
EX-POST NET PEAK KW							
CFL	Globe	n/a	1,789	n/a	509	n/a	160
	Reflector	n/a	1,426	n/a	1,417	n/a	324
	Twister/A-lamp	n/a	38,461	n/a	43,112	n/a	5,634
	All CFLs	19,072	41,677	15,935	45,038	1,915	6,117

	Realization Rates					
	PG&E		SCE		SDG&E	
	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW
All CFLs	19%	16%	34%	26%	23%	29%

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

4. Upstream Energy Efficient Lighting Fixture HIM Evaluation Results

4.1 Summary of Results

Table 28 presents the final adjustments to quantity of measures rebated. These adjustments are the same as applied above for screw-in CFLs.

Table 28: Final Adjustments to Quantity of Measures Rebated – Upstream Fixtures[32]

Adjustment	PG&E	SCE	SDG&E
Invoice/Application Verification	96%	99%	96%
2008 Shipments Sold in 2008	88%	87%	87%
Leakage	99%	96%	93%
Final Adjustment	**87%**	**92%**	**86%**
Percent Residential	94%	94%	95%

The method used to conduct the invoice/application verification included all products rebated through the Upstream Lighting Program (i.e., screw-in CFLs, energy efficient fixtures and LEDs).

The methods used to assess shipments v. sales, leakage and residential v. nonresidential were based on research completed for screw-in CFLs alone. However, it is reasonable to assume that energy efficient fixtures distributed through the similar channels would sell through with similar patterns.

Gross savings inputs for energy efficient fixtures as derived from this evaluation are shown in Table 29 for both the residential and nonresidential sectors, and summarized below:

- Due to the upstream nature of the program and the relatively low incidence rate of usage of energy efficient fixtures across the general population, it was not possible to identify purchasers and assess installation rates. Therefore, we retain the ex-ante installation rate of 100%.
- HOU were derived from metering analysis completed for both residential and nonresidential customers. For residential, the estimates are directly tied to similar lighting applications (e.g., hard-wired interior fixtures, exterior hard-wired fixtures with photocell/motion sensors, torchieres, etc.). For nonresidential, the only information available was the overall average annual hours of use by IOU.
- Peak CFs were derived with a method similar to that described for HOU.

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

- Delta watts were derived from the residential lighting inventory database. The wattage of base case fixtures was compared to the wattage of energy efficient fixtures rebated through the program. The relationship between base case and rebated fixtures was assumed to be the same for both residential and nonresidential applications.

Table 29: Summary of Ex-post Gross Savings Inputs for Upstream Fixtures

	PG&E	SCE	SDG&E
Residential/Nonresidential Installation Rate (% installed and operating)	100%	100%	100%
Residential HOU (average daily HOU)			
Desk/Table/Floor Lamp		1.9	
Exterior HW (no control)	3.7	4.0	3.4
Exterior HW (control)		4.1	
Interior HW (ceiling)		1.9	
Interior HW (unspecified)	1.7	1.9	1.4
Torchiere	1.7	1.9	
Residential Peak Use (% use on peak)			
Desk/Table/Floor Lamp		5.4%	
Exterior HW (no control)	13.5%	15.4%	12.1%
Exterior HW (control)		15.3%	
Interior HW (ceiling)		5.4%	
Interior HW (unspecified)	5.4%	5.4%	5.4%
Torchiere	5.4%	5.4%	
Nonresidential HOU (average annual HOU)	2,710	2,517	2,191
Nonresidential Peak Use (% use on peak)	44%	39%	36%
Residential/Nonresidential Delta Watts (watts)			
Desk/Table/Floor Lamp		49.89	
Exterior HW (no control)	43.79	40.45	35.49
Exterior HW (control)		75.37	
Interior HW (ceiling)		31.64	
Interior HW (unspecified)	29.35	36.37	30.47
Torchiere	96.21	75.75	

See Section 8.15 in Appendix B for additional detail on the sources used to derive fixture-specific HOU, peak CF, and delta watts values.

Again, due to the upstream nature of the program and low incidence of purchases, it was not possible to collect information to support a NTGR estimate for energy efficient fixtures. During in-depth interviews and surveys with manufacturers, retail buyers and retail store managers, respondents were asked to indicate the percent of IOU-discounted fixture sales that would have occurred absent the program (e.g., free ridership). The NTGR estimate based on supplier self-reports was inconclusive. As a result, the default NTGR estimate of 0.80 from DEER was used for energy efficient fixtures.

4.2 Ex-ante v. Ex-Post Savings Parameters: Upstream Fixtures

Table 30: Ex-ante v. Ex-post Savings Parameters – Upstream Fixtures[33]

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE UNITS REBATED 2006-2008							
Fixtures	Desk/Table/Floor Lamp				30		
	Exterior HW (no control)	19,755	189,730	146,079			40,127
	Exterior HW (control)			98,598			
	Interior HW (ceiling)				507,236		
	Interior HW (unspecified)	21,430	205,131		1,266		65,850
	Torchiere	1,253	15,264		3,745		
	All Fixtures	42,438	410,125	244,677	512,277	0	105,977
EX-POST UNITS SOLD 06-08							
Fixtures	Desk/Table/Floor Lamp	0	0	1	23		
	Exterior HW (no control)	10,814	169,413	8,069	126,415	1,735	32,957
	Exterior HW (control)	0	0	5,457	85,496		
	Interior HW (ceiling)	0	0	27,883	436,838		
	Interior HW (unspecified)	11,850	185,649	70	1,090	2,813	53,441
	Torchiere	855	13,402	203	3,184		
	All Fixtures	23,519	368,464	41,684	653,046	4,547	86,398

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE RES/NONRES							
Fixtures	Desk/Table/Floor Lamp			0%	100%		
	Exterior HW (no control)	9%	91%	100%	0%	0%	100%
	Exterior HW (control)			100%	0%		
	Interior HW (ceiling)			0%	100%		
	Interior HW (unspecified)	9%	91%	0%	100%	0%	100%
	Torchiere	8%	92%	0%	100%		
	All Fixtures	9%	91%	32%	68%	0%	100%
EX-POST RES/NONRES							
Fixtures	Desk/Table/Floor Lamp			6%	94%		
	Exterior HW (no control)	6%	94%	6%	94%	5%	95%
	Exterior HW (control)			6%	94%		
	Interior HW (ceiling)			6%	94%		
	Interior HW (unspecified)	6%	94%	6%	94%	5%	95%
	Torchiere	6%	94%	6%	94%		
	All Fixtures	6%	94%	6%	94%	5%	95%

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE INSTALL RATES							
	All Fixtures	100%	100%	100%	100%	100%	100%
EX-POST INSTALLATION RATES							
	All Fixtures	100%	100%	100%	100%	100%	100%

[33] Revisions to the ex-post values shown in this table were submitted as part of the errata document posted on December 18, 2010.

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE UES KWH/YR							
Fixtures	Desk/Table/Floor Lamp				81.46		
	Exterior HW (no control)	335.70	225.46	111.52			95.00
	Exterior HW (control)			270.58			
	Interior HW (ceiling)				91.45		
	Interior HW (unspecified)	341.65	59.85		38.06		58.96
	Torchiere	607.80	106.98		132.72		
	All Fixtures	346.74	138.22	175.62	91.61		72.60
EX-POST UES KWH/YR							
Fixtures	Desk/Table/Floor Lamp			125.58	34.60		
	Exterior HW (no control)	118.67	59.14	101.80	59.05	77.75	44.04
	Exterior HW (control)			189.71	112.79		
	Interior HW (ceiling)			79.64	21.94		
	Interior HW (unspecified)	79.54	18.21	91.54	25.22	66.75	15.57
	Torchiere	260.74	59.70	190.65	52.53		

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE UES PEAK KW							
Fixtures	Desk/Table/Floor Lamp				0.0064		
	Exterior HW (no control)	0.0000	0.0000	0.0000			0.0000
	Exterior HW (control)			0.0000			
	Interior HW (ceiling)				0.0055		
	Interior HW (unspecified)	0.0620	0.0057		0.0049		0.0056
	Torchiere	0.1103	0.0101		0.0094		
	All Fixtures	0.0346	0.0032	0.0000	0.0056		0.0035
EX-POST UES PEAK KW							
Fixtures	Desk/Table/Floor Lamp			0.0195	0.0027		
	Exterior HW (no control)	0.0193	0.0059	0.0158	0.0062	0.0128	0.0043
	Exterior HW (control)			0.0294	0.0115		
	Interior HW (ceiling)			0.0139	0.0017		
	Interior HW (unspecified)	0.0129	0.0016	0.0142	0.0020	0.0110	0.0016
	Torchiere	0.0423	0.0052	0.0295	0.0041		

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NTGR							
Fixtures	Desk/Table/Floor Lamp				80%		
	Exterior HW (no control)	96%	80%	76%			80%
	Exterior HW (control)			76%			
	Interior HW (ceiling)				76%		
	Interior HW (unspecified)	96%	80%		76%		80%
	Torchiere	96%	80%		80%		
	All Fixtures						
EX-POST NTGR							
Fixtures	Desk/Table/Floor Lamp			80%	80%		
	Exterior HW (no control)	80%	80%	80%	80%	80%	80%
	Exterior HW (control)			80%	80%		
	Interior HW (ceiling)			80%	80%		
	Interior HW (unspecified)	80%	80%	80%	80%	80%	80%
	Torchiere	80%	80%	80%	80%		
	All Fixtures						

4.3 Realization Rates: Upstream Fixtures

Table 31: Realization Rates – Upstream Fixtures[34]

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NET KWH/YR 2006-2008							
Fixtures	Desk/Table/Floor Lamp				1,955		
	Exterior HW (no control)	6,366,555	34,221,624	12,380,596			3,049,497
	Exterior HW (control)			20,275,880			
	Interior HW (ceiling)				35,252,164		
	Interior HW (unspecified)	7,028,718	9,821,528		36,624		3,105,845
	Torchiere	731,112	1,306,329		397,629		
	All Fixtures	14,126,385	45,349,481	32,656,476	35,688,372		6,155,341
EX-POST NET KWH/YR							
Fixtures	Desk/Table/Floor Lamp	0	0	149	645	0	0
	Exterior HW (no control)	1,026,641	8,015,316	657,149	5,971,865	107,892	1,161,106
	Exterior HW (control)	0	0	828,205	7,714,504	0	0
	Interior HW (ceiling)	0	0	1,776,481	7,668,322	0	0
	Interior HW (unspecified)	754,060	2,704,923	5,096	21,996	150,202	665,590
	Torchiere	178,435	640,072	31,001	133,817	0	0
	All Fixtures	1,959,136	11,360,311	3,298,080	21,511,148	258,094	1,826,696

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NET PEAK KW 2006-2008							
Fixtures	Desk/Table/Floor Lamp				0.15		
	Exterior HW (no control)	0.00	0.00	0.00			0.00
	Exterior HW (control)			0.00			
	Interior HW (ceiling)				2130.47		
	Interior HW (unspecified)	1276.04	931.41		4.72		294.55
	Torchiere	132.73	123.89		28.16		
EX-POST NET PEAK KW							
Fixtures	Desk/Table/Floor Lamp	0.00	0.00	0.02	0.05	0.00	0.00
	Exterior HW (no control)	166.69	801.23	101.82	629.91	17.73	113.21
	Exterior HW (control)	0.00	0.00	128.33	788.72	0.00	0.00
	Interior HW (ceiling)	0.00	0.00	310.55	597.10	0.00	0.00
	Interior HW (unspecified)	122.43	235.40	0.79	1.71	24.68	70.34
	Torchiere	28.97	55.70	4.80	10.42	0.00	0.00

	Realization Rates					
	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW
All Fixtures	22%	57%	36%	119%	34%	77%

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

5. Upstream LED HIM Evaluation Results

5.1 Summary of Results

Table 32 presents the final adjustments to quantity of measures rebated. These adjustments are the same as applied above for screw-in CFLs and energy efficient fixtures.

Table 32: Final Adjustments to Quantity of Measures Rebated – Upstream LEDs[35]

Adjustment	PG&E	SCE	SDG&E
Invoice/Application Verification	96%	99%	96%
2008 Shipments Sold in 2008	88%	87%	87%
Leakage	99%	96%	93%
Final Adjustment	**84%**	**92%**	**80%**
Percent Residential*	94%	94%	95%

* Except open/closed signs which are 100% nonresidential.

The method used to conduct the invoice/application verification included all products rebated through the Upstream Lighting Program (i.e., screw-in CFLs, energy efficient fixtures and LEDs).

The methods used to assess shipments v. sales, leakage and residential v. nonresidential were based on research completed for screw-in CFLs alone. However, it is reasonable to assume that LEDs distributed through the similar channels would sell through with similar patterns.

Gross savings inputs for LEDs as derived from this evaluation are shown in Table 33 for both the residential and nonresidential sector. These average HOU, peak CF and delta watts values were derived from several sources, as discussed in Section 8.16 of Appendix B.

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

Table 33: Summary of Ex-post Gross Savings Inputs for Upstream LEDs[36]

	PG&E	SCE	SDG&E
Residential/Nonresidential Installation Rate	100%	100%	100%
Residential HOU (average annual HOU)			
Holiday Lights	444		444
Night Lights	4380	4380	4380
Table/Desk Lamp		n/a	n/a
Residential Peak CF (% use on peak)			
Holiday Lights	0%		0%
Night Lights	0%	0%	0%
Table/Desk Lamp		n/a	n/a
Nonresidential HOU (average annual HOU)			
Holiday Lights	719		666
Night Lights	4380	4380	4380
Table/Desk Lamp		n/a	n/a
Open/Close Signs		2,517	2,191
Nonresidential CF (% use on peak)			
Holiday Lights	44%		36%
Night Lights	0%	0%	0%
Table/Desk Lamp		n/a	n/a
Open/Close Signs		39%	36%
Residential/Nonresidential Delta Watts (watts)			
Holiday Lights	1.20		1.20
Night Lights	5.09	5.08	5.09
Table/Desk Lamp		n/a	n/a
Open/Close Signs		31	31

Similar to energy efficiency fixtures, extremely low incidence and upstream distribution made it impossible to verify installation rates and NTGR estimates for the rebated LED measures. As a result, the ex-ante value was retained for installation rate (100%), and the default value from DEER was used for the NTGR estimate (0.80).

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

5.2 Ex-ante v. Ex-post Savings Parameters: Upstream LEDs

Table 34: Ex-ante v. Ex-post Savings Parameters – Upstream LEDs[37]

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE UNITS SOLD 06-08							
LEDs	Holiday Lights	853,769	7,890,833				3,232,080
	Night Light	133,884	1,211,053		1,533,034		
	LED Bulb						394,416
	Signage				4,018	1,034	
	Table/Desk Lamp				275,300		12,480
	All LEDs	987,653	9,101,886		1,812,352	1,034	3,638,976
EX-POST UNITS SOLD 06-08							
LEDs	Holiday Lights	437,463	6,853,583			128,204	2,435,873
	Night Light	68,319	1,070,332	84,393	1,322,153		
	LED Bulb					17,214	327,073
	Signage			199	3,120	43	817
	Table/Desk Lamp			15,282	239,414	515	9,793
	All LEDs	505,782	7,923,915	99,874	1,564,687	145,977	2,773,555

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE RES/NONRES							
LEDs	Holiday Lights	10%	90%			0%	100%
	Night Light	10%	90%	0%	100%		
	LED Bulb					0%	100%
	Signage			0%	100%	100%	0%
	Table/Desk Lamp			0%	100%	0%	100%
EX-POST RES/NONRES							
LEDs	Holiday Lights	6%	94%			5%	95%
	Night Light	6%	94%	6%	94%		
	LED Bulb					5%	95%
	Signage			100%	0%	100%	0%
	Table/Desk Lamp			6%	94%	5%	95%

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE INSTALL RATES							
	All LEDs	100%	100%	100%	100%	100%	100%
EX-POST INSTALLATION RATES							
	All LEDs	100%	100%	100%	100%	100%	100%

[37] Revisions to the ex-post values shown in this table were submitted as part of the errata document posted on December 18, 2010.

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE UES KWH/YR							
LEDs	Holiday Lights	5.16	0.31				0.02
	Night Light	72.88	29.42		28.14		
	LED Bulb						73.58
	Signage				159.50	54.75	
	Table/Desk Lamp				0.00		19.75
	All LEDs	14.34	4.18		24.16	54.75	8.06
EX-POST UES KWH/YR							
LEDs	Holiday Lights	0.86	0.53			0.86	0.53
	Night Light	23.84	23.84	23.80	23.80		
	LED Bulb					23.84	23.84
	Signage			78.03		67.92	
	Table/Desk Lamp			0.00	0.00	0.00	0.00

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE UES PEAK KW							
LEDs	Holiday Lights	0.0014	0.0000				0.0000
	Night Light	0.0000	0.0000		0.0000		
	LED Bulb						0.0000
	Signage				0.0300	0.0500	
	Table/Desk Lamp				0.0000		0.0000
	All LEDs	0.0012	0.0000		0.0001	0.0500	0.0000
EX-POST UES PEAK KW							
LEDs	Holiday Lights	0.0000	0.0000			0.0000	0.0000
	Night Light	0.0000	0.0000	0.0000	0.0000		
	LED Bulb					0.0000	0.0000
	Signage			0.0121		0.0112	
	Table/Desk Lamp			0.0000	0.0000	0.0000	0.0000

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NTGR							
LEDs	Holiday Lights	80%	80%				80%
	Night Light	96%	80%		80%		
	LED Bulb						80%
	Signage				80%	80%	
	Table/Desk Lamp						80%
EX-POST NTGR							
LEDs	Holiday Lights	80%	80%			80%	80%
	Night Light	80%	80%	80%	80%		
	LED Bulb					80%	80%
	Signage			80%		80%	
	Table/Desk Lamp			80%	80%	80%	80%

5.3 Realization Rates: Upstream LEDs

Table 35: Realization Rates – Upstream LEDs[38]

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NET KWH/YR							
LEDs	Holiday Lights	3,522,018	1,956,927				51,713
	Night Light	9,367,149	28,507,178		34,510,211		
	Other						23,218,166
	Signage				512,697	45,289	
	Table/Desk Lamp						197,184
	All LEDs	12,889,167	30,464,104	0	35,022,908	45,289	23,467,063
EX-POST NET KWH/YR							
LEDs	Holiday Lights	301,532	2,918,350	0	0	88,368	1,037,228
	Night Light	1,302,778	20,410,191	1,606,729	25,172,084	0	0
	LED Bulb	0	0	0	0	328,261	6,236,958
	Signage	0	0	12,430	0	2,336	0
	Table/Desk Lamp	0	0	0	0	0	0
	All LEDs	1,604,310	23,328,540	1,619,159	25,172,084	418,964	7,274,186

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-ANTE NET PEAK KW							
LEDs	Holiday Lights	940.7100	0.0000				0.0000
	Night Light	0.0000	0.0000		0.0000		
	Other						0.0000
	Signage				96.4320	41.3600	
	Table/Desk Lamp						0.0000
	All LEDs	940.7100	0.0000	0.0000	96.4320	41.3600	0.0000
EX-POST NET PEAK KW							
LEDs	Holiday Lights	0.00	0.00	0.00	0.00	0.00	0.00
	Night Light	0.00	0.00	0.00	0.00	0.00	0.00
	LED Bulb	0.00	0.00	0.00	0.00	0.00	0.00
	Signage	0.00	0.00	1.93	0.00	0.38	0.00
	Table/Desk Lamp	0.00	0.00	0.00	0.00	0.00	0.00
	All LEDs	0.00	0.00	1.93	0.00	0.38	0.00

	Realization Rates					
	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW
All LEDs	58%	0%	76%	2%	33%	1%

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

6. Findings and Recommendations

Table 36 presents the final results from the evaluation of the 2006-2008 Upstream Lighting Program. As shown, more than 1,325 GWh in net annual energy savings were achieved as a result of the measures rebated through this program. Net peak demand reductions amounted to nearly 134 MW.[39] 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.

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

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	233,553,499	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%	**25%**
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	**607,596,705**	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	**62,159**	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%	**26%**
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%

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.

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:[41]

- 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

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

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

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:

- 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.

Table 38: Average Statewide Residential Daily Hours-of-Use (HOU) – By CFL Type

IOU-Discounted CFLs	**Daily HOU**	**90% CI +/-**	**90% CI +/-%**
All CFL Styles	1.8	0.1	5%
Twister/A-lamp shaped CFLs	1.9	0.1	5%
Globe-style CFLs	1.6	0.3	20%
Reflector-style CFLs	1.8	0.3	19%
All CFLs	**Daily HOU**	**90% CI +/-**	**90% CI +/-%**
All CFL Styles	1.9	0.1	3%
Twister/A-lamp shaped CFLs	2.0	0.1	4%
Globe-style CFLs	1.5	0.3	20%
Reflector-style CFLs	1.9	0.3	17%

Statewide HOU results for segments of interest summarized in Table 39. Segment-specific results by IOU are provided in Appendix B.

Table 39: Average Statewide Residential Daily Hours-of-Use (HOU) – All CFLs

Segment	Level	Daily HOU	90% CI +/-	90% CI +/-%
Overall		1,9	0.1	3%
Own/Rent	Own	1.9	0.1	4%
	Rent	2.1	0.1	6%
Education	Less than high school	1.9	0.2	10%
	High school	2.0	0.2	10%
	College	2.0	0.1	4%
	Post graduate	1.4	0.1	8%
Dwelling Type	Multifamily	2.0	0.1	6%
	Mobile home	3.9	0.7	18%
	Single family	1.8	0.1	4%
Number of Bathrooms (proxy for home size)	1	2.2	0.1	6%
	2	2.1	0.1	5%
	3+	1.4	0.1	7%
Room/Location	All Exterior	3.9	0.4	9%
	All Interior	1.7	0.1	3%
	Bathroom	1.4	0.1	8%
	Bedroom	1.7	0.1	6%
	Dining	1.9	0.3	16%
	Garage	1.2	0.4	29%
	Hall	1.2	0.2	13%
	Kitchen	2.5	0.2	8%
	Living	2.3	0.2	8%
	Office	1.6	0.2	13%
	Other	1.4	0.2	12%

Nonresidential HOU estimates were developed by Itron through the methods described in Section 3 and Appendix G of Itron's Small Commercial Contract Group Evaluation Report. Table 40 provides average annual nonresidential HOU estimates by IOU and by building type.

Table 40: Average Annual Nonresidential Hours-of-Use (HOU) by IOU and Building Type

Average HOU (Average Annual HOU)	PG&E	SCE	SDG&E
All Building Types	2,710	2,517	2,191
Assembly	1,661	1,906	1,617
Health/Medical – Clinic	2,478	1,978	2,015
Lodging	1,624	1,456	1,125
Office – Small	2,814	2,745	2,519
Other	2,998	3,008	2,354
Restaurant	3,757	3,981	3,961
Retail – Small	3,693	3,013	3,486

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.

Table 41: Average Statewide Residential Peak Usage (CF) – By CFL Type

IOU-discounted CFLs	CF	90% CI +/-	90% CI +/-%
All CFL Styles	5.6%	0.8%	14%
Twister/A-lamp shaped CFLs	6.2%	0.9%	14%
Globe-style CFLs	6.2%	2.8%	45%
Reflector-style CFLs	6.0%	3.0%	50%
All CFLs	**CF**	**90% CI +/-**	**90% CI +/-%**
All CFL Styles	6.4%	0.6%	9%
Twister/A-lamp shaped CFLs	6.6%	0.6%	10%
Globe-style CFLs	6.3%	2.8%	44%
Reflector-style CFLs	6.5%	2.9%	45%

Table 42: Average Statewide Peak Coincidence Factors (CF) – CFLs

Segment	Level	CF	90% CI +/-	90% CI +/-%
Overall		6.4%	0.6%	9%
Own/Rent	Own	6.6%	0.7%	10%
	Rent	5.7%	1.0%	17%
Education	Less than high school	5.2%	2.1%	40%
	High school	7.9%	2.0%	25%
	College	6.4%	0.7%	11%
	Post graduate	5.5%	1.1%	20%
Dwelling Type	Multifamily	8.6%	1.6%	18%
	Mobile home	14.4%	4.0%	28%
	Single family	5.6%	0.6%	11%
Number of Bathrooms (proxy for home size)	1	7.3%	1.2%	16%
	2	7.9%	0.9%	11%
	3+	3.9%	0.9%	22%
Room/Location	All Exterior	16.8%	3.2%	19%
	All Interior	5.4%	0.5%	9%
	Bathroom	6.1%	1.3%	22%
	Bedroom	5.0%	1.0%	19%
	Dining	8.5%	3.4%	39%
	Garage	8.0%	3.9%	48%
	Hall	3.6%	1.3%	35%
	Kitchen	7.0%	1.7%	25%
	Living	6.1%	1.4%	23%
	Office	3.0%	1.3%	42%
	Other	3.1%	1.2%	37%

Nonresidential HOU estimates were developed by Itron through the methods described in Section 3 and Appendix G of Itron's Small Commercial Contract Group Evaluation Report. Table 43 provides average annual nonresidential HOU estimates by IOU and by building type.

Table 43: Average Nonresidential Peak Coincidence Factors (CF) by IOU and Building Type

Peak CF	PG&E	SCE	SDG&E

(% use on peak)			
All Building Types	44%	39%	36%
Assembly	22%	30%	14%
Health/Medical - Clinic	66%	27%	46%
Lodging	19%	16%	14%
Office - Small	42%	33%	38%
Other	56%	45%	43%
Restaurant	54%	61%	60%
Retail - Small	68%	63%	70%

6.1.2.4 Delta Watts

Residential-sector estimates of the wattage of lamps and fixtures displaced by IOU-discounted products (i.e., delta watts) were derived from the analysis of lighting inventory data collected as part of the Residential Lighting Metering Study. Nonresidential estimates of delta watts for IOU-discounted CFLs were determined using the method described in Section 3 and Appendix C of the Small Commercial Contract Group Evaluation Report.

Residential sector estimates of delta watts for fixtures were used for both residential and nonresidential fixtures. The types of fixtures rebated through the program (e.g., fluorescent desk/table lamps, hard-wired interior and exterior lighting fixtures, and torchieres) represent the types for which residential base case assumptions were deemed the most appropriate. That is, the typical fixture wattage displaced by these rebated fixtures would likely be within the same range regardless of whether it was being used in residential or nonresidential applications.

For LEDs, delta watts was determined based on a review of the IOU workpapers, as discussed in Section 8.16, Appendix B. Table 44 presents the delta watts results by IOU for CFLs, fixtures and LEDs.

Table 44: Average Delta Watts (W) by IOU – CFLs, Fixtures and LEDs

		PG&E	SCE	SDG&E
Residential CFLs	All CFL Styles	44.3	44.8	44.4
	Twister/A-lamp shaped CFLs	47.2	47.8	48.9
	Globe-shaped CFLs	33.3	35.4	34.8
	Reflector-shaped CFLs	53.1	52.3	52.9
Nonresidential CFLs	All CFL Styles	44.6	41.9	45.1
Fixtures (Residential and Nonresidential)	Desk/Table/Floor Lamp		49.9	
	Exterior HW (no control)	43.8	40.5	35.49
	Exterior HW (control)		75.4	
	Interior HW (ceiling)		26.7	
	Interior HW (unspecified)	29.0	20.8	26.0
	Torchiere	96.2	75.8	
LEDs (Residential and Nonresidential)	Holiday Lights	1.3		1.3
	Night Lights		5.1	
	Table/Desk Lamp		n/a	n/a
	Open/Close Signs		31.0	31.0

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.[42]

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)
- 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

[42] 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.

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 this 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 Recommendations

We have organized the recommendations from this evaluation around three broad categories:

- Recommendations to improve program tracking, documentation, and reporting
- Recommendations to improve design and operational performance
- Recommendations for future research and analysis (e.g., extended analyses of existing evaluation data, additional studies leveraging existing evaluation data, and additional/new studies needed)

In general, we recommend the IOUs 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.

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. The following types of information should be required as part of the documentation submitted with each monthly claim:

- Detailed product information, including:
    - Consistently defined measure name mapped to consistently defined, detailed product descriptions
        - CFL examples: globe-style MSB CFL, dimmable reflector-style CFL, twister-style threeway-wattage CFL, etc.
        - Fixture examples: interior hard-wired ceiling fixture, exterior hard-wired wall-mounted fixture (with photocell/motion control), plug-in fluorescent desk lamp, etc.
        - LED examples: 100-bulb LED holiday light string, 0.3 watts per bulb, 1.4 watt fluorescent night light with photocell sensor, etc.
    - Actual wattage and lumens (not ranges)
    - Manufacturer name and model numbers

- Names and locations of retailers receiving shipments
- Rebate paid per unit (with unit consistently defined)
- Pricing information with and without rebate (if available/reliable)
- Key dates, consistently defined
    - Date manufacturer/retailer approved for allocation
    - Estimated date products shipped from manufacturer
    - Estimated date products received by retail storefront
    - Actual sales date (month and year)

IOUs should also be required to substantially improve the quality of the information/sources used to document these monthly transactions. Specifically, sales data or sell-through reports generated by retailers (on retailer letterhead) should be required on at least a quarterly basis if not monthly. Additional documentation that was provided for some (but not all) of the invoices/applications verified through evaluation include:

- Bill of lading/freight/shipping – a print/scan of shipping documentation including receipt signature on delivery
- Equivalencies document – a form that lists product by model and quantities/weights per unit in shipping terms (e.g., one pallet = 20 cartons, each carton contains 100 units)
- Manufacturer's invoice to the utility listing rebates to be paid for X units
- Invoice from retailer to manufacturer listing number of units to be shipped
- Distribution list provided by retailer showing shipments to specific store locations

This type of documentation should be available for every product rebated through the program. The IOUs should be required to provide this documentation to the Energy Division for independent verification. The verification process completed for this evaluation should be repeated on at least a quarterly basis.

6.2.2 Recommendations for Improving Program Design and Operational Performance

The following recommendations were developed based on the specific results of this impact evaluation:

- The IOUs should continue to take measures to minimize leakage (e.g., reject shipments to stores located outside of IOU service territories, allow bulk purchasing on a case by case basis with adequate documentation, require identification numbers on stickers so “leaked” bulbs can be traced back to a specific store/time period, etc.).

- In addition, the IOUs should continue to monitor the market (i.e., checks on e-Bay, amazon.com, etc.) for evidence of leakage both prior to and after sales. IOUs should report on a quarterly basis on the results of these efforts (e.g., products searched for, number of sites contacted, screen shots, dates of search, etc.)
- Continue to rebate 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). These channels tend to have either no CFL sales or limited non-program CFLs sales absent the program, they generally sell to hard-to-reach sectors (i.e., low-income, ethnic, and rural) with minimal potential for "channel shift," and these channels are the ones where the economic downturn was most likely to encourage customers to switch back from CFLs to incandescent bulbs due to the lower incandescent price points.
- 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.

In addition, IOUs are strongly encouraged to implement many additional recommendations developed as part of recent process evaluations completed for the 2006-2008 Upstream Lighting Program.[43]

6.2.3 Recommendations for Future Research and Analysis

The following recommendations were developed for future research and analysis to help improve the reliability of both gross and net impact estimates for energy efficient lighting programs. We have offered recommendations in two broad categories:

- Extended analyses of existing evaluation data
- Additional studies leveraging existing evaluation data

6.2.3.1 Extended Analyses of Existing Evaluation Data

The estimates of average residential daily HOU, peak usage (CF), and delta watts developed through this evaluation were based on the most comprehensive and systematic metering and onsite inventory of residential lighting conducted to-date. Since the focus of the analysis completed for this evaluation was on CFLs (and fixtures containing CFLs), additional value can be added through extensions such as:

[43] For example, Process Evaluation of the 2006-2008 SCE Upstream Lighting Program, http://www.calmac.org/publications/SCE_ULP_Process_Evaluation_final_v3.pdf.

- Whole House Lighting Usage Analysis. The analysis of CFL HOU and peak usage can be applied to the non-CFLs contained in the metering sample to provide a comprehensive set of lighting usage results. This data can be mined to further understand and predict future CFL v. non-CFL usage patterns.

- Seasonal Variations in Use: The annualization of the metering data relied on models that estimate daily usage for each logger by calendar day, weekday or weekend. These estimated models can also be used to produce estimates of daily usage by month and daytype, for any of the subgroups of interest.

- Subgroup Estimates: The leveraged analysis uses ANCOVA models to estimate daily and peak usage for each lamp in the inventory data base, as functions of household, room, lamp, and fixture characteristics. This expanded data base can be used to produce estimates for many additional subgroups of interest beyond those displayed in this report. It may be useful to create a query tool that could produce appropriate weighted estimates for any subgroup specification.

- Load Profiles: Peak usage analysis considered the hours from 2 to 5 pm on summer weekdays. Hourly load curves were not developed for the full year. However, such load curves could be developed from the logger data, using techniques similar to those used to develop the peak estimates. This analysis could be used to produce estimates of daily usage by month and daytype, for any of the subgroups of interest.

- Delta Watts: Baseline wattage was estimated as the average wattage in place for non-CFLs corresponding to particular lamp shapes and installed in particular room and/or fixture types. We explored possible relationships between CFL saturation and average wattage of replaced bulbs. This exploration was inconclusive. However, further work could be done in this area.

- Measure Life: Some research indicates that CFL measure life closely related either to the average cycle time between switching a bulb on and off, or the number of times the bulb is switched on or off. The metering data can be used to estimate average cycle times and/or number of on/off times per year, as function of bulb, household, and room type characteristics, as well as annual hours of use.

- Remaining Potential: This study identified that there are roughly 500 million sockets in California IOU homes, and CFLs are currently installing in approximately 100 million of these. The metering and inventory data can be further mined to develop estimates of the remaining potential from the remaining sockets, in terms of applicability of basic twister CFLs v. the need for specialty CFLs, as well as hours of use and peak use. This type of analysis was provided at a high level early in the study, based on the first 600 meters collected. The analysis could be updated and expanded.

6.2.3.2 Additional Studies Leveraging Existing Evaluation Data

Several types of data collection for this study were conducted in multiple waves, collecting the same type of data collection for several samples at different points in time. This approach allows large total samples to be collected without a massive effort at any one time. In addition, the wave approach provides a series of snapshots for tracking changes over time. Continuing the same data collection through future evaluation periods can provide further insights into changes over time, as well as expanding the overall data set available for analysis. Specific suggestions include the following:

- <u>Expanded Peak Data Collection.</u> The residential lighting metering study was designed with the recognition that the sample size was likely to be too small to provide 90/10 precision for peak use, overall or for each IOU. As it turned out, the 90/10 precision target was met for all IOUs combined, but not for any individual IOU. Conducting additional waves of metering particularly in the summer time using the data collection and analysis protocols already established could provide a stronger basis for estimating peak usage.
- <u>Ongoing CFL User Survey For Tracking Purposes</u>. The CFL Users Survey was conducted in five waves. While this survey did not provide as accurate data as the onsite inventories, it does provide indicators of whether CFL saturation and purchase rates are changing over time. The survey also indicates whether customers' self-described commitment to CFL use is changing over time. Tracking this information across periods of substantially reduced program activity can give insights into how customer attitudes and purchases change after program activity abates. There have already been some indications that CFL purchases have dropped off in 2009 after the close of the 2006-08 program.
- <u>Ongoing In-store Research Required to Capture Variation by Channel Over Time.</u> Revealed preference surveys obtained by intercepting lighting purchasers were conducted over an extended period of time. Conducting similar surveys over a broader range of conditions will continue to provide a strong basis for estimating program effects.

There are also opportunities to use the existing evaluation data to leverage upcoming data analysis, including:

- <u>Lighting end-use consumption estimates</u>. 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 end-use 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.

- Additional demographic segmentation. Because we have detailed information about the home and its occupants from RASS, we can use this information to further segment the lighting data from this study for use in program planning and target marketing. CFL and non-CFL usage patterns could be further analyzed by the more extensive information available from the RASS sub-sample.
- Upcoming CLASS. It is anticipated that the California Lighting and Appliance Saturation Survey (CLASS) – essentially similar to RASS just conducted onsite – will be repeated in 2010. Information from that study can be combined with results of this evaluation. For example, the purchase, storage, and installation rate trajectories developed for the present study can be extended using the 2010 CLASS results. In addition, it might be possible to conduct additional monitoring as part of the next CLASS effort to provide even stronger estimates of annual and peak usage.

7. Appendix A – Glossary of Terms

Acronym	Definition
AC	Air Conditioning
ANCOVA	Analysis of Covariance
CATI	Computer Aided Telephone Interview
CBO	Community-Based Organizations
CF	Coincident Factor
CFL	Compact Fluorescent Lamp
CIS	Customer Information System
CLASS	California Statewide Lighting and Appliance Efficiency Saturation Study
CPUC	California Public Utilities Commission
DEER	Database for Energy Efficient Resources
ED	Energy Division
EM&V	Evaluation Measurement and Verification
ERT	Evaluation Reporting Tool
FR	Free Ridership
HE	High Efficiency
HIM	High Impact Measure
HOU	Hours-of-Use
HVAC	Heating Ventilation Air Conditioning
HW	Hard-wired
IOU	Investor-owned Utility
IPF	Iterative Proportional Fitting
kW	Kilowatt
kWh	Kilowatt hour
LADWP	Los Angeles Department of Water and Power
LED	Light Emitting Diode
MECT	Master Evaluation Contractor Team
MF	Multifamily
MH	Mobile Home
MPS	Minimum Performance Standards
MSB	Medium screw-base
NBRM	Negative Binomial Regression
NL	Nested Logit
NRDI	Nonresidential Direct Install
NTGR	Net-to-Gross Ratio
P/NP	Participant/Nonparticipant
PG&E	Pacific Gas and Electric Company
RASS	Residential Appliance Saturation Survey
RB	Retail buyer
RP	Revealed preference
RSM	Retail store manager

Acronym	Definition
SCCG	Small Commercial Contract Group
SCE	Southern California Edison Company
SCG	Southern California Gas Company
SDG&E	San Diego Gas & Electric Company
SF	Single family
SMUD	Sacramento Municipal Utility District
SP	Stated preference
SR	Self-report
SRA	Self-report Approach
SSSR	Supply-side self report
TOU	Time of Use
UES	Unit Energy Savings
ULP	Upstream Lighting Program

8. Appendix B – Technical Appendix

8.1 Overview of Sources and Analysis

The targeted confidence and precision levels for the high-impact measures (HIMs) within the Upstream Lighting Program were set at 90% confidence and 10% precision. The Upstream Lighting Program evaluation consisted of several data collection activities and sub-studies. Many of the estimates developed utilized a combination of these sources.

Table 45 below summarizes how the various types and sources of data that were used in the evaluation, as well as the relevant sample sizes. Table 46 indicates what accuracy measures were relevant for each data source. For some of these sources, statistical confidence measures do not apply, but qualitative accuracy assessment does. For some data sources and analysis, statistical sampling provides the basis for confidence interval calculations. For some types of analysis, the statistical accuracy is based on modeling accuracy. Some combine both. The approach to providing statistical accuracy for each source and/or analysis is indicated in this section. Qualitative issues and threats to validity are addressed in Section 8.2.

8.1.1 CFL User Survey

The CFL User Survey was fielded by telephone in five waves. The sample in each wave was a simple random sample of IOU customers. Each wave had a target of 100 completes with residential customers who had purchased CFLs in the past 3 months. Purchasers over the full 2006-2008 program period were also identified randomly. Non-purchasers were also included. Table 47 shows the numbers of surveys successfully completed and corresponding absolute and relative precision at 90% confidence for a proportion of 50%.

Table 45: Evaluation Elements, Evaluation Inputs, Data Types/Sources, Sample Sizes and Types of Analyses Completed

Evaluation Element	Evaluation Input	Data Type/ Source	Sample Size	Type of Analysis Completed
Quantity of Measures Rebated	Invoice/ Application Verification	Program tracking data	All records	Verification of completeness, accuracy and quality of program claims (product type, quantity rebated, retailer name/location)
		Sample of invoices/ applications	764 total (439 PG&E, 224 SCE, 101 SDG&E)	
	Shipment v. Sales	Program tracking data	All records	Percent of IOU-discounted CFL shipments not sold at end of 2008
		Interviews with participating manufacturers and retail buyers, surveys with participating retail store managers	Manufacturers (12), retail buyers (10), retail store managers (223)	
	Leakage	Program tracking data	All records	Percent of IOU-discounted CFLs purchased by non-IOU customers
		Revealed preference surveys with CFL purchasers	867 total (400 PG&E, 321 SCE, 146 SDG&E)	
	Residential/ Non-residential Sales	CFL User surveys	3979 total (1592 PG&E, 1603 SCE, 784 SDG&E)	Percent of IOU-discounted CFLs purchased by residential v. nonresidential customers
		Stated and revealed preference surveys with CFL purchasers	867 total (400 PG&E, 321 SCE, 146 SDG&E)	
		Residential metering study participants	1223 total (498 PG&E, 487 SCE, 248 SDG&E)	
		Nonresidential telephone and onsite surveys	460 total	

Evaluation Element	Evaluation Input	Data Type/ Source	Sample Size	Type of Analysis Completed
Gross Savings Inputs	Installation Rates	Program tracking data	All records	Percent of IOU-discounted CFLs installed by end of 2008
		Supply-side market actor interviews/surveys	Manufacturers (18), retail buyers (18), retail store managers (223)	Program sales as percent of total sales
		CFL User surveys	3979 total (1592 PG&E, 1603 SCE, 784 SDG&E)	Surviving installation rate, snapshot storage rates, snapshot number of CFLs in use per home, percent of CFLs never installed
		Residential metering study participants	1223 total (498 PG&E, 487 SCE, 248 SDG&E)	IOU-discounted CFLs installed as percent of total CFLs installed, snapshot storage rates, snapshot number of CFLs in use per home
	HOU	Residential metering study participants	1223 total (498 PG&E, 487 SCE, 248 SDG&E); 7299 meters (2922 PG&E, 2941 SCE, 1436 SDG&E)	Average daily hours-of-use
	Peak	Residential metering study participants		Average percent on during peak
	Delta Watts	Program tracking data	All records	Average wattage of rebated CFLs
		Residential metering study participants	1233 total (498 PG&E, 487 SCE, 248 SDG&E)	Estimated average wattage replaced by rebated CFLs

* See Itron's Small Commercial Contract Group Evaluation Report for discussion of nonresidential gross savings inputs, sources, sample sizes and types of analysis completed.

Evaluation Element	Evaluation Input	Data Type/ Source	Sample Size	Type of Analysis Completed
Net Savings Inputs	Final Recommended NTGR Estimates	Program tracking data	All records	Percent of shipments by year, IOU, channel, manufacturer, retailer, product type
		Supply-side market actor interviews/surveys	Manufacturers (18), retail buyers (18), retail store managers (223)	NTGR (SSSR)
		Shelf surveys	451 total (204 PG&E, 175 SCE, 72 SDG&E)	Average prices and other characteristics for available products (i.e., discounted CFLs, non-discounted CFLs, incandescents), store environment (i.e., CFL promotional materials, shelf space, etc.)
		Conjoint surveys	327 total (109 PG&E, 108 SCE and 110 SDG&E)	Elasticity of demand, NTGR (Econometric, pricing/conjoint)
		Stated and revealed preference surveys with CFL purchasers	867 total (400 PG&E, 321 SCE, 146 SDG&E)	Purchase rates for different products based on observed characteristics (e.g., pricing, choice, environment, etc.), NTGR (Econometric, revealed preference)
		CFL User surveys	3979 total (1592 PG&E, 1603 SCE, 784 SDG&E)	CFL purchase and installation rates (CA v. comparison states), verification of CFL purchase and installation rates (CA v. comparison states), NTGR (multi-state regression)
		CFL User follow-up site visits	222 total (IOU counts)	
		Comparison area surveys	1,755 total	
		Comparison area follow-up site visits	193 total	

Table 46: Relevant Measures of Accuracy by Evaluation Element, Evaluation Input and Data Type/Source

Evaluation Element	Evaluation Input	Data Type/ Source	Accuracy Basis
Quantity of Measures Rebated	Invoice/ Application Verification	Program tracking data	Qualitative Assessment
		Sample of invoices/ applications	
	Shipment v. Sales	Program tracking data	Qualitative Assessment
		Interviews with participating manufacturers and retail buyers, surveys with participating retail store managers	
	Leakage	Program tracking data	Qualitative Assessment
		Revealed preference surveys with CFL purchasers	
	Residential/Non-residential Sales	CFL User surveys	Sampling Precision
		Revealed preference surveys with CFL purchasers	Qualitative Assessment
		Residential metering study participants	Sampling Precision
		Nonresidential telephone and onsite surveys	Sampling Precision
Gross Savings Inputs	Installation Rates	Program tracking data	Qualitative Assessment
		Supply-side market actor interviews/surveys	Qualitative Assessment
		CFL User surveys	Qualitative Assessment, Sampling Precision
		Residential metering study participants	Sampling Precision
	HOU	Residential metering study participants	Sampling Precision, Modeling Precision
	Peak	Residential metering study participants	Sampling Precision, Modeling Precision
	Delta Watts	Program tracking data	Qualitative Assessment
		Residential metering study participants	Sampling Precision
Net Savings Inputs	NTGR Estimate	Program tracking data	Qualitative Assessment
		Supply-side market actor interviews/surveys	Qualitative Assessment
		Shelf surveys	Modeling Precision
		Conjoint surveys	Modeling Precision
		Revealed preference surveys with CFL purchasers	Qualitative Assessment, Modeling Precision
		CFL User surveys and follow-up site visits (CA and comparison states)	Sampling Precision, Modeling Precision

Table 47: Precision and Confidence Levels for CFL User Survey

CFL User Surveys	Minimum Number of Respondents Per Wave	Total Number of Respondents Over 5 Waves	Precision of 90% Confidence Interval for a Proportion of 50%			
			Absolute Error, Single Wave	*Relative Error, Single Wave*	*Absolute Error, All Waves*	*Relative Error, All Waves*
Overall	699	3,979	3.1%	6.2%	1.3%	2.6%
Recent Purchasers	79	491	9.3%	18.5%	3.7%	7.4%

8.1.2 Residential Lighting Metering Study

The Residential Lighting Metering Study utilized a sample stratified by IOU and geographic region. Within each region, a simple random sample was selected. Essentially, every residential account in the IOU records had an equal probability of selection into the sample.

Within each home, a complete inventory was obtained for all lamps in use and for CFLs in storage. A target of four CFL fixture groups and three non-CFL fixture groups were metered in each home taking a systematic sample from the full inventory.

Initially, the required metering sample size for achieving 90/10 precision for coincident peak use was estimated at approximately 2,700 homes with summer metering. This sample size was several times the size of any previous study, and would have been impractical to achieve within the timeframe available for this evaluation. Instead, the metering sample size was set at 1,200 homes including a minimum of 600 during the summer. The projected statewide precision at 90% confidence for this design was +/- 7% for average daily hours of use and +/- 19% for percent on at peak.

Estimates of average daily hours of use and peak use were developed from the metering data in two ways. First was a direct expansion using the sampling weights. The second was a leveraged expansion. The leveraged analysis first estimated hours of use and peak use for each lamp in the inventory based on a model fit to the metered data, then applied sample expansion weights to produce averages from the full inventory data set. For the direct expansion, statistical confidence intervals are based on the estimated sampling error for the metering sample. For the leveraged estimates, statistical confidence intervals combine the modeling error with the inventory sampling error.

The leveraged expansion can provide more robust estimates for subdivisions of the data across multiple dimensions, particularly if the subdivision results in small sample sizes for direct expansion. For larger subgroups the direct expansion generally provides better precision.

Achieved precision using direct estimation for hours of use was +/- 3% for the state as a whole, and +/- 8% or better for each IOU. Achieved precision for peak was +/- 8.7% for the state as a whole and +/- 21% or better for each IOU.

8.1.3 Revealed Preference Survey

Revealed preference intercept surveys were completed with 867 respondents at 378 stores throughout PG&E, SCE and SDG&E service territories. The 2006-2008 Upstream Lighting Program tracking databases provided the sample frame for the intercept and shelf surveys. The sample was designed to represent the channels and key retail chains that had participated in the program during 2006-2008. Table 48 presents an overview of the sample design, as well as the final sample sizes achieved by channel.

Table 48: Revealed Preference and Shelf Survey Sample Sizes by Channel

Channel	Percent of Total ULP CFL Shipments (2006-2008)	Number of RP Surveys Completed	Number of Shelf Surveys Surveyed	Percent of RP Surveys Completed by Channel	Percent of Shelf Surveys by Channel
Discount	16%	115	68	13%	18%
Drug	9%	21	41	2%	11%
Grocery	36%	146	98	17%	26%
Hardware	5%	84	45	10%	12%
Home Improvement	8%	188	51	22%	13%
Lighting & Electronics	1%	0	0	0%	0%
Mass Merchandise	5%	270	55	31%	15%
Membership Club	19%	43	20	5%	5%
Total	100%	867	378	100%	100%

For the revealed preference modeling, accuracy of the estimated NTGR is determined from the standard error of the ratio of modeled program to modeled non-program CFL purchase probability. For the simple contrast NTGR estimates, accuracy is determined from the standard error of the ratio of observed CFL shares in stores with IOU-discounted CFLs present to the CFL sales share in stores without IOU-discounted CFLs.

To generate IOU-specific NTGR estimates, we weighted the channel-specific NTGR results by the actual distribution of CFL shipments by IOU and by channel.

For the logistic regression models and the simple contrast approach, the individual channels were collapsed into channel groups. Sample sizes for individual channels were too small to expect good estimates to be produced. Some cases were dropped from the modeling due to missing variables. Also, the analysis was not attempted for the stores identified as having likely very high NTGR estimates. For these stores, virtually no non-program bulbs were observed, making estimation by either the logistic regression models or the simple contrast approach impossible.

The sample sizes for each NTGR analysis are indicated in Table 49. The unit of observation in all the analyses was the package. See Sections 8.2.2, 8.11 and 8.12 for more detailed discussion of the analysis and results derived from the revealed preference surveys.

Table 49: Sample Sizes Used in Revealed Preference Analysis

Analysis	Channel Group	Bulb Class	Number of Stores	Number of Customers	Number of Packages	Number of Bulbs
Logistic Regression Model	Home Improvement/Hardward	Standard	57	150	260	784
	Large Grocery / Drug	Standard	38	54	88	235
	Mass Merchandise / Membership Club	Standard	53	175	258	843
	All	**Standard**	**148**	**379**	**606**	**1862**
Simple Contrast	Home Improvement/Hardward	Standard	58	152	262	786
	Large Grocery / Drug	Standard	38	55	89	236
	Mass Merchandise / Membership Club	Standard	53	179	262	848
	All	**Standard**	**149**	**386**	**613**	**1870**
Simple Contrast	Home Improvement/Hardware	Specialty	59	119	230	514
	Large Grocery / Drug	Specialty	34	42	53	145
	Mass Merchandise / Membership Club	Specialty	60	135	223	664
	All	**Standard**	**153**	**296**	**506**	**1323**

8.2 Validity and Reliability

8.2.1 Overview

This evaluation seeks to meet the CPUC's stated objective of obtaining reliable estimates of annual energy and peak demand savings generated by the designed HIM groups. Reasonably accurate and precise estimates can be considered reliable because they minimize the potential for each of the types of error indicated below:

- ***Measured:*** This type of error may be caused by inaccurate equipment or human error. Steps to mitigate measurement error for the major data collection and analysis components included the following:
  - Residential Lighting Metering Study. In-field policies and protocols were developed to ensure systematic procedures for the collection of detailed household lighting inventory data, the random selection of fixture groups for monitoring, the placement and installation of loggers, and the retrieval and downloading of logger data. See Appendix G (Volume 2) for the detailed protocols for the Residential Lighting Metering Study.
  - CFL User Survey. The questionnaire design built on experience with similar data collection from the 2004-2005 evaluation. Surveys were administered by Computer Assisted Telephone Interview (CATI) to ensure skip patterns were followed. Surveys were refined after initial waves based on preliminary analysis and findings. See Appendix G (Volume 2) for a copy of the CFL User Survey instrument.
  - Revealed Preference Intercept and Shelf Surveys. Detailed in-field policies and protocols were developed to ensure systematic procedures for the collection of intercept and shelf survey data. See Appendix G (Volume 2) for copies of the stated and revealed preference intercept and shelf survey data collection instruments.
  - Supply-Side Market Actor Interviews and Surveys. In-depth interviews were conducted with manufacturers, retail buyers and retail store managers leveraging experience and results from prior interviews with many of these same respondents. Quality control steps were implemented during the survey to ensure internal consistency within the surveys and, once competed, survey responses were compared to those from other market actors within the same channel (both within survey sources and across survey sources). Threats to validity were also considered, as discussed below in Section 8.8.4. See Appendix G (Volume 2) for copies of the supply-side market actor data collection instruments.
  - Conjoint Analysis. Conjoint analysis is a controlled study environment, and the study provided complete disclosure of CFL costs and benefits vs. incandescent bulbs. In particular, the lifetime savings of the CFLs, in dollars, was clearly highlighted in the experiment. In contrast, many actual CFLs do not contain the lifetime savings on the bulb

packaging, and even if they do this information typically requires that shoppers pick up the packaging to read it (i.e., it is not clearly displayed next to the price on the shelf). In addition, for study purposes participants also assumed easy availability of the CFL they wanted and in the package size desired – which is not always true in the actual marketplace. See Appendix F (Volume 2) for a detailed description of the conjoint study methodology.

- ***Collected***: Non-response error occurs when some portion(s) of the population proves less likely than other portions to provide data. Investments that increase the response rate, such as incentives and multiple contact attempts, are typically used to minimize non-response bias errors.
  - Residential Lighting Metering Study. As discussed above, the sample for this sub-study was random such that every IOU customer had equal probability of selection. Households were contacted multiple times at different times of the day. Appointments were scheduled at multiple times at different times of the day and days of the week. Incentives of $100 were offered to encourage participation. The final sample by IOU was post-stratified to align with California's 2003 Statewide RASS distributions for that IOU, by multiple dimensions. See Volume 2 for the response rate analysis and results.
  - CFL User Survey. Households were contacted multiple times at different times of the day. The final sample by IOU was post-stratified to align with California's 2003 Statewide RASS distributions for that IOU, by multiple dimensions. See Volume 2 for the response rate analysis and results.
  - Revealed Preference Intercept and Shelf Surveys. Brief (less than five minute) intercept surveys were conducted with respondents in the shopping aisle after their purchase decision had been made (i.e., after placing the selected items in their shopping basket). Small incentives ($5-10 gift cards) were offered to encourage participation in the survey effort. Shelf surveys were conducted in each store where intercept surveys were also completed.
  - Supply-Side Market Actor Interviews and Surveys. In-depth interviews were targeted for participating manufacturers and retailer who represented the largest share of program shipments, whereas participating retail store manager surveys were conducted randomly. As mentioned above, quality control steps were implemented during and after the surveys were conducted to address reliability. Threats to validity were also considered, as discussed below in Section 8.8.4. See Volume 2 for more detailed information on the supply-side market actor research completed as part of this evaluation.
  - Conjoint Analysis. Participating in a focus group is a fairly substantial commitment, requiring a few hours of time, including travel, for each participant. The study attempted to minimize potential self-selection bias by offering a generous incentive, as well as a meal. In addition, to mitigate the potential that only strong proponents of CFLs would

participate, the study stratified based on the self-reported number of CFLs installed, and included a number of low-user groups. However, during the sessions it was learned that some of the low-users actually lived in small homes or apartments, so even though they only owned a few CFLs they represented more highly saturated households (CFLs as a percentage of all sockets) than anticipated.

- ***Described (modeled):*** When statistical models create estimates, errors may occur due to the use of inappropriate functional forms, inclusion of irrelevant explanatory variables, and so on.
  - Residential Lighting Metering Study. Individual logger fits used a simple functional form that is physically-based and was observed to fit the aggregate data well. Individual loggers were screened for poor fits based on the standard errors and magnitude of observed coefficients. Variables in the ANCOVA models were tested for significance and excluded if they did not contribute. Some categorical variables were collapsed as indicated by the data to provide stable estimates.
  - Revealed Preference Intercept Survey. For the NTGR models that were based on stated preference purchaser survey results, the results are sensitive to the assumed reduction in purchases by those who reported they would have bought “fewer” at double the price. We addressed this sensitivity by bounding the likely interpretation of “fewer” based on the typical quantities purchased, and providing estimates under alternative assumptions.
- Random Error: Using sampling rather than census modeling can create random errors; any sample can be drawn from a population with a large number of possible samples of the same size and design.
  - Residential Lighting Metering Study. As discussed above in Section 8.1.2, we drew random samples and applied appropriate weighting and standard error calculation procedures.
  - CFL User Survey. These samples were drawn and analyzed as simple random samples for precision calculations.
  - Revealed Preference Intercept Surveys: For analysis of averages, we treated the achieved samples as simple random samples within each channel. For modeling, we calculated standard errors with the respondent as the cluster and the package as the unit of observation.

8.2.2 Confidence Intervals: Detailed Methods and Results

In this section we provide additional details on the methods used for calculating confidence intervals for each of the final ex-post savings parameters. Tables presenting the confidence bounds (absolute and relative) are presented at the end of the methods discussion within each section, and throughout we use a confidence level of 90%.

In the confidence interval tables, the "90% CI +/-" column gives the absolute error and the "90% CI +/-%" column gives the relative error of the 90% confidence interval. The confidence interval bounds are given by the estimate shown +/- the absolute error shown under the "90% CI +/-" column. The "90% CI +/-%" column gives that +/- amount as a percent of the estimate. Thus, for a given estimate X

$$90\%\ CI = [X - b, X + b]$$

where b is the absolute error "90% CI +/-" and b/X is the relative error expressed as a percentage "90% CI +/-%."

8.2.2.1 Invoice Verification

8.2.2.1.1 Sampling

We took a random sample of invoices. The sample frame was each IOU's program tracking data, stratified by channel. Within each IOU and channel combination, we selected a simple random sample of invoice/application numbers for review.

8.2.2.1.2 Estimation Method

For each invoice *j* in stratum *k* we have:

x_{kj} = invoice quantity per tracking data

y_{kj} = verified quantity per invoice review

The adjustment to the quantity rebated is calculated for each IOU as:

$$A = [\sum_k \sum_j y_{kj}] / [\sum_k \sum_j x_{kj}]$$

8.2.2.1.3 Confidence Interval Estimation Method

The estimate *A* is a stratified (combined) ratio estimator. Standard formulas for this type of estimator are used to calculate the confidence intervals. The analysis uses PROC SURVEYMEANS in SAS.

8.2.2.1.4 Results with Confidence Intervals

Table 50 shows the invoice verification results extended with 90% confidence bounds.

Table 50: Invoice Verification Results with Confidence Intervals

IOU	Rate	90% CI +/-	90% CI +/- %
PG&E	96.1%	4.0%	4.2%
SCE	98.8%	1.1%	1.1%
SDG&E	95.5%	3.0%	3.1%
All IOUs	96.8%	2.4%	2.4%

8.2.2.2 Leakage Rates

8.2.2.2.1 Sampling

This estimate is based on the revealed preference intercept surveys. These surveys were conducted with a sample of customers in selected stores. The sample of stores was selected at random, stratified by IOU, channel and level of vulnerability to leakage. Vulnerability was defined by distance from a non-IOU area (0-5 miles, 5-10 miles, > 10 miles).

8.2.2.2.2 Estimation Method

Each customer *j* is identified as being in-territory or out of territory. For store *s* in stratum *k*:

I_{ksj} = 0/1 dummy variable indicating customer *j* was out of territory

c_{ksj} = number of program CFLs purchased by customer *j*

n_{ks} = number of customers observed in store *s* stratum *k*

M_k = total shipments to stratum *k*, from tracking data

The leakage rate for each Vulnerability level *v* is calculated as:

$$L_v = \left(\sum_{k \varepsilon v} M_k \sum_s \sum_j I_{ksj} c_{ksj}\right) / \left(\sum_{k \varepsilon v} M_k \sum_s \sum_j c_{ksj}\right)$$

This is a stratified (combined) ratio estimator.

The overall leakage rate is then calculated as the weighted average of the leakage rates calculated for each vulnerability level, weighted by the proportion of shipments to each of these levels:

$$L = \sum_v L_v f_v$$

$$f_v = \sum_{k \varepsilon V} M_k / \sum_k M_k$$

The leakage adjustment factor used to adjust the shipped quantities for leakage is one minus the leakage rate.

8.2.2.2.3 Confidence Interval Estimation Method

Each vulnerability-level estimate L_v is a stratified (combined) ratio estimator. Standard formulas for this type of estimator are used to calculate the confidence intervals, using PROC SURVEYMEANS in SAS.

The overall estimator is a weighted average of the two separate ratios. PROC SURVEYMEANS does not produce the confidence intervals directly. The overall confidence interval bounds are given by

$$CI(L) = L \pm b$$

where

$$b = \sum_v [f_v^2 b_v^2]^{1/2}$$

and the confidence interval for each vulnerability level *v* is given by

$$CI_v = L_v \pm b_v$$

Since the leakage adjustment factor is one minus the leakage rate, the absolute errors for the adjustment factors are the same as the absolute errors for the leakage rate. That is, for the adjustment factor A_L

$$CI(A_L) = A_L \pm b$$

where b has the same value as in the CI formula for leakage. However, the relative precision is different, because the relative precision for leakage is

$$rp(L) = b/L$$

while the relative precision for the leakage adjustment factor is

$$rp(A_L) = b/A_L = b/(1-L).$$

8.2.2.2.4 Results with Confidence Intervals

Table 51 presents the leakage rate estimates, along with 90% confidence intervals. Table 52 shows the estimates and 90% confidence intervals for the corresponding leakage adjustment factors 1 minus the leakage rate. Since the leakage rates are generally small, their relative precision is poor. The adjustment factors are close to one and have much better relative precision.

Table 51: Leakage Rates with Confidence Intervals

IOU	Leakage	90% CI +/-	90% CI +/- %
PG&E	0.5%	0.4%	95.2%
SCE	4.1%	3.2%	81.7%
SDG&E	7.4%	10.6%	142.7%

Table 52: Leakage Adjustment Factors with Confidence Intervals

IOU	Leakage Adjustment	90% CI +/-	90% CI +/- %
PG&E	99.5%	0.4%	0.4%
SCE	95.9%	3.2%	3.4%

SDG&E	92.6%	10.6%	11.4%

8.2.2.3 Shipment v. Sales

The estimate of unsold product at the end of 2008 was based on channel-specific estimates from three types of Upstream Lighting Program supply-side participants: lighting manufacturers, retail lighting buyers, and retail store managers.

8.2.2.3.1 Sampling

For the lighting manufacturers we attempted interviews with all manufacturers who had participated in the 2006-2008 Upstream Lighting Program. In the 2009 wave of interviews (which asked the 2008 shipment vs. sales question) we completed interviews with 16 manufacturers. Twelve of these, representing 92% of 2008 Upstream Lighting Program shipments, were willing to provide estimates of 2008 shipments vs. sales.

For the retail lighting buyers we attempted interviews with buyers for all participating retailers that accounted for at least 500,000 in 2006-2008 Upstream Lighting Program shipments.[44] In the 2009 wave of interviews we completed interviews with 12 of these retail buyers. Ten of these, representing 45% of 2008 Upstream Lighting Program shipments, were willing to provide estimates of 2008 shipments vs. sales.

Since both the lighting manufacturer and retail lighting buyer interviews were not random samples (e.g., we targeted the population of a certain category of market actors), no statistical precision is associated with these estimates.

The 2009 store manager surveys were conducted based on a stratified random sample. The stratification criteria included the IOU service territory that the store was located in, the retail channel (e.g. drug, grocery, etc), and the size of the retailer (e.g., large chain, small chain, and independent). Retailers were then randomly selected within each of these strata.

8.2.2.3.2 Estimation Method

The method of estimating the percentage of 2008 Upstream Lighting Program shipments that resulted in 2008 sales for each IOU was based on the average of three separate estimates:

- The sales-weighted IOU-specific manufacturer estimate;
- The sales-weighted IOU-specific retail buyer estimate; and

[44] Two of the retail lighting buyers that we completed interviews with accounted for less than 500,000 shipments of rebated CFL products through the ULP. One of these was with a buyer for a national retailer that accounted for 282,754 CFL products through the ULP during the 2006-2008 period. Another was an experimental interview with a small chain buyer that accounted for 93,481 CFL products through the ULP during the 2006-2008 period.

- The sales-weighted IOU-specific retail store manager estimate.

These sales-weighted IOU-specific estimates were developed by taking the channel-specific 2008 shipment vs. sales estimates that appear in Table 13 of the report and calculating the sum-product of these retail channel-specific estimates and the proportion of 2008 Upstream Lighting Program product sales that each of these retail channel sales accounted for a given IOU. For example, the manufacturer estimate of 2008 Upstream Lighting Program shipments that resulted in 2008 sales through the Discount channel was 97%. Since the Discount channel accounted for 10% of PG&E's 2008 shipments, this 97% was multiplied by this 10% weight and so on for the other retail channels.

8.2.2.3.3 Confidence Interval Estimation Method

For the retail store manager survey-based estimate of the percentage of 2008 shipments that resulted in 2008 sales, the confidence interval is calculated using the standard formula for a confidence interval for a mean calculated from a simple random sample.

8.2.2.3.4 Results with Confidence Intervals

Table 53 presents the percent sold estimates from the retail store manager surveys, along with 90% confidence intervals.

Table 53: Percent of 2008 Shipments Sold by End of 2008 per Retail Store Managers with Confidence Intervals

Channel	Percent Sold	90% CI +/-	90% CI +/- %
Discount	82.8%	10.2%	12.3%
Drug	96.0%	7.5%	7.8%
Grocery	80.6%	4.9%	6.1%
Hardware	70.3%	7.3%	10.4%
Home Improvement	84.6%	10.4%	12.3%
Mass Merchandiser	77.4%	6.9%	9.0%
Membership Club	84.1%	15.8%	18.8%
All Channels	80.9%	3.9%	4.8%

8.2.2.4 Residential/Nonresidential Ratio

8.2.2.4.1 Sampling

The data used to determine the percentage of IOU-discounted CFLs that were installed in residential v. nonresidential locations (i.e., the residential/nonresidential "split") were the residential and nonresidential onsite surveys. The onsite survey samples were stratified random samples of IOU customers.

8.2.2.4.2 Estimation Method

For both the residential and nonresidential estimates, the average number of IOU-discounted CFLs per premise was calculated, using standard sample expansion methods for the stratified samples. The total number of IOU-discounted CFLs installed was then calculated by multiplying this average by the total population count. The ratio of residential to nonresidential installations was then calculated as the ratio of these two totals:

$$R = C_r/C_{nr}$$

where

C_r = total IOU-discounted CFLs installed in residential locations at the time of the survey

C_{nr} = total IOU-discounted CFLs installed in nonresidential locations at the time of the survey

8.2.2.4.3 Confidence Interval Estimation Method

Confidence intervals for IOU-discounted CFLs installed per premise and in total were calculated by standard methods for both the residential and nonresidential estimates. The residential and nonresidential confidence intervals for total IOU-discounted CFLs installed are given by:

$$CI_r = C_r \pm b_r$$

$$CI_{nr} = C_{nr} \pm b_{nr}$$

The confidence interval for the ratio is then calculated using the approximation:

$$CI_R = R \pm b_{Ratio}$$

where

$$b_{Ratio} \simeq R\,[(b_r/C_r)^2 + (b_{nr}/C_{nr})^2]^{1/2}$$

8.2.2.4.4 Results with Confidence Intervals

Table 54 presents the percent of IOU-discounted CFLs installed in residential locations with associated 90% confidence intervals.

Table 54: Proportion of IOU-Discounted CFLs Installed in Residential Locations with Confidence Intervals

IOU	Percent Residential	90% CI +/-	90% CI +/- %
PG&E	94%	14.3%	15.2%
SCE	94%	15.6%	16.6%
SDG&E	95%	32.5%	34.1%
All IOUs	94%	10.2%	10.8%

8.2.2.5 Installation Rates

8.2.2.5.1 Sampling

The installation rates are based on the residential and nonresidential onsite survey samples.

8.2.2.5.2 Estimation Method

The nonresidential installation rate is calculated from the nonresidential onsite survey data as the snapshot ratio of average IOU-discounted CFLs in use to average IOU-discounted CFLs observed onsite (including stored bulbs) at the time of the survey.

The residential installation rate is calculated using a trajectory analysis, but is primarily driven by the snapshot ratio of stored to in-use CFLs from the residential onsite inventory.

8.2.2.5.3 Confidence Interval Estimation Method

Each snapshot installation rate is essentially a ratio estimator and its CI can be calculated using standard ratio estimation formulas.

Most of the other factors that substantially affect the residential installation rate are not based on statistical samples or models and do not contribute to the random uncertainty of the estimate. We therefore approximate the precision of the residential installation rate by repeating the trajectory analysis at the upper and lower ends of the 90 percent confidence interval for the snapshot storage v. installation rate.

8.2.2.5.4 Results with Confidence Intervals

Installation rates with 90% confidence intervals are shown in Table 55.

Table 55: Residential Installation Rates with Confidence Intervals

IOU	2008 Surviving Installation Rate			2008 Cumulative Installation Rate		
	Estimate	90% CI +/-	90% CI +/- %	Estimate	90% CI +/-	90% CI +/- %
PG&E	62%	4.9%	7.9%	67%	2.6%	3.8%
SCE	69%	2.2%	3.2%	77%	1.1%	1.4%
SDG&E	61%	3.3%	5.4%	67%	6.5%	9.7%
All IOUs	65%	4.1%	6.3%	71%	1.8%	2.5%

8.2.2.6 Hours of Use (HOU) and Peak Coincident Factor (CF)

8.2.2.6.1 Sampling

The residential HOU and peak CF estimates were based on metered data collected through the Residential Lighting Metering Study. This utilized a two-stage cluster sample. The first stage cluster was a random sample of homes within each IOU, stratified by region. The sample frame was an extract from each IOU's customer information system.

The second stage was a random sample of independently switched fixture groups within each sampled premise. A separate within-home sample was selected for CFL fixture groups (i.e., fixture groups that included at least one CFL) and non-CFL fixture groups.

8.2.2.6.2 Estimation Method

Annual average daily HOU and peak CF are determined for each logger by the analysis procedures described in Sections 2.2.2 and 8.5 (HOU) and Sections 2.2.3 and 8.6 (peak CF).

8.2.2.6.2.1 Direct Expansion

As noted, there are three levels of weighting/expansion:

1. Premise weight: for each premise stratum *k:*

N_k = number of premises in the frame

n_k = number of premises in the final sample

w_k = premise expansion weight, given by N_k/n_k

2. Fixture group weight: within each inventoried premise *j* in stratum *k*, for fixture groups of type *c* = 1 for CFL, 0 for non-CFL

M_{kjc} = number of fixture groups of type *c* in the premise

m_{kjc} = number of metered fixture groups of type *c*

$v_{kj\text{-}c}$ = M_{kjc}/m_{kkc} = fixture group expansion weight

v_{kjg} = $v_{kj\text{-}1}$ if fixture group g is a CFL group,
$v_{kj\text{-}0}$ if fixture group g is a non-CFL fixture group

3. Lamp weight: for each metered fixture group g in premise j in stratum k

q_{kjg1} = number of CFLs in the fixture group

q_{kjg0} = number of non-CFLs in the fixture group

q_{kjgT} = $q_{kj1} + q_{kj0}$ = total number of lamps in the fixture group
For non-CFL fixture groups g, q_{kjg1} is identically 0

For the direct expansion estimates, standard cluster sample expansion formulas are used to calculate averages for each subgroup, applying the appropriate weighting factors.

Average HOU for a particular premise subgroup G and lamp subgroup L is calculated as:

$$HOU_{GL} = [\sum_k w_k \sum_{j\varepsilon G} \sum_{g\varepsilon L} v_{kjg}\, q_{kjg}\, HOU_{kjg}] / [\sum_k w_k \sum_{j\varepsilon G} \sum_{g\varepsilon L} v_{kjg}\, q_{kjg}\,].$$

In this formula, the lamp weight q_{kjg} applied is the CFL, non-CFL, or total lamp weight, depending on which subset the average is being calculated over. An analogous formula applies for the peak CF average.

8.2.2.6.2.2 ANCOVA

The ANCOVA model is estimated without using weights. The model is then applied to each lamp in the inventory. Subgroup averages are calculated as the weighted average of the fitted model across the inventory subgroup. This procedure is equivalent to calculating the model value for a lamp that has the weighted average subgroup characteristics.

8.2.2.6.3 Confidence Interval Estimation Method

8.2.2.6.3.1 Direct Expansion

The estimation formula for HOU or peak CF is a standard expansion formula for a two-stage stratified cluster design. Confidence intervals were produced using corresponding formulas for this type of design, using PROC SURVEYMEANS in SAS.

8.2.2.6.3.2 ANCOVA Estimates

For the ANCOVA estimates the confidence interval for the model estimate at a particular average characteristics value is provided by the SAS estimation routine. To this modeling error we add the uncertainty in the fitted value due to uncertainty of the subgroup average. That is, we calculate the confidence interval bounds of an estimate $\hat{y}_{GL}$ = HOU_{GL} or CF_{GL} for a particular subgroup *G* and lamp type *L* as:

$$CI(\hat{y}_{GL}) = \hat{y}_{GL} \pm b_{GL}$$

$$b_{GL} = (b_{GLmodel}{}^2 + b_{GLx}{}^2)^{1/2}$$

where

$b_{GLmodel}$ = the confidence bound "$\pm$" terms provided from the ANCOVA estimation routine as if the average subgroup characteristics $x_{\_GL}$ were known.

b_{GLx} = the confidence bound "$\pm$" terms calculated by evaluating the ANCOVA model at the upper and lower limits of the confidence interval for the average subgroup characteristics $x_{\_GL}$

That is, the model-only confidence interval is:

$$CI(\hat{y}_{GL}|x_{\_GL}) = \hat{y}_{GL}|x_{\_GL} \pm b_{model}.$$

The uncertainty in *y* due to uncertainty in *x* is given by:

$$b_{GLx} = [(\hat{y}_{GL}|\ x^{+}_{GL}) - (\hat{y}_{GL}|\ x^{-}_{GL})]/2$$

and x^{+}_{GL} and x^{-}_{GL} respectively denote the upper and lower limits of the confidence interval for the subgroup average characteristics $x_{\_GL}$.

8.2.2.6.3.3 Annualization/Normalization Modeling Uncertainty

The logger HOU and peak CF values for which the averages are calculated are each derived by models from the logger data. This modeling step contributes another component of error to the calculated averages. However, this level of modeling error is "entrained" in the uncertainty calculations described above. That is, the (random component of the) logger-specific estimation error in HOU is captured in the calculated ANCOVA modeling error. It is not necessary to add another term to the confidence interval calculation to account for this component of error.

8.2.2.6.4 Results with Confidence Intervals

Confidence intervals for the final recommended HOU and peak CF estimates are shown in Table 56 and Table 57.

Table 56: Recommended Average Residential Daily HOU by IOU with Confidence Intervals

IOU	HOU	90% CI +/-	90% CI +/- %
PG&E	1.9	0.1	7.2%
SCE	1.9	0.2	8.4%
SDG&E	1.3	0.2	12.8%
All IOUs	1.8	0.1	5.0%

Table 57: Recommended Average Residential Peak CF Results by IOU with Confidence Intervals

IOU	Peak	90% CI +/-	90% CI +/- %
PG&E	6.4%	0.6%	8.7%
SCE	6.4%	0.6%	8.7%
SDG&E	6.4%	0.6%	8.7%
All IOUs	6.4%	0.6%	8.7%

8.2.2.7 Delta Watts

8.2.2.7.1 Sampling

The sample for the residential delta watts calculation was the inventory data collected through the Residential Lighting Metering Study. All relevant bulbs were observed in each inventoried home. As a result, for the delta watts calculation there was only one stage of sampling.

8.2.2.7.2 Estimation Method

Average delta watts for a (particular premise subgroup *G* and) lamp subgroup *L* is calculated as:

$$\Delta W_{GL} = [\sum_k w_k \sum_{j\varepsilon G} \sum_{g\varepsilon L} q_{kjg}\, \Delta W_{kjg}] \,/\, [\sum_k w_k \sum_{j\varepsilon G} \sum_{g\varepsilon L} q_{kjg}].$$

This calculation uses the entire inventory sample. The summation is over all (subgroup *G*) premises in the sample and all (subgroup *L*) fixture groups in each premise. For each premise there is no within-premise sampling error, only direct observation of all relevant lamps.

8.2.2.7.3 Confidence Interval Estimation Method

For each premise there is no within-premise sampling error, only direct observation of all relevant lamps. Thus, the calculation is treated as a direct expansion estimate using a single-stage stratified ratio estimator. The estimation routine provides appropriate confidence intervals for this structure.

8.2.2.7.4 Results with Confidence Intervals

Residential delta watts results are presented in Table 58 with 90% confidence intervals.

Table 58: Residential Delta Watts with Confidence Intervals

IOU	Delta Watts	90% CI +/-	90% CI +/- %
PG&E	44.3	0.6	1.3%
SCE	44.8	0.9	2.0%
SDG&E	44.4	1.1	2.4%
All IOUs	44.5	0.5	1.1%

8.2.2.8 Net-to-Gross (NTGR)

The final recommended NTGR estimates were derived from two primary sources: the supplier interviews and the revealed preference intercept surveys. Results from other methods provided valuable context and comparability, however, ultimately, were not used in determining the final NTGR estimates for the Upstream Lighting Program. The following discusses the confidence intervals developed for the supplier interviews and revealed preference intercept surveys.

8.2.2.8.1 Sampling

The sampling process for the supplier self-report NTGR analysis is identical to that described in Section 8.2.2.3 for the 2008 shipments v. sales analysis, since these analyses relied on the same survey.

The sample for the revealed preference intercept surveys was stratified by channel and IOU.

8.2.2.8.2 Estimation Method

We calculated the supplier self-report NTGR estimate at the retail channel level for each type of market actor. These ratios were based on the shipment-weighted averages of their component NTGR estimates.

The simple contrast revealed preference NTGR estimate is the ratio of two proportions calculated from two independent stratified samples.

The NTGR estimates derived from the stated preference purchaser elasticity models are calculated as described in Section 8.12.

The overall estimate for each IOU is the weighted sum of estimates for each channel, using the IOU's channel proportions as weights. For the final recommended NTGR estimate, the value used for a particular channel was one or a combination of the separate estimates.

8.2.2.8.3 Confidence Interval Estimation Method

For the retail store manager surveys, the confidence interval is calculated using the standard formula for a confidence interval for a mean calculated from a simple random sample. For the manufacturer and retail buyers interviews, there is no sampling-based confidence interval. These interviews were targeted at respondents who collectively accounted for the full market. The only error is non-response error.

Confidence intervals for the simple contrasts revealed preference NTGR estimates were calculated by combining the relative confidence intervals for the with- and without-program sales shares for the retail stores included in the sample. These confidence intervals are provided in Table 109.

Confidence intervals for the NTGR estimates derived from the stated preference purchaser elasticity model are calculated as described in Section 8.12.

For most channels, the final recommended NTGR estimates were calculated as the average ($NTGR_{avg}$) of the simple contrast revealed preference results ($NTGR_{SC}$) and the stated preference purchaser elasticity results ($NTGR_E$). Confidence bounds for these channels are calculated as

$$CI(NTGR_{avg}) = (NTGR_{SC} + NTGR_E)/2) = NTGR_{avg} + b_{avg}$$

where the absolute error b_{avg} for $NTGR_{avg}$ is calculated from the corresponding absolute errors for the simple contrast and elasticity NTGR estimates as

$$b_{avg} = [(b^2_{SC} + b^2_E)/4]^{1/2}.$$

For the discount and small grocery channels, the NTGR estimate was set at 0.90 based primarily on the information provided by manufacturers and retail lighting buyers. We treat these estimates as being without sampling error and assign a relative precision of 0 for these channels.

The confidence interval for the overall NTGR estimate is calculated for each IOU from the channel estimates $NTGR_c$ as

$$CI(NTGR) = NTGR \pm b$$

where

$$b = sqrt(\Sigma_c\, p_c^2\, b_c^2)$$

b_c = absolute error for channel c

p_c = fraction of shipments to channel c for that IOU.

8.2.2.8.4 Results with Confidence Intervals

Table 59 and Table 60 present the NTGR estimates derived from the retail store manager surveys completed as part of the impact and process evaluations, along with the corresponding 90% confidence intervals. Table 61 presents the NTGR results from the stated preference purchaser elasticity models, and Table 62 presents the NTGR results from the combined simple contrast revealed preference and stated preference purchaser models by channel. Finally, Table 63 provides the results for the final recommended NTGR estimates for each IOU.

Table 59: Retail Store Manager Self Report NTGR Estimates (Impact Evaluation Surveys) with Confidence Intervals

Channel	NTGR	90% +/-	90% +/- %
Discount	86%	16.7%	19.5%
Drug	23%	36.6%	158.5%
Grocery	72%	10.9%	15.2%
Hardware	37%	8.8%	23.9%
Home Improvement	63%	29.7%	47.1%
Mass Merchandise	33%	13.5%	40.4%
Membership Club	67%	21.3%	31.8%
All Channels	**54%**	**46.0%**	**85.0%**

Table 60: Retail Store Manager Self Report NTGR Estimates (Process Evaluation Surveys) with Confidence Intervals

Channel	NTGR	90% +/-	90% +/- %
Discount	60%	24.0%	39.8%
Drug	88%	11.1%	12.7%
Grocery	83%	9.7%	11.7%
Hardware	63%	13.8%	21.8%
Home Improvement	29%	22.7%	78.1%
Lighting	85%	23.7%	27.9%
Mass Merchandise	57%	9.7%	17.1%
Membership Club	57%	9.7%	17.1%
All Channels	**63%**	**7.0%**	**11.1%**

Table 61: Elasticity NTGR Estimates with Confidence Intervals

Channel	NTGR	90% CI +/-	90% CI +/- %
Discount	52%	16.0%	30.8%
Drug	31%	9.0%	29.0%
Grocery - chain	29%	15.0%	51.7%
Grocery - small	51%	21.0%	41.2%
Hardware	50%	7.0%	14.0%
Home Improvement	52%	8.0%	15.4%
Ltg & Electronics	n/a	n/a	n/a
Mass Merchandise	48%	5.0%	10.4%
Membership Club	32%	20.0%	62.5%
All Channels	41%	6.8%	16.6%

Table 62: Average of Simple Contrast and Elasticity NTGR Estimates with Confidence Intervals

Channel	Average NTGR	90% CI +/-	90% CI +/- %
Discount	n/a	n/a	n/a
Drug	32%	12.8%	40.1%
Grocery - chain	31%	14.2%	45.6%
Grocery - small	n/a	n/a	n/a
Hardware	35%	4.0%	11.5%
Home Improvement	36%	4.5%	12.4%
Ltg & Electronics	n/a	n/a	n/a
Mass Merchandise	41%	4.7%	11.5%
Membership Club	33%	10.8%	32.6%

Table 63: Final Recommended NTGR Estimates with Confidence Intervals

Channel	Final Recommended NTGR Estimates	90% CI +/-	90% CI +/- %
Discount	**90%**	0.0%	0.0%
Drug	**32%**	12.8%	40.1%
Grocery - chain	**31%**	14.2%	45.6%
Grocery - small	**90%**	0.0%	0.0%
Hardware	**35%**	4.0%	11.5%
Home Improvement	**36%**	4.5%	12.4%
Ltg & Electronics	**36%**	4.5%	12.4%
Mass Merchandise	**41%**	4.7%	11.5%
Membership Club	**33%**	10.8%	32.6%
All IOUs	**54%**	3.2%	5.9%
PG&E	**49%**	3.9%	8.0%
SCE	**64%**	2.6%	4.1%
SDG&E	**48%**	3.8%	7.9%

8.3 Invoice/Application Verification

8.3.1 Detailed Methods

The objective of this task was to verify the quantity of IOU-discounted products shipped by participating manufacturers to retailers. This was determined through the verification of a sample of program invoices/applications against information contained in program tracking databases.

We analyzed shipment trends by IOU in order to select the appropriate sample of invoices/applications. Total as well as average shipments were analyzed by distribution channel (e.g., discount, drug store, etc.) and by store type (e.g., chain v. independent). We allocated the sample by IOU based on the proportion of shipments by IOU, channel and store type and then made adjustments to ensure that we had at least two invoices/applications per channel and store type, as shown in Table 64. We ultimately verified 764 of the 800 invoices/applications sampled. This is because PG&E provided fewer invoices/applications than requested.

Table 64: Invoice/Application Verification Sample Design and Final Sample Size

	Percent of Total ULP Shipments (2006-2008)	Proportional Sample	Adjusted Sample	Final Sample
PG&E	56%	445	475	439
SCE	34%	269	224	224
SDG&E	10%	86	101	101
		800	800	764

For each invoice/application, we compared program tracking data to what was provided in either paper or electronic form. In addition to quantity of IOU-discounted products shipped, we attempted to verify the following key metrics:

- Manufacturer name
- Measure name
- Product type
- Retailer name and location
- Per unit rebate
- Total rebate paid
- Shipment and sales dates

We also documented the source of the information used to verify each metric. Different types of documents were determined to have different "quality" for verification purposes. For each of the metrics listed above, we assigned a quality score based on the type and source of documents received (Table 65).

Table 65: Quality Scores Assigned to Type/Source of Documentation

Document Type/Source	Description	Quality Score
Sales data	Print/scan of sales data report from retailer	1.00
Bill of lading/freight/shipping	Print/scan of shipping documentation generally included receipt signature on delivery	1.00
Equivalencies document	A form that lists product by model and quantities/weights per unit in shipping terms (e.g., one pallet = 20 cartons, each carton contains 100 units)	1.00
Manufacturer's invoice	Invoice from manufacturer to utility listing rebate to be paid for X units	0.90
Retailer invoice	Invoice from retailer to manufacturer listing number of units to be shipped (sometimes includes additional charge billed for units being shipped)	0.90
Retailer distribution list	An allocation list provided by retailer showing shipments to specific store locations	0.75
Utility shipment summary	Summary spreadsheet filled out by manufacturer	0.50
Miscellaneous utility-provided documentation	For example, a printout of a utility data input spreadsheet, an approved check request, etc.	0.25
None	No documentation provided	0.00

There were a few exceptions to these general scores:

- Manufacturer invoices received a 1.0 quality score when we were verifying manufacturer name
- Retailer invoices received a 1.0 quality score when we were verifying retailer name and location
- Manufacturer and/or retailer invoices received a 1.0 quality score when we were verifying product type
- Manufacturer invoices received a 1.0 quality score when were verifying rebate (per bulb) or total rebate

We recorded any discrepancies found between what was captured in the program tracking data and what was shown on the documentation. We also recorded whether or not sales data was provided, and whether or not the shipments were sent to a regional distribution center along with the location of these distribution centers.

A verification score was calculated for the following metrics: product type, quantity rebated, and retailer name/location. If product type and retailer name/location were both verified as complete/accurate, than the invoice/application received an initial score of 1.0, otherwise it was given a score of 0.0. This initial score was then multiplied by the percentage of claimed units that were verified (quantity adjustment) to produce the aggregate verification score for the invoice/applications. The adjustment for documentation quality was then applied to the verification score to produce the final verification rate.

8.3.2 Detailed Results

The results from the invoice/application verification assessment are shown in Table 66. Recall that an invoice was considered verified when both product and retailer name/location matched, and then the quantity adjustment was applied. Using this restrictive definition, the overall invoice verification rate was determined to be 91% without taking into account documentation quality (i.e., the type and/or source of the documentation provided by the IOUs). When documentation quality is taken into account, the overall invoice verification rate is reduced to 72%.

Table 66: Invoice Verification Results

Verification Metric	All IOUs		PGE		SCE		SDGE	
	raw	wt	raw	wt	raw	wt	raw	wt
Product	96%	90%	94%	85%	100%	98%	99%	96%
Quantity	97%	85%	96%	81%	99%	94%	96%	86%
Retailer Name and Address	91%	82%	85%	73%	99%	94%	99%	96%
Invoice Verification Rate*	91%	72%	85%	62%	99%	88%	94%	81%

* Invoice Verification Rate assumes an invoice to be verified when product, quantity and retailer name/location are all correct.

For comparative purposes, Table 67 shows the results when the simple average of the three metrics – product type, quantity and retailer name/location – is used to determine the overall invoice verification rate. As shown, the overall invoice verification rate is higher, at 95%, and the quality-weighted invoice verification rate is 86%.

Table 67: Invoice Verification Results – Simple Average

Verification Metric	All IOUs		PGE		SCE		SDGE	
	raw	wt	raw	wt	raw	wt	raw	wt
Product	96%	90%	94%	85%	100%	98%	99%	96%
Quantity	97%	85%	96%	81%	99%	94%	96%	86%
Retailer Name and Address	91%	82%	85%	73%	99%	94%	99%	96%
Invoice Verification Rate*	95%	86%	92%	80%	99%	95%	98%	93%

* Invoice Verification Rate assumes a simple average of the scores for the product, quantity and retailer name/location metrics.

PG&E results are lower than the other IOUs due to poorer quality record-keeping in general, in particular with respect to retailer name/location information not matching between the invoice/application documentation and the program tracking databases.

In addition, PG&E provided its retailer name/location information in a separate database that had to be matched/merged with product/quantity data contained in the “frozen” program tracking database. This process resulted in 55 invoices/applications dropping out from the verification process because the records were not contained in the retailer name/location database. As a result, these 55 invoices/applications could not be verified.

Also, there were 279 PG&E invoices/applications where the quantity information contained in both the retailer name/location database and the "frozen" program tracking database did not match. We attempted to investigate the reasons for these discrepancies but we were unsuccessful in detecting any patterns. As a result, the quantity information associated with these invoices/applications could not be verified.

SCE and SDG&E retailer name/location information was provided within the "frozen" program tracking database and, therefore, matched perfectly to their product/quantity data.

8.4 Residential Installation Rates

For the Upstream Lighting Program, the installation rate is defined as the proportion of lighting products rebated through the program that were installed by December 31, 2008. Several methods were used to determine installation rates, as described below.

8.4.1 Detailed Methods

The evaluation plan proposed to estimate a set of three inter-related models from the CFL User Survey data:

1. User type diffusion model. Shows the effect of the program over time moving customers from nonusers to partial users to committed users.
2. Purchase model. Relates purchases to current use and storage levels as well as program activity.
3. Installation model. Relates installations to current use and storage levels as well as program activity.

We did not obtain meaningful results for the attempted models. This is likely attributable to several reasons:

- Customers' descriptions of their use of CFLs were not always accurate.
- Program activity levels could not be directly mapped to purchase timing.
- The reported changes in numbers of CFLs in use within a given survey wave were inconsistent with the changes between waves in numbers reported to be currently in use.

See Volume 2 for a detailed discussion of the CFL User Survey methodology.

The approach we pursued instead combined some elements of the planned modeling with some simpler estimation steps. Essentially, we constructed a trajectory from the observed CFL use and storage rates in the 2004-2005 period to those observed in 2008 and 2009 through this evaluation. This trajectory accounts for the flow of CFLs shipped and purchased, as well as rates of installation and replacement. The analysis relies on several sources of data and attempts to reconcile and corroborate them.

The analysis is illustrated in Table 68. We first determine the average CFL purchases per home in each year. This starts with total program shipments, adjusts for bulbs shipped and not sold, and for the residential/nonresidential "split."

Applying the survey-based installation rates to each year's sales, we get the number of CFL installations during each year. From these installations we subtract the number of CFL burnouts to get net additions to the number in use per home for the year. The number purchased but not installed go into storage.

By this process, we build up the numbers in use and in storage for each year from 2005 through 2009. This calculation builds up to the 2008-09 numbers in use and in storage starting from the 2004-2005 estimates from the 2005 CLASS and the 2004-2005 evaluation[45], and adding units based on program volumes.

The resulting end point estimates compare reasonably well with the 2008-2009 estimates from the CFL User Survey and the verified lighting inventories from the Residential Lighting Metering Study, as shown in Table 69.

[45] Itron and KEMA, Inc., 2007.

Table 68: Illustration of Sales, Installation, and Storage Analysis

			Calculated Trajectory					
		2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
1	IOU-discounted CFLs shipped (million)	10.0	10.0	14.8	38.4	43.6	11.8	
		2004-2005 program data, divided by 2		*2006-2008 program data*			*2009 program data*	
2	Leakage rate	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	
		2008-2009 consumer intercepts						
3	Percent sold in following year	12%	12%	12%	12%	12%	12%	
		2009 upstream market actor research						
4	IOU-discounted CFLs sold (million)	8.6	9.8	13.9	34.6	41.9	15.3	
		shipped minus leakage minus current unsold plus prior unsold						
5	IOU-discounted CFLs acquired by residential	8.1	9.3	13.2	32.9	39.8	14.6	
		IOU-discounted CFLs sold x res/nonres split (based on 2008-2009 residential and						
6	Residential ratio of all CFL sales to IOU-discounted CFL sales	1.2	1.2	1.3	1.3	1.3	1.3	
		assumed smaller than 2008		*assumed same as 2008*		*2008-2009 consumer intercepts and 2008-2009 upstream market actor research*	*assumed same as 2008*	
7	Total CFLs acquired by residential customers	9.6	10.9	17.6	44.1	53.3	19.5	
		IOU-discounted CFLs sold to residential customers						
8	Installations replacing burnout/breakage		5.6	6.2	7.7	12.3	17.5	17.7
			number in use prior year / CFL measure life (6 years)					
9	Incremental acquisitions (net of burnout/breakage		5.3	11.4	36.4	41.0	2.0	
			acquisitions per home minus burnout/breakage replacement					
10	Net additions to number in use (million)		3.9	8.7	27.6	31.2	1.5	
			stored % of all in home x net additions					
11	Net additions to number stored (million)		1.4	2.7	8.7	9.8	0.5	
			stored % of all in home x net additions					
12	Total in storage at end of year (million)	10.6	12.0	14.7	23.4	33.3	33.8	
		#/home x # homes	*prior year storage + net additions*					
13	CFLs in permanent storage (will never be	0.3	0.4	0.4	0.7	1.0	1.0	
		(user's survey % never installed) x (total in storage)						
14	CFLs in active storage (will be installed over	10.3	11.6	14.3	22.7	32.3	32.8	
		total in storage minus permanent storage						
15	Total in use at end of year (million)	33.6	37.5	46.1	73.8	105.0	106.5	
		CLASS avg x # homes	*prior year in use + acquisitions - burnout/failure replacements*					
16	Incremental storage factor	24%	26%	24%	24%	24%	24%	
		assumed equal to 2008 snapshot storage rate					*assumed*	
17	Stored percent of all in home	24%	24%	24%	24%	24%	24%	
		# stored/ (# stored + # in use)						

Table 69: Comparison of 2008-2009 CFL Use and Storage Rates from Installation Analysis, CFL User Survey, and Residential Lighting Metering Study

			Calculated Trajectory							CFL User Surveys		Meter Sample Inventory	
		2004	2005	2006	2007	2008	2009	2010		2008	2009	2008	2009
18	Number of residential homes (million)	9.3	9.4	9.5	9.7	9.9	10.2						
		IOU records											
19	Average number of CFLs acquired/home	1.0	1.2	1.8	4.6	5.4	1.9			4.2	2.1		
		sales/home x installation rate											
20	Average number of CFLs in use/home at end	3.6	4.0	4.8	7.6	10.6	10.5			7.5	8.0	9.8	11.0
		CLASS	prior year in use + acquisitions/home - burnout/failure per home										
21	Number of CFL installations/home during		1.2	1.8	4.6	5.4	1.9						
			res acquisitions/#homes										
22	Average number of CFLs in storage/home at end of year	1.1	1.3	1.5	2.4	3.4	3.3			2.9	3.5	3.1	3.2
		(# in use) x (% stored) / (1-%stored)	*total in storage / # homes*										

The purchase, installation, and storage trajectory can be broken down by acquisition year, to map how many CFL acquired in a given year are stored and in use at any given time. This accounting is illustrated in Table 70.

Table 70: Illustration of Disposition Analysis by Year of Acquisition, All CFLs

Disposition		**2005**	**2006**	**2007**	**2008**	**2009**
pre-06 acquisitions in use		37.5	37.5	36.6	30.5	25.4
storage		11.6	5.4	-	-	-
06 acquisitions in use			8.7	9.5	14.5	12.1
06 acquisitions in active			8.9	6.6	-	-
07 acquisitions in use				27.6	28.7	34.4
07 acquisitions in active				16.2	10.4	-
08 acquisitions in use					31.2	33.0
08 acquisitions in active					21.8	14.8
Total 06-08 in use			8.7	37.2	74.5	79.5
Total 06-08 in active storage			8.9	22.7	32.3	14.8
Total 09 in use						2.0
Total 09 in active storage						17.5
Total in use		**37.5**	**46.1**	**73.8**	**105.0**	**106.9**
Total in active storage		**11.6**	**14.3**	**22.7**	**32.3**	**32.3**
Total in permanent		**0.3**	**0.4**	**0.4**	**0.7**	**1.0**
Total in storage		**11.9**	**14.6**	**23.2**	**33.0**	**33.3**
Total stored/in use		32%	32%	31%	31%	31%

Dividing the CFLs used and stored from each acquisition year by the ratio of total to program bulbs sold that year produces IOU-discounted CFL counts, as shown in Table 71.

Table 71: Illustration of Disposition Analysis by Year of Acquisition, IOU-Discounted CFLs Only

Acquisition Year / Disposition		2005	2006	2007	2008	2009
pre-06 acquisitions in use		37.5	37.5	36.6	30.5	25.4
pre-06 acquisitions in active storage		11.6	5.4	-	-	-
06 acquisitions in use			8.7	9.5	14.5	12.1
06 acquisitions in active storage			8.9	6.6	-	-
07 acquisitions in use				27.6	28.7	34.4
07 acquisitions in active storage				16.2	10.4	-
08 acquisitions in use					31.2	33.0
08 acquisitions in active storage					21.8	14.8
Total 06-08 in use			8.7	37.2	74.5	79.5
Total 06-08 in active storage			8.9	22.7	32.3	14.8
Total 09 in use						1.5
Total 09 in active storage						18.0
Total in use		**37.5**	**46.1**	**73.8**	**105.0**	**106.5**
Total in active storage		**11.6**	**14.3**	**22.7**	**32.3**	**32.8**
Total in permanent storage		**0.3**	**0.4**	**0.4**	**0.7**	**1.0**
Total in storage		**11.9**	**14.6**	**23.2**	**33.0**	**33.8**
Total stored/in use		32%	32%	31%	31%	32%

Note that in this example the majority of 2006 acquisitions initially go into storage, as pre-2006 bulbs in storage are first moved into use. By the end of 2010, there are no more 2006-2008 program bulbs in storage.

The numbers of IOU-discounted CFLs newly installed, in storage, and in use in each year can thus be mapped out as in Table 72. The table provides:

- the first-year installation rate for CFLs purchased in each program year,
- the cumulative installation rate, that is, the ratio of cumulative installations of IOU-discounted CFLs to cumulative purchases, and
- the surviving installation rate, or the fraction of all 2006-2008 residential purchases still in use.

In this example, the first-year installation rate is 49% in 2006, and increases to 82% in 2008, as the ratio of new acquisitions to CFLs in storage is higher. The cumulative installation rate is 71% in 2008, meaning that by the end of the program period 71% of the CFLs purchased had been installed. The final surviving installation rate, the proportion of IOU-discounted CFLs purchased that were in use at the end of 2008, was 65%. Almost all program bulbs are installed by the end of 2010. The 1% not installed by that time represents the CFLs that will never be installed.

Table 72: Illustration of Program Bulb Installation Trajectory

	Installation Year				
	2006	2007	2008	2009	2010
New installations of current year acquisitions	6.5	20.6	23.3		
New installations of all 06-08 program bulbs	6.5	22.4	32.4	13.1	11.0
CFLs acquired	13.2	32.9	39.8		
1st year installation rate	49%	63%	58%		
Cumulative program new installations	6.5	28.8	61.3	74.3	85.4
Cumulative program CFLs acquired	13.2	46.0	85.8	85.8	85.8
Cumulative installation rate	49%	63%	71%	87%	99%
06-08 pgm bulbs in use	6.5	27.7	55.6	59.4	60.5
Surviving installation rate	49%	60%	65%		

8.4.2 Detailed Results

8.4.2.1 Installations Within and Beyond 2006-2008

Tables 73 through 75 show the estimated acquisitions and installations by year for each of the IOUs. Cumulative installation rates by the end of 2008 (all bulbs ever installed as a fraction of all bulbs acquired by residential customers, excluding short-term removals) were 67%, 77%, and 67% for PG&E, SCE, and SDG&E, respectively. Surviving installation rates at the end of the program period were 62%, 69%, and 61%.

8.4.2.2 Installation Rates Based on the CFL Users Survey

The above analysis assumes that all bulbs acquired will be either installed or stored. A small fraction of users surveyed reported that they had given bulbs away or installed or stored them using them at other premises. Bulbs given away or placed in other homes within an IOU service territory are internal transfers that do not affect the disposition analysis.

Table 73: Estimated Acquisitions and Installations by Year, PG&E

	Installation Year				
(million bulbs)	2006	2007	2008	2009	2010
New installations of current year acquisiti	3.1	9.9	13.8		
New installations of all 06-08 program bu	3.1	9.9	18.4	6.8	7.0
Program CFLs acquired	6.7	16.5	23.6		
1st year installation rate 06-08 CFLs	47%	60%	59%		
Cumulative program new installations	3.1	13.1	31.4	38.3	45.3
Cumulative program CFLs acquired	6.7	23.2	46.8	46.8	46.8
Cumulative installation rate 06-08 CFLs	47%	56%	67%	82%	97%
06-08 pgm bulbs in use	3.1	12.5	28.8	30.9	32.7
Surviving	47%	54%	62%		

Table 74: Estimated Acquisitions and Installations by Year, SCE

	Installation Year				
(million bulbs)	2006	2007	2008	2009	2010
New installations of current year acquisiti	3.0	8.7	7.2		
New installations of all 06-08 program bu	3.0	10.2	10.9	4.9	2.0
Program CFLs acquired	5.5	13.0	12.6		
1st year installation rate 06-08 CFLs	55%	67%	57%		
Cumulative program new installations	3.0	13.2	24.1	29.0	31.0
Cumulative program CFLs acquired	5.5	18.5	31.1	31.1	31.1
Cumulative installation rate 06-08 CFLs	55%	71%	77%	93%	100%
06-08 pgm bulbs in use	3.0	12.7	21.5	22.8	21.0
Surviving	55%	68%	69%		

Table 75: Estimated Acquisitions and Installations by Year, SDG&E

	Installation Year				
(million bulbs)	2006	2007	2008	2009	2010
New installations of current year acquisiti	0.3	1.9	1.3		
New installations of all 06-08 program bu	0.3	1.9	2.2	1.0	1.1
Program CFLs acquired	0.8	3.1	2.6		
1st year installation rate 06-08 CFLs	34%	62%	51%		
Cumulative program new installations	0.3	2.2	4.4	5.4	6.5
Cumulative program CFLs acquired	0.8	3.9	6.5	6.5	6.5
Cumulative installation rate 06-08 CFLs	34%	56%	67%	83%	99%
06-08 pgm bulbs in use	0.3	2.2	4.0	4.3	4.7
Surviving	34%	55%	61%		

Table 76 shows the dispositions of CFLs purchased during 2006 to 2008 according to the CFL Users Survey.

The CFL User Survey respondents reported 68% of CFLs purchased over the past three years were currently installed. This self-reported number is in good agreement with the overall final surviving installation rate from the installation trajectory analysis.

Table 76: Disposition of CFLs Acquired 2006-2008 from Quarterly CFL User Surveys (June 2008 to September 2009)

Disposition	Percent
Installed	67.9%
Stored	26.0%
Burnouts	3.9%
Broken	0.6%
Rejected	1.3%
Left territory	0.3%
	100.0%

A little over 1% of bulbs were reported to have been installed but then removed (i.e., rejected). Less than half a percent are estimated to have left the service territory. The combined burnout, breakage, rejection and out of territory proportion is 6.1 percent over 3 years, or about 2 percent per year. The estimated loss rate in the installation analysis assuming a 6-year measure life is 1/6 of the bulbs in use per year, or 16% per year at steady state. We therefore assume that the loss rate in the installation analysis accounts for the additional losses associated with bulbs being removed prior to failure and bulbs leaving the territory after acquisition by residential customers.

An additional consideration is the potential for some bulbs in storage never to be installed. The reported time to install bulbs is indicated in Table 77.

Table 77: Reported Time Until Stored Bulbs Will Be Installed

When stored lamps will be installed	Percent	Cum %
Within the next month	6.4%	6.4%
Within the next three months	10.4%	16.8%
Within the next six months	20.4%	37.2%
Within the next year	20.1%	57.3%
More than one year from now	18.1%	75.5%
Never	2.7%	
Other	21.8%	

Over half the customers who had bulbs in storage said that they would install them within a year. Nearly 20% said they would install them in more than a year. While that response could be interpreted to mean no specific intent to install, it is also reasonable to expect that it could be more than a year before a CFL replacement is needed. Except for the few who indicated they would never install them, nearly all of the "other" responses indicated the stored bulbs would be installed as needed to replace burned out bulbs. Only 3% of customers surveyed indicated that their stored bulbs would never be installed. This has been accounted for in the analysis and results presented above.

8.5 Residential Hours of Use Estimates

Estimates of the annual hours-of-use for residential lighting were derived from the analysis of logger data collected through the Residential Lighting Metering Study. Nonresidential hours-of-use were determined as described in Section 3 and Appendix G of the Small Commercial Contract Group Evaluation Report.

8.5.1 Overview

Hours of Use (HOU) estimation consisted of the following steps:

1. Annualization. Annual average hours of use per day were estimated for each logger, by fitting a sinusoid curve to the daily hours of use data.
2. Weighting. Sample expansion weights were calculated for each metered home and each logger.
3. Analysis of Covariance (ANCOVA). A model was fit across the annualized loggers to calculate annual hours of use as a function of dwelling unit characteristics, room type, fixture type, lamp type, and IOU.
4. Projection to Full Inventory Sample. The estimated model was applied to each lamp observed in the full inventory of each metered home, providing an estimate of annual hours of use for each lamp in the inventory.
5. Calculation of averages. Applying the premise weights to the inventory estimates, average annual hours of use were calculated for CFLs and non-CFLs by various breakdowns, including IOU, room type, dwelling unit type, and heating/cooling type.

Each of these steps is described further below.

Annualization

Because each logger collected data for only a portion of the year, a procedure was required to annualize the logger data. Annualization allows the seasonality and level of use indicated by each logger to be applied to the full year, rather than having different logger samples represent different parts of the year

For each logger, a sinusoid model was fit, of the form:

$$H_d = \alpha + \beta\sin(\theta_d) + \varepsilon_d$$

Where

H_d = hours of use on day d

θ_d = angle for day d, where θ_d is 0 at the spring and fall equinox, $\pi/2$ d = December 21, and $-\pi/2$ for d = June 21,

α and β are coefficients determined by the regression

ε_d = residual error.

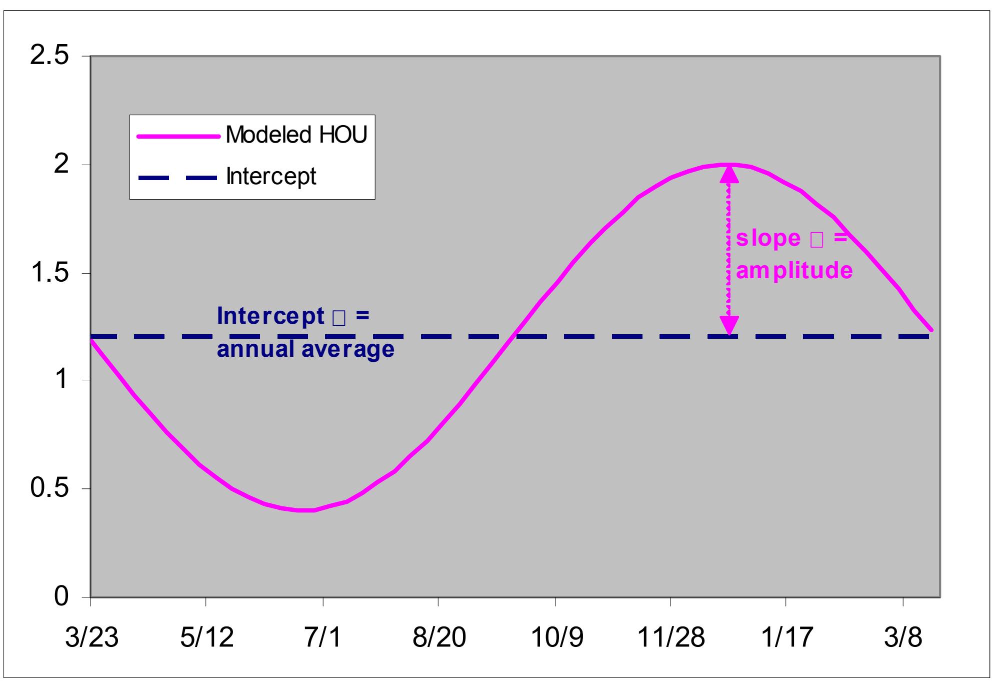
Fits that resulted in sine coefficients greater in magnitude than +10, or with standard error of the sine coefficient β greater than 1 were classified as "poor." For these cases, the average slope coefficient of "good fit" loggers (all that were not "poor") from the same room type was assigned. The intercept for each poor fit was set such that the average modeled value was equal to the observed average value over the period for which the logger had data. This approach ensured that the "level" information from the logger was included in the analysis sample, but treated the "slope" information as uninformative. Classification of fits as good or poor and transfer of average slopes from good fits to poor fits was conducted separately for weekdays and weekends.

The sinusoid shape is very close to the shape of hours of darkness, and gives very similar estimates (Figure 1). We worked with the sinusoid because it has some convenient features. In particular:

- The intercept of the weekday (weekend) model is the average weekday (weekend) use over the year.
- The slope of each daytype's model is the difference between use on the solstice (the days of maximum and minimum daylight) and the average use.

The average annual daily hours of use is calculated by averaging the weekday and weekend/holiday intercepts in proportion to the number of each daytype in the year.

Figure 1: Illustration of Sinusoidal Model



Weighting

8.5.1.1 Premise Weights

The original sample was stratified by regions, with essentially proportional sampling rates within each region. Basic premise sample expansion rates were calculated as the ratio of the number of accounts in the sampling frame in each region to the number of premises in the metering sample.

The basic premise weights were adjusted by iterative proportional fitting (IPF) or “raking,” so that the weighted proportions for each IOU aligned with the most recent statewide Residential Appliance Saturation Survey (RASS) data (2003). The raking adjusted the proportions by education, own/rent status, dwelling unit type, number of bathrooms (as a strong proxy for dwelling unit size) and income.

Some of the demographic variables required for the raking had missing values for some cases. Missing values for the raking variables were imputed by logistic regressions prior to raking.

The weighted distributions by each of these variables before and after the raking adjustment are shown in Table 78. The “pre-raking” distributions use the basic premise weights. The “post-raking” distributions use the adjusted weights.

Table 78: Weighted Distributions Before and After Raking to 2003 RASS

Demographic Segments		RASS 2003	Metering Study (pre-rake)	Metering Study (post-rake)
HH Income	<20,000	25%	16%	25%
	20-49,999	27%	26%	27%
	50-74,999	18%	17%	18%
	75-99,999	11%	16%	11%
	100,000+	18%	25%	18%
	All Households	100%	100%	100%
HH Education	< HS	12%	9%	12%
	HS degree	17%	12%	17%
	Some college/trade school	28%	27%	28%
	College degree/some grad	28%	31%	28%
	Graduate degree	16%	22%	16%
	Other	0%	0%	0%
	All Households	100%	100%	100%
Own v. Rent	Own	64%	70%	64%
	Rent	36%	30%	36%
	Other	0%	0%	0%
	All Households	100%	100%	100%
Dwelling Type	Single family	67%	74%	68%
	Multi-family	27%	24%	27%
	Mobile home	5%	2%	4%
	Other	1%	0%	0%
	All Households	100%	100%	100%
Household Composition	Have kids, no seniors	41%	31%	41%
	No kids, no seniors	36%	43%	36%
	No kids, have seniors	19%	23%	19%
	Have kids, have seniors	3%	3%	3%
	All Households	100%	100%	100.00%

8.5.1.2 Fixture Group Weights

Within each premise, fixture groups were divided into CFL (one or more CFL in the fixture group) and non-CFL (no CFLs in the fixture group). Meters were allocated separately to CFL and non-CFL fixture groups. For CFL (non-CFL) fixture groups, the fixture group expansion weight was calculated as the ratio of the total number of CFL (non-CFL) fixture groups in the premise to the number of metered CFL (non-CFL) fixture groups.

8.5.1.3 Lamp Weights

The lamp expansion weight for each fixture group was the number of lamps on the fixture group. Since non-CFL fixture groups could include both CFL and non-CFL lamps, three lamp expansion weights were assigned:

- CFL expansion weight = number of CFLs on the fixture group
- Non-CFL expansion weight = number of non-CFLs on the fixture group
- All lamps expansion weight = total number of lamps on the fixture group.

For calculation of averages involving CFLs only or non-CFLs only, the first two weights were used, respectively. For calculation of averages across all lamps regardless of type, the all lamps weights were used.

8.5.1.4 Overall Weights

To calculate averages of characteristics or quantities observed at the household level, such as total number of CFLs in use, the premise weights are applied directly. Likewise premise weights are applied directly to calculate totals or averages over information observed for all lamps in the inventory.

To calculate averages for information observed only for lamps in the metering sample, a combined weight is used. The combined weight is the product of the premise weight, the fixture group weight, and the lamp weight.

Direct Expansion of the Metered Sample

Estimates can be generated directly from the metering sample by taking weighted averages of the logger-specific metering sample results, using the overall weights. The direct expansion estimates provide precision at 90% confidence better than was projected by the original sample design, at the overall IOU and statewide level.

For some smaller subgroups, however, the direct expansion estimates have high variance because of small sample sizes with particular combinations of characteristics. An alternative estimate is provided by leveraging the entire onsite inventory sample, via an Analysis of Covariance (ANCOVA) model, as described below.

Leveraged Expansion of the Full Inventory Sample via Analysis of Covariance (ANCOVA)

The ANCOVA model provides the incremental effect of each dimension on hours of use. The model is estimated across all loggers in the sample, and also includes IOU as a model variable. This approach allows all the loggers to inform each IOU’s estimate, while still retaining the differences among the IOUs.

The ANCOVA model provides several benefits:

- It describes factors that affect lighting use.

- It provides more robust estimates for each small subgroup, compared to taking direct weighted average from the loggers that fall in that subgroup.
- It provides a basis for leveraging the full inventory sample, rather than calculating averages only from the metered loggers.
- It provides a basis for transferring estimates from this sample to other populations.

On the other hand, for estimates that do not involve taking small subsets of the data, the ANCOVA-based leveraged estimates tend to have higher variance than the direct expansion estimates using the metered loggers only.

ANCOVA Projection to Full Inventory Sample

The estimated ANCOVA model was applied to each lamp in the inventory to produce projected annual hours of use for each lamp. Use of the full inventory sample for calculating averages by subgroup allows the lamp distribution information from the full inventory to be used in these averages.

Leveraged Calculation of Averages

For the leveraged expansion, subgroup averages were calculated from the projected annual hours of use using the adjusted premise weights. Because all lamps at each premise were included in these averages, no fixture group or lamp weights were applied.

Whether or not a CFL was a model that received IOU discounts was determined only for the bulbs in the metering sample. To provide leveraged estimates by IOU-discounted versus non-IOU-discounted (program versus non-program) CFLs, we imputed program or non-program status for the remainder of the inventory. The imputation model was constructed from the metering sample.

8.5.2 Model Fitting and Findings

8.5.2.1 Annualization Models for Individual Loggers

The sinusoid model of daily hours of use fit well for most loggers. Table 79 shows the average coefficients and goodness of fits statistics for the individual logger regressions.

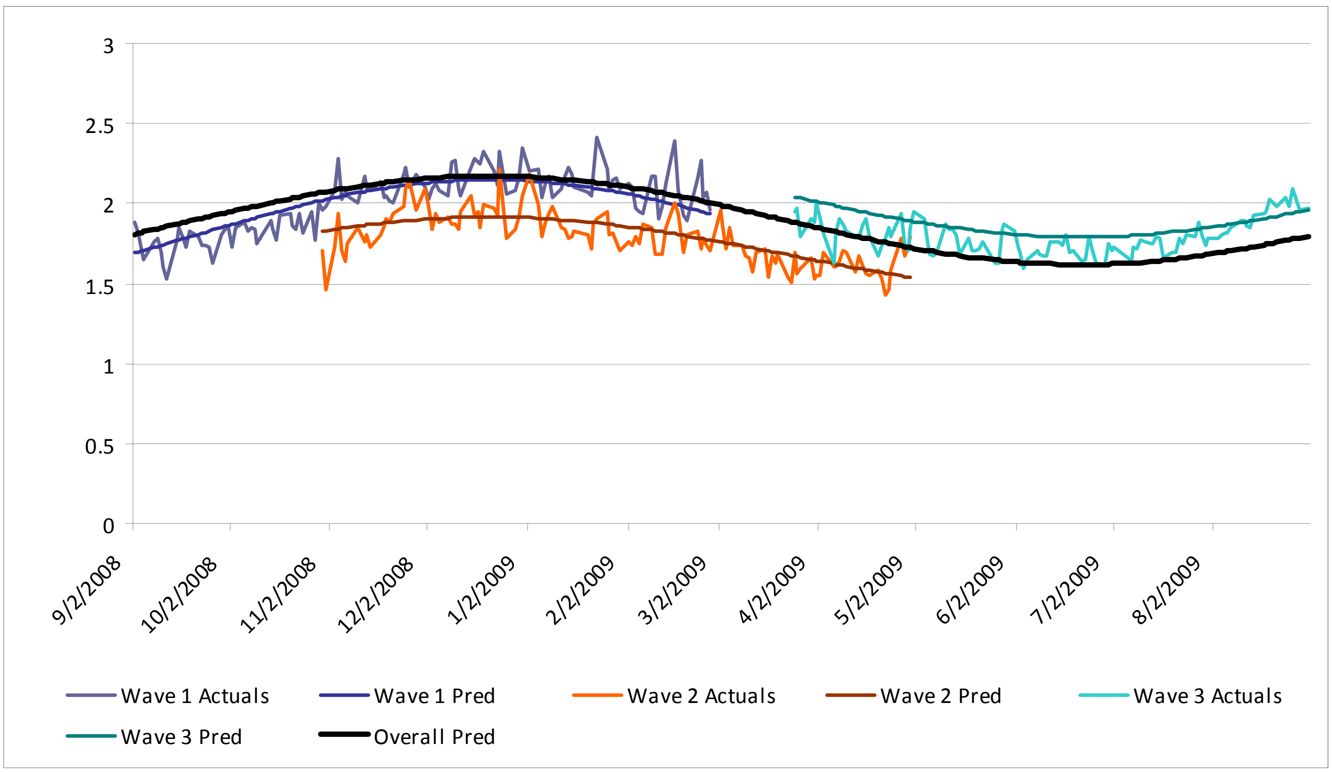
Figure 2 shows the average weekday sinusoid fits and average observed daily hours of use, by Wave and across all waves. The three waves had somewhat different average levels of use within a given season. These differences were not statistically significant; that is, they are attributable to random differences between Wave samples. Wave 2 was somewhat lower on average than Wave 1 or Wave 3 at the same time of year.

Also shown in the figure is the overall average sinusoid curve obtained by averaging the model coefficients across all loggers. The overall curve is somewhat lower in the summer than the Wave 3 data alone would indicate, because of the inclusion of the Wave 2 results in the average. Conversely, the winter average and resulting annual average hours of use are somewhat higher than would be indicated by Waves 1 and 2 alone, because of the inclusion of Wave 3 in the averages. That is, the overall curve, which determines the (weekday portion of) annual hours of use, is informed by the levels of all 3 waves, rather than relying only on the data from each month to represent that month.

Table 79: Individual Logger Sinusoid Model Summary

Wave	Daytype	Fit Quality	Number of Loggers	Variable						Average R2
				Intercept			Sine			
				Average Estimate	Average Error	Avarage t-statistic	Average Estimate	Average Error	Avarage t-statistic	
1	Weekday	Good	1,524	1.73	0.25	6.77	0.35	0.37	2.49	0.44
		Poor	42	2.33	1.48	4.41	2.87	2.22	5.47	0.58
	Weekend	Good	1,522	1.74	0.38	4.48	0.31	0.56	1.75	0.44
		Poor	44	3.2	2.47	3.12	1.71	3.49	4.01	0.62
2	Weekday	Good	1,546	1.6	0.29	7.65	0.23	0.38	2.41	0.43
		Poor	58	1.9	4.59	3.18	1.96	5.14	3.74	0.57
	Weekend	Good	1,548	1.6	0.4	4.88	0.26	0.53	1.68	0.43
		Poor	56	8.12	8.63	1.57	-5.17	9.68	2.64	0.56
3	Weekday	Good	2,924	1.89	0.58	657.13	0.26	0.71	1.5	0.42
		Poor	198	3.3	13.24	3.47	-0.52	13.76	3.64	0.56
	Weekend	Good	2,838	1.86	0.84	15.96	0.27	1.02	1.22	0.43
		Poor	284	0	11.72	2.14	-3.53	12.45	2.24	0.53

Figure 2: Average Observed and Modeled Daily Hours of Use, by Wave Non-holiday, Weekdays



Summer peak use (for direct expansion and for estimating the ANCOVA model that leverages the full inventory dataset) is based on Wave 3 data only. The figure gives the impression that the Wave 3 fit is high compared to the observed data. In response to that observation, we explored some alternate fits that would give a sharper dip in the summer season that might match the aggregate observed shape better. However, a range of alternate specifications using multiple sine terms and polynomial splines did not substantially improve the overall goodness of fit, nor the visual match between the aggregate curve and the aggregate data. We concluded that more complex models did not provide substantial improvement in fit compared to the simple sine fit, which offers analytic advantages.

The comparison of the average observed data and average curve fit is somewhat somewhat deceptive, because different loggers are included in the average observed value for each date, while the average fitted value is the average model across all loggers in each wave, for all dates in the wave. The average residuals are zero for each of the individual fitted curves. Comparisons of fitted and observed values by room type generally show good correspondence. In addition, the peak day dates range from July 9 to September 30. Over this range, the Wave 3 average fit is low compared to the average available observed data roughly as often as it is high.

Fundamentally, we had a choice between using a model that allows us to project reasonably from particular observed days to the CPUC-defined peak periods, or on the other hand relying only on the particular loggers available for particular dates (or the nearest weekdays to those particular dates). We believe the advantages of the modeling approach in providing systematic meaningful extrapolation from the particular observed values, and allowing the full Wave 3 sample to inform estimates for all dates of interest far outweigh the disadvantages in terms of slight model error.

By visual inspection, the Wave 3 sine fit appears to be about 5% too high at the summer solstice, and about 5 percent too low at the beginning of September. Taking a simple average across the summer period or from July through September would have a similar effect. Using metered data only from the particular dates for each climate zone's specified period would result in estimates varying substantially across climate zones in ways that reflect neither climate zone differences nor differences in dates, but are simply random day to day variation combined with differences in which loggers provided data on each date. Thus, on balance, we believe that the approach taken is superior, and provides estimates that are stable, meaningful, and reliable.

8.5.2.2 HOU ANCOVA Model

The HOU ANCOVA model was tested with variables that were likely to affect lighting usage or might be correlated with lighting use drivers. Final variables included in the model are listed and described in Table 80. ANCOVA results are shown in Table 81 and Table 82 below.

Additional variables tested that were found not to be statistically significant in the model included:

- Dwelling unit type
- Fixture type
- Heating system type
- Cooling system type

- Lamp type (e.g., twister/spiral, A-line, globe, reflector)
- IOU-discounted v. non-IOU discounted CFL

There are differences in average hours of use across these dimensions. However, these differences are accounted for by the other variables included in the model.

As anticipated, HOU declines with increasing CFL saturation. However, the general decline had a different pattern for very small numbers of CFLs in use: homes with 3 or 4 CFLs in use had much higher average use than those with 1 or 2 or with 5. These differences are captured by the categorical CFL count variable.

Even after accounting for all the other factors in the list, there were still statistically significant differences by IOU. These terms were therefore retained in the model.

Table 80: Variables Used in HOU ANCOVA

Variable	Description	Levels
CFL Saturation	Ratio of MSB CFLs and applicable MSB sockets.	Numeric
Number of Sockets	Total number of applicable sockets in the premise.	Numeric
Number of CFLs	Total number of CFLs in the household.	1-2
		3-4
		5+
IOU	Which utility serves the household.	PG&E
		SCE
		SDG&E
Own/Rent	Household is owned or rented.	Own
		Rent
Dwelling Type	Dwelling unit type.	Single Family
		Multifamily
		Mobile Home
Household Composition	Household has kids or no kids.	Kids
		No Kids
Number of Bedrooms	Number of bedrooms in the household.	1
		2-3
		4+
Number of Bathrooms	Number of bathrooms in the household.	1
		2
		3+
Education Level	Highest education level of the respondent.	Less than HS
		HS Graduate
		College
		Post Graduate
Room Type	Type of room or location in which the bulb was found.	Bedroom
		Bathroom
		Dining Room
		Garage
		Hall/Entrance
		Kitchen
		Living Room
		Other
		Office
		Exterior
Fixture Type	Type of fixture in which the bulb was found.	Ceiling
		Other

Table 81: HOU ANCOVA Model Dependent Variable = Annual Average Hours of Use per Day Analysis of Variance

Variable Name	***p*-value**
Intercept	<.0001
CFL Saturation	0.1362
Number of Sockets	<.0001
Number of CFLs	0.1921
IOU	0.0007
Household Composition	0.0026
Room Type	<.0001
Number of Bedrooms	0.0400
Number of Bathrooms	0.0012
Education Level	0.0317
Fixture Type	0.0090

Table 82: HOU ANCOVA Model Parameter Estimates

Variable Name	Level	Coefficient	Std Error	t-stat	*p*-value
Intercept		3.483	0.316	11.020	<.0001
CFL Saturation		-0.423	0.226	-1.870	0.062
Number of Sockets		-0.004	0.002	-2.030	0.042
Number of CFLs	1-2	0.001	0.272	0.000	0.997
Number of CFLs	3-4	0.301	0.172	1.750	0.080
Number of CFLs	5+				
IOU	PGE	0.212	0.139	1.520	0.128
IOU	SCE	0.494	0.139	3.560	0.000
IOU	SDGE				
Household Composition	Kids	0.325	0.107	3.040	0.002
Household Composition	No Kids				
Room Type	Bedroom	-2.191	0.191	-11.500	<.0001
Room Type	Bathroom	-2.304	0.203	-11.350	<.0001
Room Type	Dining Room	-1.854	0.335	-5.530	<.0001
Room Type	Garage	-1.752	0.375	-4.680	<.0001
Room Type	Hall/Entrance	-2.226	0.241	-9.240	<.0001
Room Type	Kitchen	-1.139	0.243	-4.700	<.0001
Room Type	Living Room	-1.459	0.202	-7.220	<.0001
Room Type	Other	-2.022	0.230	-8.800	<.0001
Room Type	Office	-2.133	0.289	-7.390	<.0001
Room Type	Exterior				
Number of Bedrooms	1	-0.878	0.241	-3.640	0.000
Number of Bedrooms	2-3	-0.320	0.140	-2.280	0.023
Number of Bedrooms	4+				
Number of Bathrooms	1	0.753	0.200	3.760	0.000
Number of Bathrooms	2	0.396	0.149	2.650	0.008
Number of Bathrooms	3+				
Education Level	Less than HS	-0.115	0.207	-0.550	0.579
Education Level	HS Graduate	0.429	0.183	2.340	0.019
Education Level	College	0.213	0.122	1.750	0.081
Education Level	Post Graduate				
Fixture Type	Ceiling	-0.297	0.114	-2.610	0.009
Fixture Type	Other				

8.5.3 Results Tables

Average daily hours of use (HOU) are shown in Table 83 by IOU overall, by lamp shape, and by program versus non-program bulbs. These estimates used direct expansion. A parallel table of estimates using leverage expansion via ANCOVA is given in Table 84. Additional ANCOVA results by various subgroups of interest are shown in Table 85.

For the overall HOU estimates by IOU, the direct expansion estimates have much better precision than the leveraged ANCOVA-based estimates. These are the recommended estimates.

To calculate total net savings, we separated HOU by IOU, CFL lamp style, and program versus non-program. For estimates at this level of disaggregation, we recommend use of the ANCOVA estimates.

For the overall HOU estimates by IOU, program-only as well as all program and non-program combined, the direct expansion estimates have much better precision than the leveraged ANCOVA-based estimates. The direct expansion estimates also have better precision for the twister/spiral-style and A-line style CFL product category (twister/A-line), which accounts for the bulk of the products rebated through the program. These are the recommended estimates at this level.

However, the leveraged ANCOVA-based estimates have better precision for the less common lamp shapes (e.g., globes, reflectors). The direct expansion estimates for these less common lamp shapes include wide swings across IOUs. The ANCOVA estimates smooth out the small-sample variation across IOUs and provide more robust estimates. The ANCOVA and direct expansion estimates for the twister/A-line style are almost the same, though the ANCOVA estimates have wider confidence intervals.

Table 83: Average Daily HOU Results by IOU, Lamp Shape, and Program/Non-Program Direct Expansion of Metered Sample

		IOU											
		PGE			SCE			SDGE			Overall		
		HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%
Program/ Nonprogram	Lamp Shape												
Nonprogram	Globe	2.4	0.9	38%	0.6	0.4	66%	0.4	0.2	45%	1.4	0.5	34%
	Other	1.9	0.3	14%	2.3	0.3	15%	1.7	0.4	25%	2.0	0.2	10%
	Reflector	3.3	1.3	40%	1.8	0.7	42%	2.9	1.2	41%	2.6	0.7	25%
	Twister/A-Line	1.6	0.1	8%	2.4	0.2	7%	1.7	0.2	11%	2.0	0.1	5%
	Overall	1.7	0.1	7%	2.3	0.1	7%	1.7	0.2	10%	2.0	0.1	4%
Program	Globe	1.2	0.5	42%	3.1	2	64%	0.7	0.4	58%	1.3	0.4	34%
	Other	0.9	0.7	78%	1.0	0.4	36%	0.9	0.5	55%	0.9	0.3	33%
	Reflector	1.4	0.7	52%	0.7	0.8	115%	1.2	0.4	32%	1.2	0.4	36%
	Twister/A-Line	2.0	0.1	7%	1.9	0.2	9%	1.4	0.2	14%	1.9	0.1	5%
	Overall	1.9	0.1	7%	1.9	0.2	8%	1.3	0.2	13%	1.8	0.1	5%
Overall	Globe	1.7	0.5	28%	1.1	0.6	58%	0.6	0.2	38%	1.3	0.3	24%
	Other	1.8	0.3	14%	2.1	0.3	15%	1.6	0.4	24%	1.9	0.2	10%
	Reflector	2.5	0.8	32%	1.4	0.5	39%	1.8	0.6	33%	2.0	0.4	21%
	Twister/A-Line	1.8	0.1	5%	2.2	0.1	6%	1.6	0.1	8%	2.0	0.1	4%
	Overall	1.8	0.1	5%	2.1	0.1	5%	1.5	0.1	8%	1.9	0.1	3%

Table 84: Average Daily HOU Results by IOU and Lamp Shape Leveraged ANCOVA Expansion of Inventory Sample

		IOU											
		PGE			SCE			SDGE			Overall		
		HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%
Program/ Nonprogram	Lamp Shape												
Nonprogram	Globe	1.4	0.3	24%	1.6	0.3	19%	1.5	0.4	25%	1.5	0.3	21%
	Other	1.7	0.3	18%	2.2	0.3	15%	1.5	0.3	22%	1.9	0.3	17%
	Reflector	1.7	0.5	31%	2.3	0.4	17%	1.5	0.5	35%	2.0	0.4	18%
	Twister/A-Line	1.9	0.3	16%	2.1	0.3	15%	1.6	0.3	20%	2.0	0.3	16%
	Overall	1.8	0.3	17%	2.1	0.3	15%	1.6	0.3	21%	1.9	0.3	16%
Program	Globe	1.5	0.3	21%	1.8	0.4	21%	1.2	0.4	31%	1.6	0.3	20%
	Other	1.8	0.4	20%	2.0	0.4	19%	1.5	0.5	31%	1.9	0.3	18%
	Reflector	1.7	0.4	26%	2.0	0.4	17%	1.3	0.4	31%	1.8	0.3	19%
	Twister/A-Line	1.8	0.3	17%	2.0	0.3	15%	1.5	0.3	21%	1.8	0.3	17%
	Overall	1.7	0.3	17%	2.0	0.3	15%	1.5	0.3	22%	1.8	0.3	17%
Overall	Globe	1.4	0.3	21%	1.7	0.3	18%	1.3	0.3	26%	1.5	0.3	20%
	Other	1.7	0.3	18%	2.2	0.3	15%	1.5	0.3	22%	1.9	0.3	17%
	Reflector	1.7	0.4	23%	2.2	0.3	16%	1.4	0.4	29%	1.9	0.3	17%
	Twister/A-Line	1.8	0.3	17%	2.1	0.3	15%	1.6	0.3	21%	1.9	0.3	16%
	Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Table 85: Average Residential Daily HOU Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

Estimated Hours of Use - Overall

IOU											
PGE			SCE			SDGE			Overall		
HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By ownrent

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Own/Rent	1.7	0.3	17%	2	0.3	15%	1.5	0.3	21%	1.8	0.3	17%
OWN												
RENT	1.9	0.3	16%	2.3	0.3	14%	1.6	0.3	20%	2.1	0.3	15%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By dwelling

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Dwelling Type	1.9	0.3	16%	2.2	0.3	14%	1.7	0.3	20%	2	0.3	15%
MF												
MH	1.8	0.3	18%	2.2	0.4	16%	1.6	0.4	25%	1.9	0.3	17%
SF	1.8	0.3	17%	2	0.3	15%	1.5	0.3	21%	1.8	0.3	17%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Table 85: Average Residential Daily HOU Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

Estimated Hours of Use - By composition

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Household Composition **KIDS**	1.9	0.3	16%	2.3	0.3	13%	1.6	0.3	21%	2	0.3	15%
NO KIDS	1.6	0.3	18%	1.9	0.3	16%	1.4	0.3	22%	1.7	0.3	18%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By educ

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Education **1 LESS THAN HS**	1.8	0.4	20%	2	0.3	17%	1.6	0.4	26%	1.9	0.3	19%
2 HS GRAD	2.2	0.3	15%	2.5	0.3	14%	1.8	0.4	21%	2.4	0.3	14%
3 COLLEGE	1.8	0.3	17%	2	0.3	14%	1.5	0.3	21%	1.8	0.3	16%
4 POST GRADUATE DEGREE	1.5	0.3	21%	1.8	0.3	17%	1.5	0.3	22%	1.6	0.3	19%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By bedrooms

Table 85: Average Residential Daily HOU Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Number of Bedrooms **1**	1.6	0.3	20%	2	0.3	16%	1.5	0.4	24%	1.8	0.3	18%
2 to 3	1.8	0.3	16%	2.1	0.3	14%	1.6	0.3	20%	1.9	0.3	15%
4+	1.7	0.3	18%	2	0.3	16%	1.5	0.3	22%	1.8	0.3	18%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By bathrooms

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Number of Bathrooms **1**	2.1	0.3	15%	2.5	0.3	13%	1.9	0.3	18%	2.2	0.3	14%
2	1.9	0.3	16%	2.1	0.3	14%	1.8	0.3	17%	2	0.3	15%
3+	1.4	0.3	22%	1.7	0.3	18%	1.3	0.3	26%	1.5	0.3	21%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By location

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Location	3.7	0.3	9%	4	0.3	8%	3.4	0.3	9%	3.8	0.3	8%

Table 85: Average Residential Daily HOU Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

Exterior												
Interior	1.6	0.3	19%	1.9	0.3	17%	1.3	0.3	24%	1.7	0.3	18%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By roomtype

	IOU											
	PGE			**SCE**			**SDGE**			**Overall**		
	HOU	**90% CI +/-**	**90% CI +/- %**	**HOU**	**90% CI +/-**	**90% CI +/- %**	**HOU**	**90% CI +/-**	**90% CI +/- %**	**HOU**	**90% CI +/-**	**90% CI +/- %**
Room Type	1.2	0.3	23%	1.5	0.3	19%	1	0.3	30%	1.3	0.3	22%
Bathroom												
Bedroom	1.4	0.3	20%	1.7	0.3	16%	1.2	0.3	25%	1.5	0.3	18%
Dining	1.6	0.4	27%	1.9	0.4	23%	1.5	0.5	32%	1.7	0.4	25%
Exterior	3.7	0.3	9%	4	0.3	8%	3.4	0.3	9%	3.8	0.3	8%
Garage	1.8	0.5	28%	1.9	0.5	27%	1.5	0.5	33%	1.8	0.5	28%
Hall	1.2	0.3	27%	1.5	0.3	21%	0.9	0.3	36%	1.3	0.3	25%
Kitchen	2.3	0.3	14%	2.6	0.3	12%	1.9	0.3	17%	2.4	0.3	13%
Living	2.2	0.3	13%	2.5	0.3	12%	2	0.3	15%	2.3	0.3	13%
Office	1.2	0.4	31%	1.6	0.4	25%	1.1	0.4	35%	1.3	0.4	29%
Other	1.4	0.3	22%	1.7	0.3	19%	1.1	0.3	29%	1.5	0.3	21%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By fixture

	IOU			
	PGE	**SCE**	**SDGE**	**Overall**

Table 85: Average Residential Daily HOU Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Fixture Type	1.5	0.3	20%	1.8	0.3	17%	1.3	0.3	26%	1.6	0.3	19%
Ceiling												
Other	2	0.3	14%	2.3	0.3	13%	1.8	0.3	17%	2.1	0.3	14%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By lampshape

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Lamp Shape	1.4	0.3	21%	1.7	0.3	18%	1.3	0.3	26%	1.5	0.3	20%
Globe												
Other	1.7	0.3	18%	2.1	0.3	15%	1.5	0.3	22%	1.9	0.3	17%
Reflector	1.7	0.4	23%	2.2	0.3	16%	1.4	0.4	29%	1.9	0.3	17%
Twister/A-Line	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By program

	IOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %	HOU	90% CI +/-	90% CI +/- %
Program/Non-program	1.8	0.3	17%	2.1	0.3	15%	1.6	0.3	21%	1.9	0.3	16%
Non-program												
Program	1.7	0.3	17%	2	0.3	15%	1.5	0.3	22%	1.8	0.3	17%

Table 85: Average Residential Daily HOU Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

Estimated Hours of Use - By
climateZone

	IOU											
	PGE			**SCE**			**SDGE**			**Overall**		
	HOU	**90% CI +/-**	**90% CI +/- %**	**HOU**	**90% CI +/-**	**90% CI +/- %**	**HOU**	**90% CI +/-**	**90% CI +/- %**	**HOU**	**90% CI +/-**	**90% CI +/- %**
Climate Zone												
1	1.9	0.3	17%							1.9	0.3	17%
2	1.9	0.3	16%							1.9	0.3	16%
3	1.8	0.3	18%							1.8	0.3	18%
4	1.6	0.3	19%							1.6	0.3	19%
5	1.6	0.3	19%							1.6	0.3	19%
6				1.9	0.3	16%	1.5	0.3	22%	1.9	0.3	17%
7							1.5	0.3	21%	1.5	0.3	21%
8				2.1	0.3	15%	1.2	0.3	28%	2	0.3	15%
9				2.1	0.3	14%				2.1	0.3	14%
10				2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%
11	2	0.3	15%							2	0.3	15%
12	1.7	0.3	18%							1.7	0.3	18%
13	1.9	0.3	16%	2.4	0.4	15%				2	0.3	16%
14				2.2	0.3	14%	1.6	0.4	22%	2.2	0.3	15%
15				2.1	0.3	14%				2.1	0.3	14%
16	1.4	0.4	27%	1.9	0.3	16%				1.8	0.3	18%
Overall	1.8	0.3	17%	2.1	0.3	15%	1.5	0.3	21%	1.9	0.3	16%

8.6 Peak Usage

Estimates of peak usage for residential lighting were derived from the analysis of logger data collected through the Residential Lighting Metering Study. Nonresidential hours-of-use were determined as described in Section 3 and Appendix G of the Small Commercial Contract Group Evaluation Report.

Modeling of residential peak use was similar to that for annual hours of use, and built on the HOU analysis. Only loggers with data during the summer peak hours were used for this analysis. Steps in the process were:

1. Coincidence Factor Calculation for each logger.
    a. Peak period fraction. For each logger, determine the fraction of daily use that falls during the peak hours 2:00 to 5:00 pm for peak weekdays.
    b. Daily Use. For each logger, use the sinusoid model from the HOU analysis to calculate the daily use for each of the three days that define the DEER 2008 peak day period, for each climate zone.
    c. Coincidence Factor. For each logger, calculate the coincidence factor or percent on at peak for each climate zone by multiplying the peak period fraction by the total hours of use for the three-day period, and dividing by nine hours.
2. Population Expansion. As for the HOU analysis, peak results are expanded to the full population by direct expansion, applying the adjusted expansion weights to the metering sample, as well as via ANCOVA modeling and leveraging of the full inventory sample. The leveraged expansion involves the same steps as for the HOU analysis.
    a. Analysis of Covariance (ANCOVA). A model was fit across the loggers to calculate percent on at peak as a function of dwelling unit characteristics, room type, fixture type, lamp type, and IOU, for each climate zone.
    b. ANCOVA Projection to Full Inventory Sample. For each lamp in the full inventory of each metered home, the ANCOVA peak model for that home's climate zone was applied, yielding an estimate of % on at peak for each lamp in the inventory.
    c. Leveraged calculation of averages. Applying the premise weights to the inventory estimates, % on at peak was calculated for CFLs by various breakdowns, including IOU, room type, dwelling unit type, and heating/cooling type.

8.6.1 Coincidence Factor Calculation

For each logger we calculated the average percent on during the climate-zone designated peak hours as follows. First, we calculated the "peak period fraction." This fraction is the proportion of daily use falling in the three-hour period between 2:00 and 5:00 pm, for each metered day. A plot of the average proportion versus time showed no seasonality. We therefore calculated the peak period fraction as the average of this proportion across all weekdays from July 9 (the earliest of the peak day dates by climate zone) through September 1. There are later peak day dates, but our Wave 3 sample size became sparse after this date.

Second, we used the weekday model from the HOU analysis to calculate the average daily use for the three peak days of the logger's climate zone. We then calculated the coincidence factor as:

CF = (Average daily use, hr/d) x (proportion between 2:00 and 5:00 pm) /(3 hrs)

That is we determined the average hours of runtime from 2:00 to 5:00 pm on peak days, then divided by three to get the average fraction of the time the lamp is running during the peak period.

For each lamp in the metering sample, we calculated the coincidence factor for each climate zone's peak day definition. That is, we calculated 16 coincidence factors for each logger, one for each climate zone's peak days.

8.6.2 Population Expansion

The coincidence factor was expanded to the population by similar procedures to those used for HOU. For direct expansion, we used the coincidence factor only for each logger's assigned climate zone. For leveraged expansion, we used all loggers in the metering sample to estimate an ANCOVA model specific to that climate zone. We fit a separate ANCOVA model across all loggers for each of the climate zone peak days. For each lamp in the inventory we then applied the ANCOVA model for that lamp's climate zone.

8.6.3 Coincidence Factor ANCOVA Model

The CF ANCOVA model was fit with the same variables used for the HOU model. Variable definitions are indicated below in Table 86. The CF ANCOVA results are shown in Table 86 and Table 87 below.

The same terms were included in the peak ANCOVA model as were used in the HOU model, though some of them were not statistically significant in the peak model. In particular, CFL saturation was not at all statistically significant for peak use. On the other hand, number of sockets was more strongly significant for peak use than for HOU.

Table 86: CF ANCOVA Model Dependent Variable = Coincidence Factor (Percent on during peak period) Analysis of Variance

Variable Name	*p*-value
Intercept	<.0001
CFL Saturation	0.0022
Number of Sockets	<.0001
Number of CFLs	<.0001
IOU	<.0001
Household Composition	0.0381
Room Type	<.0001
Number of Bedrooms	<.0001
Number of Bathrooms	0.0232
Education Level	0.0024
Fixture Type	0.3084

Table 87: CF ANCOVA Model Parameter Estimates

Variable Name	Level	Coefficient	Std Error	t-stat	*p*-value
Intercept		0.161	0.007	22.730	<.0001
CFL Saturation		-0.001	0.005	-0.260	0.796
Number of Sockets		-0.0003	0.000	-5.760	<.0001
Number of CFLs	1-2	0.010	0.006	1.590	0.112
Number of CFLs	3-4	0.023	0.004	5.510	<.0001
Number of CFLs	5+				
IOU	PGE	0.011	0.003	3.560	0.000
IOU	SCE	0.027	0.003	8.410	<.0001
IOU	SDGE				
Household Composition	Kids	-0.014	0.002	-5.850	<.0001
Household Composition	No Kids				
Room Type	Bedroom	-0.099	0.004	-22.460	<.0001
Room Type	Bathroom	-0.070	0.005	-15.040	<.0001
Room Type	Dining Room	-0.086	0.008	-11.110	<.0001
Room Type	Garage	-0.033	0.008	-3.890	<.0001
Room Type	Hall/Entrance	-0.096	0.005	-17.530	<.0001
Room Type	Kitchen	-0.072	0.006	-12.600	<.0001
Room Type	Living Room	-0.091	0.005	-19.220	<.0001
Room Type	Other	-0.088	0.005	-16.700	<.0001
Room Type	Office	-0.117	0.007	-16.930	<.0001
Room Type	Exterior				
Number of Bedrooms	1	-0.060	0.006	-10.050	<.0001
Number of Bedrooms	2-3	-0.029	0.003	-8.550	<.0001
Number of Bedrooms	4+				
Number of Bathrooms	1	0.012	0.005	2.640	0.008
Number of Bathrooms	2	0.006	0.004	1.600	0.111
Number of Bathrooms	3+				
Education Level	Less than HS	0.006	0.005	1.280	0.202
Education Level	HS Graduate	0.013	0.004	3.000	0.003
Education Level	College	-0.001	0.003	-0.400	0.688
Education Level	Post Graduate				
Fixture Type	Ceiling	-0.003	0.003	-1.020	0.308
Fixture Type	Other				

8.6.4 Results Tables

Coincidence Factors (CF) are shown in Table 88 by IOU overall, by lamp shape, and by program versus non-program bulbs. These estimates used direct expansion. A parallel table of estimates using leverage expansion via ANCOVA is given in Table 89. Additional results by various subgroups of interest are in shown in Table 90.

As was seen for HOU, for the overall CF estimates by IOU, program-only as well as all program and non-program combined, the direct expansion estimates have much better precision than the leveraged ANCOVA-based estimates. The direct expansion estimates also have better precision for the twister/A-line CFL style category, which accounts for the bulk of the products rebated through the program. These are the recommended estimates at this level.

The direct expansion estimates for less common CFL styles (e.g., globes, reflectors) again show wide swings across IOUs. For SCE and SDG&E, there are no direct expansion estimates of peak for IOU-discounted reflectors, because none occurred in the summer metering sample. The leveraged ANCOVA-based estimates have better precision for these less common CFL styles. The ANCOVA estimates smooth out the small-sample variation across IOUs and provide more robust estimates. The ANCOVA and direct expansion estimates for the twister/A-line style are similar, although the ANCOVA estimates have wider confidence intervals.

Table 88: Coincidence Factor Results by IOU, Lamp Shape, and Program/Non-Program Direct Expansion of Metered Sample

		IOU											
		PGE			SCE			SDGE			Overall		
		Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Program/ Nonprogram	Lamp Shape												
Nonprogram	Globe	1.3%	1.2%	87.6%	1.9%	3.5%	183.2%				1.4%	0.9%	64.7%
	Other	4.2%	2.0%	48.7%	5.0%	1.4%	28.6%	5.9%	2.8%	47.6%	4.8%	1.1%	22.9%
	Reflector	59.9%	33.8%	56.5%	6.0%						57.8%	28.7%	49.7%
	Twist or Aline	3.8%	1.0%	25.9%	10.1%	1.7%	17.3%	7.7%	2.1%	27.7%	7.1%	0.9%	13.1%
	Overall	5.7%	1.2%	22.0%	8.4%	1.3%	15.3%	7.3%	1.7%	23.7%	7.1%	0.8%	11.3%
Program	Globe	2.0%	2.4%	120.2%	13.9%	25.7%	184.5%	1.6%	1.6%	102.9%	3.2%	3.0%	95.2%
	Other	2.4%	3.6%	153.6%	0.5%	0.6%	117.8%	0.4%	0.5%	125.1%	1.5%	1.4%	90.5%
	Reflector	0.8%	0.7%	87.0%	0.0%						0.8%	0.6%	80.2%
	Twist or Aline	6.6%	1.3%	19.0%	6.4%	1.5%	23.6%	3.4%	1.5%	44.4%	6.2%	0.9%	13.7%
	Overall	5.8%	1.1%	19.2%	6.3%	1.4%	23.0%	3.0%	1.3%	43.9%	5.6%	0.8%	13.7%
Overall	Globe	1.8%	1.7%	94.7%	10.5%	14.5%	137.2%	1.6%	1.6%	102.9%	2.8%	2.3%	82.2%
	Other	3.8%	1.8%	46.8%	4.6%	1.3%	28.4%	5.1%	2.5%	48.4%	4.3%	1.0%	22.7%
	Reflector	34.6%	18.7%	53.9%	3.8%	5.4%	142.6%				33.5%	16.6%	49.5%
	Twist or Aline	5.4%	0.8%	15.3%	8.3%	1.2%	14.1%	5.8%	1.3%	23.0%	6.6%	0.6%	9.5%
	Overall	5.7%	0.8%	14.6%	7.5%	1.0%	12.8%	5.4%	1.1%	20.9%	6.4%	0.6%	8.7%

Table 89: Coincidence Factor Results by IOU, Lamp Shape, and Program/Non-Program Leveraged ANCOVA Expansion of Inventory Sample

		IOU											
		PGE			SCE			SDGE			Overall		
		Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Program/ Nonprogram	Lamp Shape												
Nonprogram	Globe	5.8%	2.9%	48.8%	7.1%	2.8%	39.2%	6.0%	3.1%	51.1%	6.4%	2.8%	43.5%
	Other	5.7%	2.9%	50.0%	7.9%	2.9%	37.1%	4.5%	3.0%	67.2%	6.4%	2.9%	45.0%
	Reflector	6.5%	3.5%	54.8%	8.6%	2.9%	34.2%	3.5%	3.7%	106.2%	7.2%	3.0%	41.5%
	Twist or Aline	6.0%	2.9%	47.8%	7.4%	2.9%	38.7%	4.6%	2.9%	63.7%	6.5%	2.9%	44.0%
	Overall	5.9%	2.8%	48.4%	7.5%	2.9%	38.1%	4.6%	3.0%	64.7%	6.5%	2.9%	44.2%
Program	Globe	5.9%	2.8%	47.3%	7.8%	3.0%	38.7%	4.2%	3.0%	70.5%	6.2%	2.8%	44.8%
	Other	6.3%	2.9%	47.1%	8.3%	3.2%	38.9%	4.6%	3.5%	76.0%	7.0%	3.0%	43.4%
	Reflector	6.5%	3.3%	50.6%	6.8%	2.9%	42.2%	3.0%	3.4%	112.5%	6.0%	3.0%	49.6%
	Twist or Aline	5.2%	2.8%	53.9%	6.9%	2.8%	40.9%	4.1%	2.9%	71.6%	5.7%	2.8%	49.3%
	Overall	5.3%	2.8%	53.1%	7.0%	2.8%	40.6%	4.1%	2.9%	72.4%	5.8%	2.8%	48.8%
Overall	Globe	5.9%	2.8%	47.4%	7.4%	2.8%	38.0%	5.0%	2.9%	58.4%	6.3%	2.8%	43.7%
	Other	5.7%	2.9%	49.6%	7.9%	2.9%	37.1%	4.5%	3.0%	67.2%	6.5%	2.9%	44.9%
	Reflector	6.5%	3.2%	48.6%	7.6%	2.8%	37.3%	3.2%	3.3%	103.9%	6.5%	2.9%	45.0%
	Twist or Aline	5.6%	2.8%	51.0%	7.2%	2.8%	39.6%	4.4%	2.9%	67.1%	6.1%	2.8%	46.5%
	Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Table 90: Average Residential Peak CF Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

Estimated Peak Use - Overall

IOU											
PGE			SCE			SDGE			Overall		
Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By ownrent

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Own/Rent OWN	5.6%	2.8%	49.9%	7.2%	2.8%	38.8%	4.4%	2.9%	66.1%	6.2%	2.8%	45.5%
RENT	5.6%	3.0%	52.3%	7.6%	3.0%	39.6%	4.3%	3.1%	71.3%	6.3%	3.0%	47.6%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By dwelling

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Dwelling Type MF	5.4%	2.9%	53.2%	7.0%	3.0%	42.5%	4.4%	3.1%	69.2%	6.0%	2.9%	48.5%
MH	6.8%	3.0%	44.0%	7.4%	2.9%	39.3%	5.6%	2.7%	48.4%	6.9%	2.9%	42.2%
SF	5.6%	2.8%	50.6%	7.4%	2.8%	38.2%	4.3%	2.9%	67.6%	6.2%	2.8%	45.7%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Table 90: Average Residential Peak CF Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

Estimated Peak Use - By composition

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Household Composition												
KIDS	5.3%	2.9%	53.4%	6.9%	2.9%	41.6%	4.1%	3.0%	73.2%	5.8%	2.9%	49.5%
NO KIDS	5.9%	2.8%	47.8%	7.7%	2.8%	36.9%	4.7%	2.9%	61.1%	6.6%	2.8%	43.1%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By educ

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Education												
1 LESS THAN HS	6.6%	3.3%	50.6%	7.6%	3.3%	44.0%	4.2%	3.8%	90.3%	6.9%	3.3%	48.6%
2 HS GRAD	7.7%	3.1%	40.3%	9.2%	3.1%	33.4%	6.4%	3.4%	52.5%	8.4%	3.1%	36.6%
3 COLLEGE	5.3%	2.7%	51.2%	6.6%	2.7%	41.0%	4.1%	2.9%	69.4%	5.6%	2.7%	48.3%
4 POST GRADUATE DEGREE	4.8%	2.9%	60.0%	7.2%	2.8%	38.9%	4.5%	3.0%	66.3%	5.9%	2.9%	48.7%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By bedrooms

Table 90: Average Residential Peak CF Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Number of Bedrooms	4.1%	3.3%	79.5%	6.1%	3.3%	54.6%	3.5%	3.5%	101.3%	5.0%	3.3%	66.2%
1												
2 to 3	5.3%	2.7%	51.5%	6.9%	2.8%	40.4%	4.1%	2.9%	69.7%	5.9%	2.8%	47.1%
4+	6.3%	2.9%	45.9%	8.5%	2.9%	34.0%	4.9%	3.0%	61.8%	7.0%	2.9%	41.7%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By bathrooms

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Number of Bathrooms	5.8%	2.9%	50.8%	7.5%	3.0%	40.2%	4.6%	3.2%	70.4%	6.4%	3.0%	46.6%
1												
2	6.0%	2.8%	46.8%	7.1%	2.8%	38.7%	4.9%	2.8%	57.3%	6.4%	2.8%	43.6%
3+	5.0%	2.8%	56.5%	7.4%	2.9%	38.5%	4.0%	3.0%	74.7%	5.8%	2.9%	49.0%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By location

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Location	13.5%	2.9%	21.6%	15.4%	2.9%	18.7%	12.2%	2.9%	24.0%	14.1%	2.9%	20.5%

Table 90: Average Residential Peak CF Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

Exterior												
Interior	4.7%	2.8%	60.1%	6.4%	2.8%	44.5%	3.5%	3.0%	85.4%	5.3%	2.8%	53.9%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By roomtype

	IOU											
	PGE			**SCE**			**SDGE**			**Overall**		
	Peak	**90% CI +/-**	**90% CI +/-%**	**Peak**	**90% CI +/-**	**90% CI +/-%**	**Peak**	**90% CI +/-**	**90% CI +/-%**	**Peak**	**90% CI +/-**	**90% CI +/-%**
Room Type	6.2%	2.6%	42.5%	7.8%	2.7%	34.0%	4.8%	2.8%	57.1%	6.7%	2.7%	39.5%
Bathroom												
Bedroom	3.5%	2.5%	72.5%	5.1%	2.5%	49.0%	2.3%	2.6%	113.7%	4.0%	2.5%	62.8%
Dining	4.9%	4.0%	81.6%	6.3%	3.9%	62.7%	3.7%	4.2%	114.3%	5.5%	4.0%	72.5%
Exterior	13.5%	2.9%	21.6%	15.4%	2.9%	18.7%	12.2%	2.9%	24.0%	14.1%	2.9%	20.5%
Garage	10.2%	4.5%	43.8%	12.1%	4.4%	36.7%	9.0%	4.4%	48.9%	10.9%	4.4%	40.6%
Hall	3.7%	2.8%	77.8%	5.3%	2.8%	53.4%	2.4%	3.0%	124.1%	4.2%	2.8%	67.3%
Kitchen	5.8%	2.9%	49.4%	7.7%	2.9%	38.1%	4.2%	3.0%	70.2%	6.4%	2.9%	45.0%
Living	4.5%	2.7%	60.6%	5.9%	2.7%	45.8%	3.3%	2.8%	86.1%	4.9%	2.7%	54.6%
Office	1.3%	3.7%	277.2%	3.2%	3.6%	114.7%	0.2%	3.7%	2123.0%	1.9%	3.7%	193.8%
Other	4.5%	2.9%	64.5%	6.0%	2.8%	47.6%	2.9%	3.0%	102.2%	4.9%	2.9%	58.7%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By fixture

	IOU			
	PGE	**SCE**	**SDGE**	**Overall**

Table 90: Average Residential Peak CF Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Fixture Type	4.7%	2.9%	61.6%	6.5%	3.0%	45.5%	3.6%	3.0%	85.1%	5.3%	2.9%	55.2%
Ceiling												
Other	6.6%	2.8%	41.7%	8.2%	2.7%	33.6%	5.3%	2.9%	54.3%	7.1%	2.8%	38.7%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By lampshape

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Lamp Shape	5.9%	2.8%	47.4%	7.4%	2.8%	38.0%	5.0%	2.9%	58.4%	6.3%	2.8%	43.7%
G												
O	5.7%	2.9%	49.6%	7.9%	2.9%	37.1%	4.5%	3.0%	67.2%	6.5%	2.9%	44.9%
R	6.5%	3.2%	48.6%	7.6%	2.8%	37.3%	3.2%	3.3%	103.9%	6.5%	2.9%	45.0%
T/A	5.6%	2.8%	51.0%	7.2%	2.8%	39.6%	4.4%	2.9%	67.1%	6.1%	2.8%	46.5%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By program

	IOU											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Program/Non-program	5.9%	2.8%	48.4%	7.5%	2.9%	38.1%	4.6%	3.0%	64.7%	6.5%	2.9%	44.2%
Non-program												
Program	5.3%	2.8%	53.1%	7.0%	2.8%	40.6%	4.1%	2.9%	72.4%	5.8%	2.8%	48.8%

Table 90: Average Residential Peak CF Results by IOU and Segments of Interest Leveraged ANCOVA Expansion of Inventory Sample

Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

Estimated Peak Use - By climateZone

	IOU											
	PGE			**SCE**			**SDGE**			**Overall**		
	Peak	**90% CI +/-**	**90% CI +/-%**	**Peak**	**90% CI +/-**	**90% CI +/-%**	**Peak**	**90% CI +/-**	**90% CI +/-%**	**Peak**	**90% CI +/-**	**90% CI +/-%**
Climate Zone	5.1%	2.8%	54.7%							5.1%	2.8%	54.7%
1												
2	5.5%	2.7%	50.0%							5.5%	2.7%	50.0%
3	5.2%	2.9%	54.5%							5.2%	2.9%	54.5%
4	5.1%	2.8%	55.6%							5.1%	2.8%	55.6%
5	5.1%	2.6%	51.5%							5.1%	2.6%	51.5%
6				6.9%	2.9%	41.9%	3.6%	3.0%	83.8%	6.5%	2.9%	44.9%
7							4.8%	3.0%	62.1%	4.8%	3.0%	62.1%
8				7.1%	2.8%	40.1%	1.8%	3.0%	168.1%	7.0%	2.8%	40.6%
9				7.3%	2.8%	39.2%				7.3%	2.8%	39.2%
10				7.3%	2.8%	39.0%	4.0%	2.9%	73.1%	6.5%	2.9%	43.6%
11	6.1%	2.8%	45.6%							6.1%	2.8%	45.6%
12	5.5%	2.8%	51.1%							5.5%	2.8%	51.1%
13	6.5%	2.9%	45.0%	8.7%	3.1%	35.9%				6.7%	2.9%	43.7%
14				8.3%	2.9%	34.7%	4.7%	3.0%	63.7%	8.1%	2.9%	35.5%
15				7.9%	2.6%	32.8%				7.9%	2.6%	32.8%
16	6.0%	3.3%	55.8%	7.3%	2.8%	37.9%				7.0%	2.9%	40.7%
Overall	5.6%	2.8%	50.4%	7.3%	2.8%	38.9%	4.4%	2.9%	67.3%	6.2%	2.8%	46.0%

8.7 Delta watts

Residential-sector estimates of the wattage of bulbs/fixtures replaced by rebated products were derived from the analysis of lighting inventory data collected as part of the Residential Lighting Metering Study. Nonresidential estimates were determined as described in Section 3 and Appendix C of the Small Commercial Contract Group Evaluation Report.

Given the upstream nature of the program, there was no reliable method for collecting wattage data for lighting products replaced by the rebated measures. Instead, we relied on the residential lighting inventory data and the nonresidential site visits as bases for estimating delta watts:

- Base case wattage:
    - For residential CFLs, we calculated the average wattage of non-CFL equivalents by lamp shape and room type. We then averaged the room-type non-CFL wattages, weighting by the room-type distribution of CFLs of that shape[46].
    - For nonresidential CFLs, self-report data was collected onsite to estimate the wattage of pre-existing equipment. Pre-existing wattages were estimated using regression techniques for various post-retrofit wattage categories. [47] Pre-existing wattages were estimated to be 62.8 watts for PG&E, 57.3 watts for SCE, and 63.0 watts for SDG&E.
    - The wattage of base case fixtures was estimated for each of the applicable fixture categories rebated through the program (taking into account room type and fixture type). The base case for fixtures was assumed to be the same for both residential and nonresidential applications since the types of fixtures rebated implied a similar relationship between base case and installed wattage/application.
- Installed wattage:
    - For CFLs, we computed the population-weighted average wattage for IOU-discounted CFLs observed onsite. This approach was consistent for both residential and nonresidential CFLs. It should be noted that this produced much lower installed CFL wattages than what was indicated in the program tracking data, as shown in Table 91. Unfortunately, we cannot explain the difference between the observed IOU-discounted CFL average wattage and the program tracking data average. The delta watts calculation

[46] For example, for each rebated CFL product type, the average wattage of corresponding non-CFLs was weighted by the distribution across room types for that particular CFL product type or lamp shape. For example, MSB incandescent A-line shaped lamps were weighted by the room type distribution of observed MSB twister/a-line shaped CFLs, and MSB incandescent globes were weighted by the room type distribution of observed MSB CFL globes.

[47] See Section 3 and Appendix C of Itron's Small Commercial Contract Group Evaluation Report.

was based on the average wattage of IOU-discounted CFLs that was observed and verified onsite.

Table 91: Comparison of Average IOU-Discounted CFL Wattages: Program Tracking Data v. Onsite Verification

	Program Tracking Average CFL Wattage	Residential IOU-Discounted Observed Average CFL Wattage	Nonresidential IOU-Discounted Observed Average CFL Wattage
All IOUs	19.1	18.1	na
PG&E	18.2	18.0	18.2
SCE	20.4	18.0	15.4
SDG&E	19.2	19.1	17.9

Table 92 presents the delta watts results for residential CFLs. This table compares the base case wattage (e.g., “MSB Incand (installed)”) to the observed, installed IOU-discounted CFL wattage (e.g., “MSB CFL (pgm installed)”). These are the values highlighted in yellow, along with the resulting delta watts results. Also shown for comparative purposes is the average shipment-weighted average CFL wattage for each product category.

- For fixtures, we computed the shipment-weighted average wattage for since data was not collected onsite for either residential or nonresidential IOU-discounted fixtures.

Table 92: Comparison of Base Case, Installed and Rebated CFL Wattages for Residential Delta Watts Calculations

	All IOUs				PG&E				SCE				SDG&E			
	n [1]	AvgW	ΔW	Ratio	n [1]	AvgW	ΔW	Ratio	n [1]	AvgW	ΔW	Ratio	n [1]	AvgW	ΔW	Ratio
MSB Incand (installed)	191,595,884	61.7			83,534,735	61.7			81,062,920	61.8			26,998,229	61.3		
MSB CFL (pgm installed)	39,574,351	17.2	44.5	3.6	20,946,666	17.4	44.3	3.6	14,549,134	16.9	44.8	3.6	4,078,551	16.9	44.4	3.6
MSB CFL (rebated)	93,467,809	19.1	42.6	3.2	50,571,147	18.2	43.5	3.4	35,284,858	20.4	41.4	3.0	7,611,804	19.2	42.2	3.2
MSB Incand A-line (installed)	118,291,709	65.1			53,249,637	64.9			49,849,621	64.9			15,192,452	66.3		
MSB CFL Twister/A-line (pgm installed)	36,545,682	17.4	47.7	3.7	19,438,487	17.7	47.2	3.7	13,430,980	17.1	47.8	3.8	3,676,214	17.4	48.9	3.8
MSB CFL Twister/A-line (rebated)	86,787,285	19.5	45.6	3.3	46,113,157	18.7	46.2	3.5	33,714,983	20.6	44.3	3.1	6,959,145	19.6	46.7	3.4
MSB Incand Globe (installed)	25,402,707	44.8			10,772,917	44.5			10,212,966	45.7			4,416,824	43.5		
MSB CFL Globe (pgm installed)	1,665,307	10.7	34.2	4.2	1,048,129	11.2	33.3	4.0	420,192	10.4	35.4	4.4	196,986	8.7	34.8	5.0
MSB CFL Globe (rebated)	3,632,310	9.7	35.1	4.6	2,805,847	9.8	34.7	4.5	549,293	8.0	37.7	5.7	277,168	12.0	31.5	3.6
MSB Incand Reflector (installed)	33,794,295	70.0			13,672,690	70.3			14,725,279	70.0			5,396,327	69.4		
MSB Halogen Reflector (installed)	12,063,251	73.1			6,629,546	70.1			3,784,328	79.6			1,649,377	70.4		
MSB CFL Reflector (pgm installed)	1,119,598	17.3	52.7	4.0	337,723	17.2	53.1	4.1	585,460	17.7	52.3	4.0	196,415	16.5	52.9	4.2
MSB CFL Reflector (rebated)	3,044,134	18.2	51.8	3.8	1,651,220	18.5	51.9	3.8	1,017,389	18.3	51.7	3.8	375,491	16.8	52.6	4.1

[1] n (incand or halogen installed) = total sockets weighted from lighting inventory sample; n (CFL pgm installed) = total sockets containing IOU-discounted CFLs weighted from meter sample; n (CFL rebated) = total rebated CFLs.

Note: The distribution of CFLs installed by room type was used to weight the calculation of the average incandescent wattage.

8.8 Supplier Self-Report NTGR Estimates

The supply-side self-reported (SSSR) net-to-gross method relies primarily on information collected from in-depth interviews and surveys with manufacturers, retail buyers, and retail store managers. Generally, these market actors were asked a series of questions designed to estimate the percentage of IOU-discounted lighting products that would have been sold in the absence of the program (i.e., free ridership). These results were analyzed to determine NTGR estimates by channel (or, one minus free ridership) for both basic CFLs, specialty CFLs, and energy efficient fixtures.

8.8.1 Sample Sizes

The final sample sizes achieved from these in-depth interviews and surveys are as follows:

- Manufacturers – A total of 18 participating manufacturers were surveyed as part of this evaluation, 16 of which were able to provide data used in the NTGR calculation. These 16 manufacturers represented 91% of total 2006-2008 CFL shipments.
- Retail buyers – A total of 18 participating retail buyers were surveyed and 18 provided data used in the NTGR calculation, representing 61% of total 2006-2008 CFL shipments.
- Retail store manager surveys – Two retail store manager surveys were completed and used for the NTGR calculation:
    - Process evaluation: In May 2008, 141 participating retail store managers in the PG&E and SCE service territories were surveyed as part of a process evaluation completed for these IOUs. Input for NTGR calculations were obtained from 114 of these store managers.
    - Impact evaluation: Using essentially the same questionnaire, a second survey of retail store managers was conducted in 2009 as part of the impact evaluation. Participating retail store managers from all IOUs were included in this effort. A total of participating 242 retail store managers were surveyed but only 127 were able to provide data used in the NTGR calculation.

8.8.2 Questionnaires

The main question asked of manufacturers to inform the NTGR calculation was worded as follows:

- You received manufacturer buy-down discounts of $X per bulb for sale of [CFL TYPE X] through [RETAIL CHANNEL X] such as [RETAILER X]. ULP also provides promotional material. If these discounts and promotional materials hadn't been available during 2006-2008, do you think sales of [CFL PRODUCT TYPE X] through [RETAIL CATEGORY X] would have been same, higher, or lower?
    - [IF LOWER] By what percentage do you estimate your sales of [CFL PRODUCT TYPE X] through [RETAILER CHANNEL X] stores would have been lower during 2006-2008 if these manufacturer buydowns and program promotional materials for [CFL PRODUCT TYPE X] had not been available?

Retail buyers were asked a similar question without the channel-level distinction.

8.8.3 Consistency Checks and Quality Control

A number of steps were taken to ensure the responses from manufacturers and retail buyers were internally consistent and reliable.

- **Recapping/Exploring the nature of their program participation:** At the beginning of the interview, we asked the interviewees a number of questions that recapped and explored the nature of their company's participation in the Upstream Lighting Program. The main purpose of these questions was to trigger their memories about the nature of their company's involvement so that they would be able to give a fair assessment of the Program's influence. The nature of these questions included:
  - *Confirming the general nature of the Program tracking data:* We asked them to confirm general information from the Upstream Lighting Program tracking database such as the types of the energy-efficient lighting products they sold through the Program (e.g., basic vs. specialty CFLs, CFL fixtures, LED products), the general magnitude of their Upstream Lighting Program product sales, and the types of retail channels they used for selling these products.
  - *Asking about involvement in other aspects of the Program:* We also asked them whether they were involved in any other aspects of the Program besides receiving the financial incentives, such as participating in any joint CFL marketing or customer education efforts with the IOUs.
  - *Asking about the history of their involvement in the Program and their pre-Program experience with CFLs.* While the main purpose of these questions was to collect information for the CPUC's parallel study of the Upstream Lighting Program Program's long-term influence on the California CFL market, these questions also provided the interviewees with additional useful context.
  - *Asking about Program vs. non-Program CFL products and retailers:* Near the beginning of the survey we also asked them a serious of questions exploring the differences, if any, between the types and volumes of CFL products they sold through the Program and those they sold outside the Program. Typical questions included: "Why did you choose to sell these particular products and packages through the California Upstream Lighting Program?" or "Why didn't you sell these CFL bulbs through the Program?" or "What sorts of distribution channels did you sell these [non-Program] Energy Star CFLs through?" Besides providing the interviewees with additional "memory triggers" about the nature of their company's participation, these questions also got them thinking about the market barriers and dynamics that influence product choices. For example, if an interviewee said that they did not sell a certain specialty CFL through discount retailers because the price point was too high, even with the Upstream Lighting Program buydown

discounts, this reminded the interviewee of the importance of these price points for certain retailer types.

- **Consistency checks before the free ridership battery:** Before entering the formal free ridership battery of questions, we asked them a few questions that served as de facto consistency checks for their subsequent free ridership estimates. First we asked: "When discounts from the Upstream Lighting Program were not available, due to delays in Program startup or product allocations for discounted CFLs running out, did you sell non-specialty Energy Star CFL bulbs in California?" This question likely made them think about their company's capability to sell CFLs in the absence of the Program, especially for manufacturers or retailers who primarily served discount markets. We also asked the interviewees to estimate what percentage of their 2006-2008 California CFL sales were: 1) Energy Star CFLs sold through the Upstream Lighting Program, 2) Energy Star CFLs sold outside the Upstream Lighting Program, and 3) Non-Energy-Star CFLs. This question was also useful as a consistency check because if an interviewee later said that his/her company's CFL sales would have gone to zero in the absence of the Upstream Lighting Program, if they currently had non-Program CFL sales, they would be asked how the disappearance of the Program would affect these non-Program sales.
- **Confirmation questions during the free ridership battery:** While asking the formal battery of free ridership questions (summarized in the previous subsection) we also would frequently ask confirmation questions or statements. Sometimes this would be a simple re-stating of their free ridership estimate or its implications. For example, the interviewer might say something like: "So if I understand you correctly, you are saying you would have sold no [product X] through [retail channel X] if the Upstream Lighting Program Program had not been available?" Hearing this some respondents might qualify or clarify their response. Another confirmation question might be used to clarify the estimate of the reduction in sales in the absence of the Upstream Lighting Program Program. For example, the interviewer might say something like: "So you are saying that if you actually sold 100 non-specialty CFLs in a given week, you think you'd have sold only about 20 non-specialty CFLs in that period if the manufacturer buydowns had not been available."
- **Post-survey quality control:** After the interviews with the upstream market actors were completed, we also did some additional quality control. For example, we would compare an interviewee's free ridership estimate for a certain retail channel with the estimates given by other market actors for the same retail channel. If possible, we would also compare the free ridership estimates given by an interviewee in 2008 for the 2006-2008 Upstream Lighting Program evaluation with estimates they might have given in 2007 for the 2004-2005 Upstream Lighting Program. These comparisons were useful for trouble-shooting recording errors or as indicators of possible "gaming."

  However, it is important to point out that differences in free ridership estimates between market actors operating in the same retail channel, or between estimates given by the same market actor at different points in time, may exist for perfectly legitimate reasons. For example, differences in the relative market positions of manufacturers or retailers – such as differences in their non-Upstream Lighting Program product diversity -- may explain why two market actors operating in the same retail channel may gave very different estimates of the effects of the absence of the Upstream Lighting Program on their CFL sales. Similarly a market actor may give a different free ridership estimate in 2008 than they did in 2007 not because they are "gaming" but because the 2008 economic downturn has made consumers more price-conscious and thereby increasing the perceived value of the Upstream Lighting Program discounts. A second wave of market actor interviews we conducted in 2009 helped shed light on such market trends. Finally re-reading the complete interviews -- with the interviewee's description of their market position and their understanding of the market dynamics -- was often very useful in explaining why their free ridership estimates might have been different than other market actors in the same retail channel.

8.8.4 Threats to Validity

8.8.4.1 Potential biases

One threat to the validity of the supplier self-report methodology are two types of potential bias. These include:

- **The gaming or "don't kill the golden goose" bias:** This potential bias occurs when market actors purposely overestimate the negative impact that the removal of the rebates would have on their product sales. This is done to make the rebates seem more effective than they actually are and therefore insure that the rebates they receive continue to be funded.
- **The green retailer bias:** This potential bias occurs when market actors underestimate the negative impact that the removal of the rebates would have on their product sales because they have exaggerated confidence in their company's ability to market environmentally-friendly products. In some respects this bias might be considered a variation of the "social desirability bias" well known in program evaluation literature. This green retailer bias was described in the 2008 DEER update study by Itron and was actually used to justify an adjustment of the CFL net-to-gross ratio upwards.

The gaming bias and the green retailer bias work in opposite directions – with the former tending to overestimate program attribution and the later tending to underestimate it. However, it is not clear what the relative strengths of these biases are and to what degree they offset each other.

In the case of the Upstream Lighting Program, the lighting manufacturers are the market actors with the strongest motives to engage in the gaming bias because the vast majority of the program rebates are buydown payments that go to manufacturers rather than point-of-sale rebates that go to retailers. In-depth interviews with lighting manufacturers also revealed that some were aware that decisions in 2007 and 2008 by some participating IOUs to shift rebate allocations away from "big box" retailer channels such as

Home Improvement were based on channel-specific net-to-gross findings from the evaluation of this 2004-2005 Upstream Lighting Program. This knowledge might tempt manufacturers who ship CFL products to these “big box” channels to purposely overestimate the sales impacts of removing or reducing the Upstream Lighting Program rebates going to these channels.

By definition retailers would be the Upstream Lighting Program market actors most likely to engage in the green retailer bias. Of the two types of retailer representatives that we interviewed – retail buyers and store managers – we would theorize that the retail buyers were the ones who would be most likely to engage in the green retailer bias. One reason for this is that retail buyers would likely be more knowledgeable of corporate environmental campaigns than store managers even if they both worked for the same company. Another reason is that many store managers represented independent stores or small chains that did not have corporate green policies.

If this theory of potential biases is correct, then the net-to-gross estimates of the manufacturer representatives should be higher than those of the retailer representatives. And this indeed was almost always the case.

Since these gaming and green retailer biases move in opposite directions, one way to try to adjust for these potential biases is to simply average the manufacturer and retail buyer estimates. Since retail store managers are less likely to be aware of any gaming opportunities, averaging in their net-to-gross estimates can also help dilute any potential gaming. These are approaches we incorporated in this report.

8.8.4.2 Lack of market knowledge

Another threat to validity is the possibility that some market actors may simply lack the broader market knowledge to competently assess what would happen to product sales in the absence of the rebate. Lighting manufacturers have the greatest potential to accurately predict what would happen to their sales in the absence of the Upstream Lighting Program. This is because for them this is not an academic exercise, they have good practical reasons for making such predictions accurately. Every year, and in some cases multiple times per year, lighting manufacturers submit proposals to the Upstream Lighting Program managers indicating how many CFL products they think they can sell of what product type and through which retail channels. If they overestimate the sales effects of these rebates, they must deal with unhappy retail partners and Upstream Lighting Program managers. Retailers in general do not like allocating limited store space to products that do not sell and overstocks can be particularly burdensome for smaller retailers, as the evaluation of the 2004-2005 Upstream Lighting Program indicated. Upstream Lighting Program managers dislike overstocks because it increases the chances that store managers might ship their excess CFLs outside the program, resulting in CFL “leakage.”

A good example of how a lack of broader market knowledge can threaten the validity of net-to-gross estimates occurs in the discount channel. In the in-depth interviews a number of manufacturers provided estimates of their costs for producing a typical Energy Star CFL and none of these estimates were less than $1.20 per bulb. Since many discount stores operate with $1 or 99 cent price caps it is likely that these stores would not be able to sell Energy Star CFLs without the manufacturer buydowns. All the manufacturers who supplied these $1/99 cent stores confirmed this was the case. Retail buyers with two largest chains of $1/99 cent stores also said that they would not be able to sell Energy Star CFLs without the Upstream Lighting Program incentives and that they stop selling them when the Upstream Lighting Program rebates run out. And yet when we interviewed store managers with some of these $1/99 cent stores, they estimated that their sales of basic Energy Star CFLs would only go down 60 – 86 percent if the Upstream Lighting Program discounts went away. Because of limited market knowledge they did not know what the manufacturers and retail buyers knew – that is, if these Upstream Lighting Program incentives disappeared they would no longer receive shipments of these products. In cases like these, the manufacturer and retail buyer responses were considered more reliable and the retail store manager responses were ignored in the calculation of the supplier self-report NTGR estimates.

8.8.5 Calculation of Net-to-Gross Ratio

We calculated net-to-gross ratios for the supplier self-report methodology at the retail channel level for each category of market actors and for each category of CFL products.

8.8.5.1 The Retail Channel Categories

Retail channels included and were defined as follows:

- **Discount:** This channel included not only chain or independent stores that had a $1 or 99 cents price caps but also other discount retailers such as Big Lots.
- **Drug:** This channel included large drugstore chains such as Rite Aid and Walgreens as well as independent drugstores and smaller chains.
- **Grocery:** This channel included large mainstream grocery chains such as Albertsons' and Ralph's, discount grocery chains such as Food 4 Less and Grocery Outlet, and many smaller grocery stores or chains that often catered to a certain ethnic clientele.
- **Hardware:** This channel included small hardware chains such as Ace or True Value along with independent hardware stores.
- **Large Home Improvement:** This channel included large home-improvement stores such as Home Depot, Lowe's and Orchard Supply.
- **Mass Merchandise:** Wal-Mart accounted for the large majority of sales in this channel, although in 2008 other mass merchandise retailers such as Target and Bed, Bath, and Beyond began to enter the Program.
- **Membership Club:** This channel was dominated by Costco although Sam's Club entered the Upstream Lighting Program Program in 2007 and increased its market share in 2008.
- **Lighting and Electronics:** This included chain or independent retailers that specialized in lighting or electronics products.

8.8.5.2 The CFL Product Categories

The categories of CFL products included and were defined as follows:

- **Basic or non-specialty CFLs:** These were standard spiral CFLs or mini-spirals CFLs.
- **Specialty CFLs:** These were CFLs that had special functionalities such as dimmable CFLs or reflectors as well as covered CFLs with non-spiral shapes such as A-lamps or globes.
- **CFL fixtures:** These were lighting fixtures that were designed to use CFLs.

8.8.5.3 The Market Actor Categories

The market actors that provided the free ridership estimates included:

- **Participating lighting manufacturers/importers:** These were lighting manufacturers or importers who were listed in the Upstream Lighting Program tracking database as having received buydown rebates for the shipment of CFL or LED products to participating retailers. We obtained free ridership estimates from 14 of the manufacturers/importers in the summer of 2008 as part of lengthy in-depth interviews. We obtained estimates from two more of them in the summer of 2009. We asked the lighting manufacturers to provide separate free ridership estimates for each retail channel they served through the program.
- **Participating retail buyers:** These were representatives of chain retailers who were participating in the Upstream Lighting Program. Usually they were responsible for buying lighting products for their stores and were the primary points of contact for the manufacturers/importers participating in the Upstream Lighting Program as well as for the Upstream Lighting Program program staff. We obtained free ridership estimates from 16 of these retail buyers in the summer and fall of 2008 as part of lengthy in-depth interviews. We obtained estimates from two more of them in the summer and fall of 2009.
- **Participating retail store managers:** For the sake of simplification we refer to these market actors as "store managers" even though some of them do not manage the whole store per se – e.g. they may be responsible for lighting and a few other products. We obtained free ridership estimates from them in Computer-Assisted Telephone Interview (CATI) surveys that were conducted in two waves:
    - In May 2008 we surveyed 141 participating retail store managers in the PG&E and SCE service territories. . Free ridership estimates were obtained from 114 of these store managers.
    - In the summer of 2009 we surveyed 242 participating retail store managers from the PG&E, SCE, and SDG&E service territories. Free ridership estimates were obtained from 127 of these store managers.

8.8.5.4 Weighting of the Estimates

As noted, we calculated a separate net-to-gross ratio for each retail channel for each market actor and for each product category. These ratios were based on the shipment-weighted averages of their component free ridership estimates. For example, if five lighting manufacturers had each provided estimates of the decline in their sales of specialty CFLs through the grocery channel in the absence of the Upstream Lighting Program, the overall free ridership estimate would be the sum-product of each estimate and the underlying volume of specialty CFLs shipped through the 2006-2008 Upstream Lighting Program that each estimate represented. The net-to-gross ratio would then simply be 1 minus this shipment-weighted free ridership estimate.

8.8.5.5 Estimates by Product Type

8.8.5.5.1 SSSR NTGR Estimates for Basic CFLs

Results from the various data sources are shown in Table 93 for basic CFLs (i.e., twister/spiral-style, 9-30 watts, non-dimmable, non-threeway). The recommended SSSR NTGR estimates for basic CFLs are shown in Table 94 by channel as well as overall. These values were based on evaluator judgment informed by all available evidence, as explained below:

- **Discount channel –** The average of the manufacturer and retail buyer NTGR values (100%) were used for this channel. This decision was based on a number of reasons:
    - IOUs encouraged participation from stores in this channel essentially for the first time in 2006-2008;
    - Manufacturer, retail buyer and retail store manager survey responses are in agreement that nearly 100% of the CFLs sold through this channel are discounted by the program (i.e., close to zero non-program sales);
    - Revealed preference surveys support near 100% program sales estimates in this channel;
    - Manufacturers and retail buyers were also in agreement in terms of their independently-generated estimates of 100% program attribution; and
    - Retail store managers in this channel do not have as much product supply influence as manufacturers and retail buyers and, as a result, their responses regarding program attribution are less reliable.
- **Drug stores –** Similarly, the average of the manufacturer and retail buyer NTGR values (73%) were used for this channel. One large retail chain dominated participation from this channel. The retail buyer for this chain indicated that 47% of its IOU-discounted CFL sales would not have occurred in the absence of the program. Manufacturers in this channel were more optimistic, reporting 98% program attribution. As discussed above for the discount channel, retail store manager responses were deemed the least reliable source for the NTGR determination given their

relative lack of influence over product supply choices. Finally, the average of manufacturer and retail buyer NTGR values was exactly aligned with the estimates of IOU-discounted sales as a percent of total sales from the revealed preference surveys (73%).

- **Grocery channel –** The results from all sources for this channel were fairly well-aligned and, as a result, the simple straight average of all four NTGR estimates was used (82%).

Table 93: Supply-Side Self-Reported NTGR Estimates by Data Source: Basic CFLs

Channel	Row Category	Data Source			
		Manu-facturer Interviews	**Retail Buyer Interviews**	**Process Evaluation Retail Store Manager Surveys** [1]	**Impact Evaluation Retail Store Manager Surveys** [2]
Discount	n (% of program sales)	13 (98%)	2 (67%)	19	14
	Shipment-weighted NTGR	**100%**	**100%**	**60%**	**86%**
Drug	n (% of program sales)	6 (73%)	1 (58%)	16	8
	Shipment-weighted NTGR	**98%**	**47%**	**88%**	**23%**
Grocery	n (% of program sales)	15 (98%)	6 (35%)	45	78
	Shipment-weighted NTGR	**88%**	**79%**	**83%**	**72%**
Hardware	n (% of program sales)	13 (93%)	4 (56%)	8	38
	Shipment-weighted NTGR	**80%**	**39%**	**63%**	**37%**
Home Improvement	n (% of program sales)	4 (81%)	2 (85%)	8	16
	Shipment-weighted NTGR	**53%**	**40%**	**29%**	**63%**
Lighting & Electronics	n (% of program sales)	4 (45%)	n/a	4	n/a
	Shipment-weighted NTGR	**81%**	**n/a**	**85%**	**n/a**
Mass Merchandise	n (% of program sales)	1 (69%)	1 (98%)	16	17
	Shipment-weighted NTGR	**100%**	**20%**	**57%**	**33%**
Membership Club	n (% of program sales)	4 (63%)	2 (85%)		5
	Shipment-weighted NTGR	**76%**	**52%**		**67%**

[1] Completed in 2008, these process evaluation surveys used essentially the exact same questions as the impact evaluation surveys but were conducted with participating retail store managers located within PG&E and SCE service territories only.

[2] Completed in 2009, these impact evaluation surveys used essentially the exact same questions as the process evaluation surveys but conducted with participating retail store managers located within PG&E, SCE and SDG&E service territories.

Table 94: Recommended Supply-Side Self-Report NTGR Estimates by Channel and Overall: Basic CFLs

Channel	IOU-Discounted Basic CFL Shipments Percent by Channel	Supply-Side Self-Report (SSSR) NTGRs: Basic CFLs				Simple SSSR Avg NTGR: Basic CFLs	Recommended SSSR NTGR: Basic CFLs
		NTG-M	NTG-RB	NTG-RSM(P)	NTG-RSM(I)		
Discount	17%	100%	100%	60%	86%	87%	**100%**
Drug	8%	98%	47%	88%	23%	64%	**73%**
Grocery	37%	88%	79%	83%	78%	82%	**82%**
Hardware	6%	80%	39%	63%	39%	55%	**60%**
Home Improvement	8%	54%	40%	29%	53%	44%	**41%**
Ltg & Electronics	2%	81%		85%		83%	**83%**
Mass Merchandise	5%	100%	20%	57%	40%	54%	**39%**
Membership Club	17%	76%	52%	57%	60%	61%	**61%**
All Channels (weighted by shipment distribution by channel**)**		**86%**	**66%**	**67%**	**65%**	**72%**	**74%**

Notes:

Highlighted cells contain the most reliable evidence that were used to compute the average "best judgment," channel-specific SSSR NTGR.

Key:

NTG-M – NTGR estimate based on manufacturer self-reports

NTG-RB – NTGR estimate based on retailer buyer self-reports

NTG-RSM(P) – NTR estimate based on retail store manager self-reports from 2008 process evaluation surveys

NTG-RSM(I) – NTR estimate based on retail store manager self-reports from 2009 impact evaluation surveys

- **Hardware stores –**The average of the manufacturer and retail buyer NTGR values (60%) were used for this channel. Much like drug and discount stores, retail store managers have little influence over product supply in these channels. In addition, results from the revealed preference surveys indicate that 55% of total sales were IOU-discounted in chain hardware stores and 72% of total sales were IOU-discounted.
- **Home improvement channel –** Program participation from this channel has declined significantly from prior years, representing 8% of total IOU-discounted shipments in 2006-2008. As a result, manufacturer and retail buyer responses about program attribution may have been biased (positively or negatively) based on both past as well as ongoing experience with the

programs. As a result, retail store manager responses were averaged to produce the overall NTGR estimate for this channel (46%) because their perspectives were assumed to be more independent and reliable. It should be noted that observed IOU-discounted sales were only 26% of total sales and, as such, the self-report NTGR estimate for this channel may be too high.

- **Lighting & Electronics stores –** This channel represents only about 1% of total IOU-discounted shipments in 2006-2008. Results from the manufacturer and retail store manager interviews were fairly well aligned and the average of the two (83%) was used as the NTGR estimate for this channel.
- **Mass merchandise channel –** The estimate of 100% program attribution from the one manufacturer that distributed the majority of the IOU-discounted products sold through this channel was believed to be biased given the relatively large market share (69%) its products achieved as a direct result of the program. Responses from retail buyers for this channel, on the other hand, indicated that alternative suppliers could have been engaged to supply about 80% of the IOU-discounted products in the absence of the program. Because these responses were so divergent, the retail store manager responses were included in the calculation for the overall NTGR estimate for this channel (37%). Further support for this estimate comes from the revealed preference survey results, which indicate that IOU-discounted sales were 35% of total sales.
- **Membership club stores –** Responses from all four sources were fairly well aligned and, as such, a simple straight average (63%) was used for the NTGR estimate for this channel. This is a relatively conservative estimate, given that revealed preference surveys in this channel indicate that IOU-discounted sales were observed to be 76% of total sales.

Table 95 presents the recommended SSSR NTGR estimates by IOU. As shown, the recommended SSSR NTGR estimates for basic CFLs are 71% for PG&E, 80% for SCE, and 71% for SDG&E.

Table 95: Recommended Supply-Side Self-Report NTGR Estimates by IOU and Overall: Basic CFLs

IOU	Supply-Side Self-Reported (SSSR) Basic CFL NTGRs					
	NTG-M	NTG-RB	NTG-RSM(P)	NTG-RSM(I)	Simple SSSR Avg NTGR: Basic CFLs	**Recommended SSSR NTGR: Basic CFLs**
PG&E	84%	61%	66%	61%	69%	**71%**
SCE	89%	73%	67%	69%	77%	**80%**
SDG&E	86%	62%	65%	62%	70%	**71%**
All IOUs	86%	66%	67%	63%	71%	**74%**

8.8.5.5.2 SSSR NTGR Estimates for Specialty CFLs

Table 96 provides the SSSR NTGR estimates by channel and data source for specialty CFLs (e.g., a-lamps, globes, reflectors, dimmables, threeway, etc.). Table 97 shows the recommended SSSR NTGR estimates for specialty CFLs by channel, and Table 98 shows the results by IOU. The recommended SSSR NTGR estimates for specialty CFLs by IOU are 73% for PG&E, 51% for SCE, and 65% for SDG&E.

Table 96: Supply-Side Self-Reported NTGR Estimates by Data Source: Specialty CFLs

<table>
<tr><th rowspan="2">Channel</th><th rowspan="2">Row Category</th><th colspan="4">Data Source</th></tr>
<tr><th>Manu-facturer Interviews</th><th>Retail Buyer Interviews</th><th>Process Evaluation Retail Store Manager Surveys [1]</th><th>Impact Evaluation Retail Store Manager Surveys [2]</th></tr>
<tr><td rowspan="2">Discount</td><td>n (% of program sales)</td><td>3 (98%)</td><td>2 (81%)</td><td rowspan="2">No estimates obtained</td><td>1</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>100%</td><td>100%</td><td>100%</td></tr>
<tr><td rowspan="2">Drug</td><td>n (% of program sales)</td><td>1 (45%)</td><td rowspan="2">No estimates obtained</td><td rowspan="2">No estimates obtained</td><td rowspan="2">No estimates obtained</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>99%</td></tr>
<tr><td rowspan="2">Grocery</td><td>n (% of program sales)</td><td>5 (100%)</td><td>5 (63%)</td><td>5</td><td>11</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>57%</td><td>94%</td><td>87%</td><td>97%</td></tr>
<tr><td rowspan="2">Hardware</td><td>n (% of program sales)</td><td>5 (67%)</td><td>2 (4%)</td><td rowspan="2">No estimates obtained</td><td>18</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>67%</td><td>24%</td><td>27%</td></tr>
<tr><td rowspan="2">Large Home Improvement</td><td>n (% of program sales)</td><td>3 (41%)</td><td>1 (77%)</td><td>5</td><td>7</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>51%</td><td>67%</td><td>28%</td><td>43%</td></tr>
<tr><td rowspan="2">Mass Merchandise</td><td>n (% of program sales)</td><td>1 (73%)</td><td rowspan="2">No estimates obtained</td><td rowspan="4">14
47%</td><td>8</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>70%</td><td>48%</td></tr>
<tr><td rowspan="2">Membership Club</td><td>n (% of program sales)</td><td>2 (32%)</td><td>2 (100%)</td><td>3</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>92%</td><td>51%</td><td>56%</td></tr>
<tr><td rowspan="2">Lighting & Electronics</td><td>n (% of program sales)</td><td>1 (6%)</td><td rowspan="2">No estimates obtained</td><td>1</td><td rowspan="2">No estimates obtained</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>70%</td><td>50%</td></tr>
</table>

[1] Completed in 2008, these process evaluation surveys used essentially the exact same questions as the impact evaluation surveys but were conducted with participating retail store managers located within PG&E and SCE service territories only.

[2] Completed in 2009, these impact evaluation surveys used essentially the exact same questions as the process evaluation surveys but conducted with participating retail store managers located within PG&E, SCE and SDG&E service territories.

Table 97: Recommended Supply-Side Self-Report NTGR Estimates by Channel and Overall: Specialty CFLs

Channel	**IOU-Discounted Specialty CFL Shipments Percent by Channel**	**Supply-Side Self-Report (SSSR) NTGR: Specialty CFLs**					
		NTG-M	NTG-RB	NTG-RSM(P)	NTG-RSM(I)	Simple SSSR Avg NTGR: Specialty CFLs	**Best Judgment SSSR NTGR: Specialty CFLs**
Discount	5%	100%	100%		100%	100%	**100%**
Drug	14%	99%				99%	**99%**
Grocery	28%	57%	94%	87%	97%	84%	**93%**
Hardware	2%	67%	24%		27%	39%	**26%**
Home Improvement	10%	51%	67%	28%	43%	47%	**47%**
Ltg & Electronics	1%	70%		50%		60%	**60%**
Mass Merchandise	7%	70%		47%	48%	55%	**48%**
Membership Club	35%	92%	51%	47%	56%	62%	**51%**
All Channels (weighted by shipment distribution by channel)		**78%**	**56%**	**49%**	**50%**	**74%**	**72%**

Notes:

Highlighted cells contain the most reliable evidence that were used to compute the average "best judgment," channel-specific SSSR NTGR estimates

Key:

NTG-M – NTGR estimate based on manufacturer self-reports

NTG-RB – NTGR estimate based on retailer buyer self-reports

NTG-RSM(P) – NTR estimate based on retail store manager self-reports from 2008 process evaluation surveys

NTG-RSM(I) – NTR estimate based on retail store manager self-reports from 2009 impact evaluation surveys

Table 98: Recommended Supply-Side Self-Report NTGR Estimates by IOU and Overall: Specialty CFLs

IOU	Supply-Side Self-Report (SSSR) Specialty CFL NTGRs					
	NTG-M	NTG-RB	NTG-RSM(P)	NTG-RSM(I)	Simple SSSR Avg NTGR: Specialty CFLs	**Recommended SSSR NTGR: Specialty CFLs**
PG&E	78%	57%	48%	47%	74%	**73%**
SCE	77%	47%	47%	48%	58%	**51%**
SDG&E	79%	55%	43%	44%	69%	**65%**
All IOUs	78%	56%	47%	47%	71%	**68%**

8.8.5.5.3 SSSR NTGR Estimates for Fixtures

Table 99 shows SSSR NTGR estimates by channel and data source for upstream energy efficient fixtures (e.g., exterior and interior hardwired fixtures, fluorescent desk/table lamps, torchieres).

Table 99: Recommended Supply-Side Self-Report NTGR Estimates by IOU and Overall: Fixtures

<table>
<tr><th rowspan="2">Channel</th><th rowspan="2">Row Category</th><th colspan="4">Data Source</th></tr>
<tr><th>Manu-facturer Interviews</th><th>Retail Buyer Interviews</th><th>Process Evaluation Retail Store Manager Surveys [1]</th><th>Impact Evaluation Retail Store Manager Surveys [2]</th></tr>
<tr><td rowspan="2">Discount</td><td>n (% of program sales)</td><td>3 (58%)</td><td>2 (75%)</td><td>11</td><td>8</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>97%</td><td>100%</td><td>90%</td><td>99%</td></tr>
<tr><td rowspan="2">Drug</td><td>n (% of program sales)</td><td>1 (75%)</td><td rowspan="2">No estimates obtained</td><td>1</td><td>2</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>75%</td><td>100%</td><td>83%</td></tr>
<tr><td rowspan="2">Large Grocery</td><td>n (% of program sales)</td><td>1 (100%)</td><td>1 (100%)</td><td rowspan="2">No estimates obtained</td><td rowspan="2">No estimates obtained</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>100%</td><td>100%</td></tr>
<tr><td rowspan="2">Small Grocery</td><td>n (% of program sales)</td><td>2 (79%)</td><td rowspan="2">No estimates obtained</td><td>5</td><td>15</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>75%</td><td>76%</td><td>95%</td></tr>
<tr><td rowspan="2">Hardware</td><td>n (% of program sales)</td><td>4 (66%)</td><td>1 (13%)</td><td>1</td><td>21</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>82%</td><td>80%</td><td>100%</td><td>48%</td></tr>
<tr><td rowspan="2">Large Home Improvement</td><td>n (% of program sales)</td><td>1 (5%)</td><td>No estimates obtained</td><td>3</td><td>8</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>60%</td><td></td><td>50%</td><td>39%</td></tr>
<tr><td rowspan="2">Mass Merchandise</td><td>n (% of program sales)</td><td>1 (96%)</td><td rowspan="2">No estimates obtained</td><td rowspan="4">10
38%</td><td>8</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>90%</td><td>40%</td></tr>
<tr><td rowspan="2">Membership Club</td><td>n (% of program sales)</td><td>2 (100%)</td><td>1 (100%)</td><td>3</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>100%</td><td>100%</td><td>12%</td></tr>
<tr><td rowspan="2">Lighting & Electronics</td><td>n (% of program sales)</td><td>2 (93%)</td><td rowspan="2">No estimates obtained</td><td>3</td><td rowspan="2">No estimates obtained</td></tr>
<tr><td>Shipment-weighted NTGR</td><td>83%</td><td>23%</td></tr>
</table>

8.9 Pricing Analysis[48]

8.9.1 Method

Using information collected from retailer shelf surveys in California and comparison areas, a statistical (hedonic) pricing model was estimated in which the price of a product is regressed on the product's characteristics. Through the pricing model, the variation in a product's price can be explained by the observable attributes. In the model, the coefficient corresponding to an attribute represents the "implicit price" of the attribute. The CFL pricing model used in this study followed the basic formulation:

$$\text{Register price per CFL} = \beta_0 + \beta_1\text{IOU Discount} + \beta_2\text{Other Discount} + \beta_3\text{Product Characteristics} + \beta_4\text{Retail Channel} + \beta_5\text{MetroArea} + \beta_6\text{MonthYear} + \varepsilon$$

The dependent variable in the regression model was the price per CFL in a package. The independent variables were the CFL characteristics, including: watts, ENERGY STAR Label, the number of bulbs in the package, manufacturer, metropolitan statistical area, and year-month of data collection. We allowed the impact of the number of CFLs in the package on price per CFL to vary non-parametrically (i.e., without making functional form assumptions) with the number of bulbs in the package. This was done by including separate indicator variables for the number of CFLs in the package. In addition, we included indicator variables for whether the package was discounted by an IOU or discounted by another entity such as the retailer. We expected both variables to have negative and statistically significant effects on register price, but the magnitudes of the coefficients were a priori unclear.

To test several of our research questions, it was necessary to augment the main regression equation with additional independent variables. For example, to test the hypothesis about variation between retail sales channels in the upstream incentive's impact on register price, we introduced interaction terms between "IOU Discount" and the "Retail Channel" variables into the model.

8.9.2 Results

The average price of program vs. non-program CFLs was estimated through both descriptive statistics (i.e., a difference of means) approach and a statistical (hedonic) pricing model approach. As shown in Figure 3, the average IOU-discounted twister style bulb retailed for $1.30, significantly less than equivalent non-program bulbs in California ($3.98) or the Comparison Area ($4.00). The price difference between program and non-program bulbs, therefore, was about $2.70.

The hedonic pricing model, which controls for multiple variables at one time in order to isolate the impact of the IOU discount, found nearly identical results as the descriptive statistics: the model suggests that

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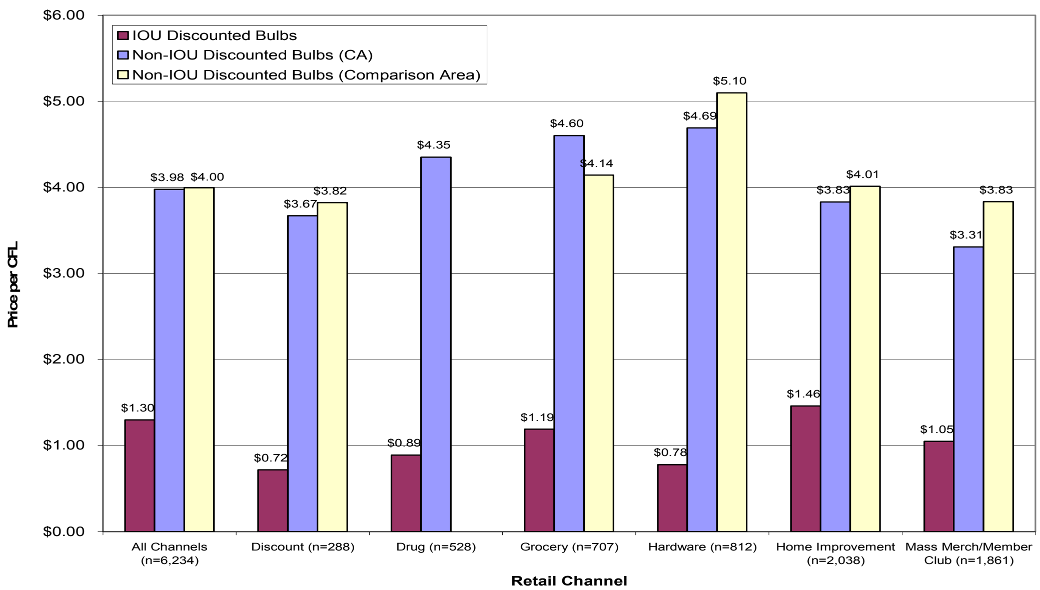
[48] The pricing analysis was led by The Cadmus Group, Inc. with support from Andrew Goett (independent consultant) and KEMA. See the CFL Market Effects Report for a more detailed methodology and discussion of pricing regression methods and findings.

IOU-sponsored upstream incentives had a large and significant impact on the price per CFL at the register, reducing the register price of a CFL by $2.70 (all else being equal).[49]

The average retail price discount for IOU-discounted twister style bulbs, therefore, was approximately 68% ($2.70/$4.00).

Figure 3: Average Price per CFL for California vs. Comparison Area (Basic CFLs)



[49] Note that a review of the utility tracking data revealed that the average incentive for twister/spirals was $1.57 per CFL. Thus, an average incentive of $1.57 per bulb led to an average discount at the register of $2.70 per bulb, suggesting the existence of a multiplier effect. The ratio of the estimated price impact of the incentive to the average incentive paid to manufacturers was 1.72 ($2.70 divided by $1.57). In other words, the mean price impact of the rebate at the register was 172% of the mean rebate. The manufacturer and retailer interviews confirmed these findings, as respondents reported offering "add-on" discounts in addition to passing through the ULP discount. Respondents cited faster sell-through, competition, and achieving a particular price point as reasons for offering additional discounts.

8.10 Conjoint Analysis[50]

8.10.1 Method

The conjoint analysis survey was designed with the following objectives in mind:

- Understanding why consumers choose to buy (or not to buy) CFLs (e.g., environmental concerns, saving money, appearance, light quality, product quality, previous satisfaction with CFLs, value of specialty features in both incandescent and CFLs, lifetime, etc.), and determining the role of price in the mix of these qualitative considerations.
- Measuring the price sensitivity (elasticity) of demand for CFL bulbs in selected California markets to determine price points that trigger and optimize consumers' conversions from incandescent to CFLs.

A conjoint survey was chosen for this evaluation because it provides an objective methodology to trade-off price and non-price attributes without directly asking the question "what are you willing to pay?" Conjoint analysis surveys provide respondents with descriptions of different goods, characterized by a consistent set of six or less distinct attributes (the levels of which vary across questions). The steps undertaken to conduct the conjoint analysis are described below.

8.10.1.1 Recruiting

The Conjoint Survey was conducted in concert with a series of eighteen, 90-minute focus groups, consisting of six in each of IOU service territories. A total of 327 participants were recruited, exceeding the goal of having 300 participants or 100 in each utility service territory.

8.10.1.2 Weighting

Results were weighted based on utility and income level, consistent with the Residential Appliance Saturation Survey (RASS) results. Segmentation analysis was also performed by utility, household income, education level, CFL usage, and gender.

8.10.1.3 Questionnaire

Sawtooth Software, a proprietary web-based survey software, was utilized to generate the "random choice" survey questions (computer generated questions with random levels of CFL attributes that vary by participant), compile data, and analyze results. Participants completed survey questionnaires electronically using laptop computers in supervised settings with 5-7 other participants, either before or concurrent with the focus groups at the same locations (but in a different room). The questionnaire was split into two segments, each consisting of 17 random choice questions and a "fixed choice" question

[50] The conjoint study was a collaborative effort, led by The Cadmus Group with substantial support provided by several independent consultants, Carol Kauder and Linda Fergusson, and KEMA. For more detail on the conjoint study methodology, see Appendix F.

(specified by the Team and asked twice of all participants to check response consistency). In one segment the topic was standard CFLs, comparing 2 types of standard CFLs (mini twister, standard twister, or covered A-bulb) to a standard incandescent bulb, and the other segment comparing two CFL flood lights to an incandescent flood light. All participants were also asked several "direct response questions" (gathering awareness and self-reported attribute ranking information).

The varying attributes for both the standard and flood CFL segments are identified in Table 100. To ensure reliable results, certain constraints will be set which prohibit the program from creating a choice that compares the highest priced CFLs against the lowest-priced CFLs. For instance, a $.60 A-lamp with the longest life would not be compared against a $7.50 standard twister with the shortest life. Detailed explanations of each of the attributes were also provided during the on-line introduction to the survey and in a hard copy, to be used by participants if necessary, as a reference guide while taking the survey.

Table 100: Conjoint Survey Attributes and Levels

Attribute	Standard Bulbs	Flood Bulbs	Incandescent
Price	$.60 to $7.50	$2.40 to $15	$.65 (standard) $4.00 (flood)
Light Color	Warm/soft (with yellow tones) Cool/bright/natural (with white tones)		Warm/soft with yellow tones
Turn On	IMMEDIATELY on, DIM at first DELAYED on, FULL BRIGHTNESS		IMMEDIATELY on, FULL BRIGHTNESS
Labels	No ENERGY STAR label ENERGY STAR label ENERGY STAR label plus utility sticker		No ENERGY STAR label
Lifetime Cost Savings	8 year life, $60 saved 10 year life, $75 saved 12 year life, $90 saved		1 year life, $0 saved
Environment	BETTER for environment MUCH BETTER for environment		NO IMPROVEMENT for environment
Bulb Shape	Mini twister Standard Twister Covered Twister	N/A	N/A

8.10.1.4 NTGR Calculation

The core of the Upstream Lighting Program theory is to offer upstream incentives to reduce the retail costs of CFLs, and thus increase sales of CFLs. The NTGR estimate, therefore, can be calculated by combining the findings from the pricing study (which estimates the percent reduction in CFL prices that resulted from program incentives) with the demand elasticity results from the conjoint analysis (which estimates the corresponding percent increase in market share/sales that result from the price decrease). The combination of these results provides an estimate of program-induced sales which, when compared to the program-claimed sales, can provide an estimate of the NTGR.

8.10.2 Results

To compute price demand elasticity, a choice-based conjoint survey tool (Sawtooth CBC) simulated "market shares" of one configuration versus another at different price points using results from the conjoint study. In other words, the market share of a particular configuration of one CFL (choosing a particular level for each attribute) is compared to the market share of the incandescent bulb at each of the price levels for the CFL. Market share elasticity is computed by a regression analysis of $y = ax + b$ where y = natural log of market shares, and x = natural log of the CFL price. The analysis solves for a, or elasticity which equals Ln(market shares)/Ln (price).

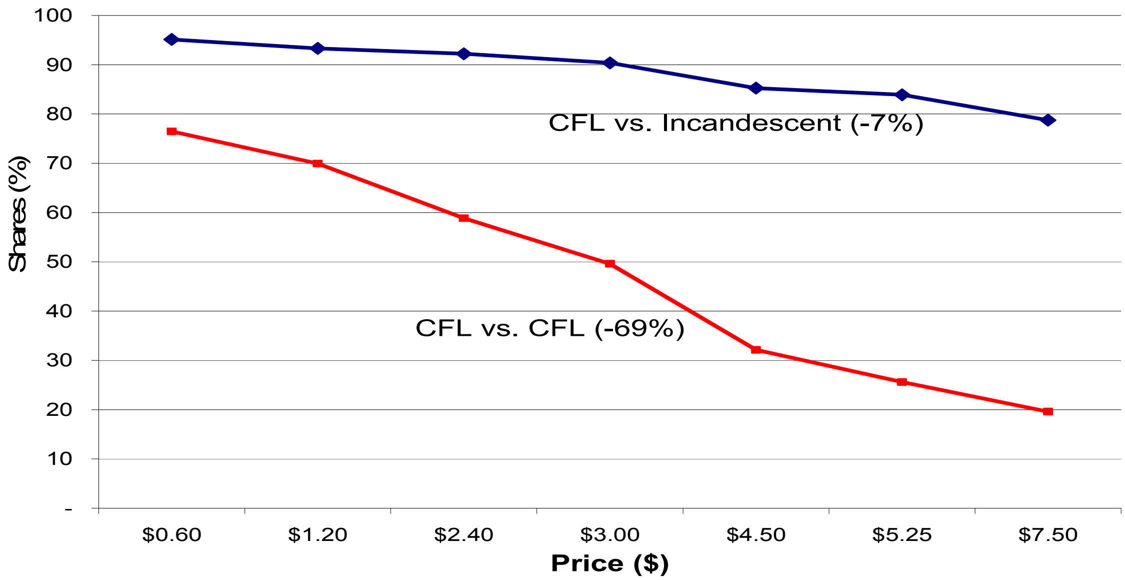
The price elasticity of a common standard CFL compared to an incandescent bulb was -0.07 (i.e., for every $1 decrease in bulb price, market share of CFLs will increase by 7%). Figure 4 is a graphical representation of price elasticity for a common standard CFL compared to an incandescent bulb showing its relatively inelastic results.

The relatively low price elasticity implies that utility incentives paid to lower the price of CFLs have very little effect on purchase rates. Indeed, the associated focus group results indicated that for many consumers, as long as there are long term savings from CFLs, differences in upfront prices are not as important. However, the Team cautions against placing too much importance on this elasticity result – as the controlled study environment and complete disclosure of CFL costs and benefits vs. incandescent bulbs may have biased the results. For study purposes participants also assumed easy availability of the CFL they wanted and in the package size desired – which is not always true in the actual marketplace. Further, illustrating this point, throughout the conjoint study 90% of the bulb choices were CFLs while estimates of the actual proportion of CFL choice compared to incandescent bulbs[51] is 1 in 3.

A more realistic determinate of price demand elasticity might be the price elasticity among two different configurations of CFLs. Figure 4 also illustrates that for consumers choosing between two types of CFLs, price has a much greater impact on purchasing decision. For standard CFLs, the price elasticity between two types of CFLs was -69%.

[51] As indicated from Wave 2 of the CFL User Survey.

Figure 4: Demand Elasticity from the Conjoint Analysis (Basic CFLs)



8.10.3 NTGR Estimate

To NTGR estimate from the pricing and conjoint study results the percentage change in CFL prices due to the program was multiplied by price elasticity to compute the inferred change in program sales. As noted above, average price reduction for IOU-discounted twister style bulbs was approximately 68%. This 68% price decrease, multiplied by -7% market share elasticity, results in a 4.7% increase in market share. The CFL Market Effects report estimated at total of 55.6 million CFLs sold in the IOU service territories during 2007.[52] Total increased sales were therefore estimated as 2.5 million bulbs (55.6 * (1-1/1.047). In addition, approximately 42.5 million received the IOU discount in 2007. As summarized in Table 101, therefore, the NTGR estimate would be 6% (2.5/42.5). However, if the 69% demand elasticity is assumed, the NTGR estimate would be 42%.

[52] The NTGR calculations presented here are based on 2007 only because the CFL Market Effects report did not have estimates of total sales for 2006 nor 2008. As 2007 is the middle year of the cycle, however, this estimate likely captures the mid-point for market changes that were occurring from 2006 to 2008 (i.e., likely increases in baseline CFL sales that were occurring during this period).

Table 101: NTGR Calculations Using Price Demand Elasticity (Basic CFLs)

Demand Elasticity	**7% Demand Elasticity Scenario**	**69% Demand Elasticity Scenario**
Percent Increased Sales	4.7%	46.6%
Total 2007 CFL Sales	52,294,817	52,294,817
Increase in Sales	2,359,446	16,616,961
IOU Discounted Bulbs	39,957,967	39,957,967
NTGR	**6%**	**42%**

Tables 102 and 103 present NTGR results by IOU for each of the demand elasticity scenarios, respectively.

Table 102: Conjoint Survey-Based NTGR Estimate at 7% Elasticity (Basic CFLs)

	PG&E	**SCE**	**SDG&E**	**All IOUs**
Average Non ULP Price	$4.23	$4.02	$3.85	$4.00
Average ULP Price	$1.09	$1.63	$1.15	$1.30
Average Price Decrease	74%	59%	70%	68%
Increased Sales (%)	5.2%	4.2%	6%	4.7%
Increased Sales	1,092,017	857,488	288,265	2,241,474
Total IOU Bulb Sales	18,037,718	14,506,297	3,597,980	36,063,233
NTGR Estimate	**6%**	**6%**	**8%**	**6%**

Table 103: Conjoint Survey-Based NTGR Estimate at 69% Elasticity (Basic CFLs)

	PG&E	**SCE**	**SDG&E**	**All**
Average Non ULP Price	$4.23	$4.02	$3.85	$4.00
Average ULP Price	$1.09	$1.63	$1.15	$1.30
Average Price Decrease	74%	59%	70%	68%
Increased Sales (%)	51.2%	41.0%	48.4%	46.6%
Increased Sales	7,488,103	6,243,080	2,008,873	15,786,113
Total IOU Bulb Sales	18,037,718	14,506,297	3,597,980	36,063,233
NTGR Estimate	**42%**	**43%**	**56%**	**44%**

NTGR estimates were also calculated using similar methodology for specialty (i.e., reflector-style) CFLs. These results also produced two sets of demand elasticity scenarios, with the resulting NTGR estimates presented in Table 104.

Table 104: Conjoint Survey-Based NTGR Estimate for Specialty (Reflector-Style) CFLs

	20% Elasticity	**92% Elasticity**
Average Non ULP Price	$8.05	$8.05
Average ULP Price	$3.89	$3.89
Average Price Decrease	52%	52%
Increased Sales (%)	10.3%	47.5%
Increased Sales	310,062	1,426,286
Total IOU Bulb Sales	2,177,728	2,177,728
NTGR Estimate	**14%**	**66%**

8.11 Revealed Preference Purchase Models

8.11.1 Detailed Models

This approach utilized revealed preference survey data collected through the in-store consumer intercepts. Steps in calculating the NTGR estimate using revealed preference data are as follows:

1. Data Coding. Intercept data were coded into analysis variables.
2. Logistic Regressions. We model the probability of buying a CFLs rather than an "equivalent" non-CFL as a function of price, displays, customer characteristics, and bulb characteristics, by channel
3. Regression Application. Evaluate the fitted model at "program" and "non-program" price, display conditions
4. Calculation of Program Attribution and NTGR.
5. Weight to Total Sales.

Details on each step are provided below.

8.11.1.1 Data Coding

For use in the modeling, the complex shelf survey and revealed preference data had to be coded into analysis variables. Coding included:

- Defining equivalence groups of non-CFLs and CFL substitutes at each store
- Characterizing CFL displays in terms of prominence and size
- Calculating shelf volumes for CFLs and non-CFLs

Variables developed included:

- Store-level information
    - Sets of CFL, non-CFL equivalents
    - Average and minimum prices for each CFL and non-CFL group of equivalents
    - Promotional index
    - Display index
    - Presence of discounted CFLs
- Package-level information
    - Average and minimum price for CFL or non-CFL equivalent to what was purchased

8.11.1.2 Logistic Regressions

Logistic regressions are run separately by channel group. Because of the limited number of revealed preference surveys in some channels, we aggregated the channels into groups for this analysis.

Since customers must buy whole packages, and a given customer may buy both CFL and non-CFLs packages, the unit of observation for the analysis is the package, rather than the bulb or the customer. We use customer or store as a cluster variable. This affects the calculated precision of the estimate but does not affect the estimates themselves.

For customers who planned to buy lighting before entering the store (planned purchases), a dominant driver of the choice to buy CFLs is intent to buy CFLs. Customers who did not intend to buy lighting at all (unplanned purchases) could not have intended to buy CFLs. We therefore fit models separately for those who planned to buy lighting and those who did not. We weight the associated NTGR results according to the proportions of customers in each channel who made planned and unplanned purchases.

Terms tested for inclusion in the models included:

- Store characteristics
    - Various measure of CFL price and price increment above non-CFL equivalents
    - Presence of discounts
    - CFL display prominence
    - Promotional index
- Customer characteristics
    - Intent to buy CFLs
    - Current use of CFLs at home or business

Because we had customer demographic information only for a subset of the surveys, we did not use these variables in most of the models run.

For cases where intent to purchase CFLs dominated the determination of CFL purchase, we took the next step of modeling the factors that affected intent to purchase CFLs. We included store characteristics in this model, on the assumption that price, display, and discount characteristics of the store affected the decision to come to the store for CFLs, or are correlated with outside marketing that affected that decision.

Final models were selected based on:

- Having well determined coefficients
- Having coefficients that made sense
- Having coefficients that were stable under minor re-specifications or stepwise regressions in varied order.

8.11.1.3 Regression Application

The fitted models were evaluated under "program" and "non-program" conditions. The program condition was the average of the actual observed conditions. The non-program condition was determined by substituting non-program average prices, displays, etc.

8.11.1.4 Calculation of Net-to-Gross Ratio

For each channel, the difference between the probability of purchasing CFLs under the program condition (p_{pgm}) and that under the non-program condition (p_{nonpgm}) is the program-attributable CFL sales share. The ratio of this difference to the with-program probability is the proportion of program sales attributable to the program, that is, the NTGR. Thus, the NTGR is calculated from the modeled purchase probabilities as:

$$NTGR = (p_{pgm} - p_{nopgm})/p_{pgm}$$

8.11.1.5 Contrast Method

An alternative NTGR estimate is provided by a simple contrast from the sales data themselves. The contrast estimate is:

$$NTGR = [(\text{sales w/ pgm}) - (\text{sales w/o pgm})]/(\text{sales w/ pgm})$$

$$= (f_{pgm}T_{pgm} - f_{no\text{-}pgm}\,T_{no\text{-}pgm})/(f_{pgm}T_{pgm})$$

Where,

f = CFL sales share

T = total bulb sales (including CFLs and non-CFLs, program and non-program)

If total CFL sales are not affected by the program, the totals T drop out of the equation and it reduces to:

$$NTGR = (f_{pgm} - f_{no\text{-}pgm})/f_{pgm}$$

Alternatively, if we are able to estimate the relative change in total sales due to the program, we calculate:

$$NTGR = (f_{pgm} - f_{no\text{-}pgm}\,T_{no\text{-}pgm}/\,T_{pgm})/f_{pgm}$$

Calculating the NTGR assuming that total CFLs sales is not substantially changed by the program provides a conservative estimate of NTGR. This is the approach taken in the contrast model analysis.

8.11.2 Detailed Results

8.11.2.1 Logistic Regressions (Basic CFLs)

Table 105 shows the variables included in the logistic regression models with the revealed preference data for basic CFLs, along with their estimated coefficients and p-values. Also shown are the average values of each variable in the program and no-program condition. The program condition is the actual situation as found. The no-program condition was constructed using the substitutions indicated in the Table 106.

Table 105: Logistic Regression Models (Basic CFLs)

Channel	Variable Meaning	coefficient	p-value	with program		without program	
Hardware Home Imp				Average	SD	Average	SD
Planned to buy	Intercept	-3.64	3.2%				
Lighting	Intent to Purchase CFL	6.05	<.0001	0.57	0.50	0.57	0.50
	Has CFLs in Storage at home or work	1.40	6.6%	0.40	0.49	0.40	0.49
	Price of Brand-Name CFL - Brand-Name Incand	-8.73	0.2%	1.13	2.25	1.12	2.26
	Price Avg CFL - Avg Incand	-4.13	<.0001	2.43	2.42	2.61	2.60
	Avg Price of CFL	3.59	0.0%	3.27	2.30	3.45	2.49
	Presence of Brand-Name CFL	-0.49	76.8%	0.37	0.48	0.37	0.48
	# Comparable Incand Models	-0.43	0.1%	9.00	4.78	9.00	4.78
	# Comparable Discount CFL Models	-0.75	2.7%	1.08	1.55	0.00	0.00
	Price of Cheapest Brand-Name CFL	7.83	0.6%	1.52	2.39	1.52	2.39
	Presence of IOU-Discount CFLs in Store	1.16	23.2%	0.82	0.39	0.00	0.00
	CFL Display Index	0.67	22.7%	1.56	0.66	1.28	0.48
Lg Grocery Drugstore							
Planned to buy	Intercept	15.44	3.9%				
	Avg Price of CFL	-3.67	5.7%	3.85	2.28	3.90	2.30
	Price Brand-Name Inc/Price Inc	-6.94	5.4%	1.47	0.70	1.47	0.70
	Price of Cheapest Brand-Name Inc	23.93	6.9%	0.67	0.27	0.67	0.27
	Min #Bulbs Per Package, All Incand	-6.31	9.8%	1.40	0.97	1.40	0.97
	# Comparable Discount CFL Models	8.06	11.0%	0.74	1.41	0.00	0.00
Mass Merch/Memb Cl							
Planned to buy	Intercept	4.44	5.8%				
Lighting	Intent to Purchase CFL	13.72	0.2%	0.56	0.50	0.56	0.50
	Avg Price of CFL	-2.55	0.4%	2.24	1.18	2.24	1.18
	Avg Discount $ (comparable bulbs per store, where knc	1.45	1.8%	1.08	1.28	1.08	1.28
	# Comparable CFL Models	-0.40	4.6%	10.14	5.13	10.14	5.13
Hardware Home Imp	Intercept	-6.36	13.3%				
Did Not Plan To Buy	Price Avg CFL - Avg Incand	-2.37	8.0%	1.64	1.86	1.66	1.90
Lighting	Price of Cheapest CFL	5.48	3.2%	1.80	1.09	2.25	1.05
	Min #Bulbs Per Package, Brand-Name CFL	-10.56	9.0%	0.41	0.50	0.41	0.50
	Min #Bulbs Per Package, Brand-Name Incand	3.64	16.1%	2.39	1.40	2.39	1.40
	# Comparable Discount CFL Models	4.34	15.0%	0.75	1.04	0.00	0.00
	Price Brand-Name CFL/Price CFL	1.80	70.8%	0.74	1.45	0.30	0.48
Lg Grocery Drugstore							
Did Not Plan To Buy	Intercept	4.98	2.7%				
Lighting	Price Avg CFL - Avg Incand	-2.02	2.1%	0.84	2.13	0.88	2.17
Mass Merch/Memb Cl							
Did Not Plan To Buy	Intercept	4.622	16.39%				
Lighting	Price Avg CFL - Avg Incand	-11.350	11.75%	1.472	1.196	1.515	1.269
	Price Brand-Name CFL/Price CFL	10.384	12.79%	1.652	0.890	1.180	0.943
	Avg Discount $ (comparable bulbs per store, where	1.489	63.30%	0.973	1.271	0.000	0.000

Table 106: No-Program Variable Specification (Basic CFLs)

Variable Name	Description	No-Program Counterfactual
BoughtCFL	Did Customer Buy CFL (1) or Incand (0)	no change
Q2cfl	Intent to Purchase CFL	no change
aware	Aware of Discount	all zeroes
chain	Store is Chain (1) or Independent (0)	no change
inuse	Already Uses CFLs (home or work)	no change
storage	Has CFLs in Storage at home or work	no change
HTR	Hard to Reach	no change
PriceDiffBrand	Price of Brand-Name CFL - Brand-Name Incand	calculated w/o discounted bulbs
PriceDiff	Price Avg CFL - Avg Incand	calculated w/o discounted bulbs
PriceCFL	Avg Price of CFL	calculated w/o discounted bulbs
PriceInc	Avg Price of Incand	no change
anybrandcfl	Presence of Brand-Name CFL	calculated w/o discounted bulbs
anybrandinc	Presence of Brand-Name Incand	no change
PriceBrandPremCFL	Price Brand-Name CFL/Price CFL	calculated w/o discounted bulbs
MinPriceBrandCFL	Price of Cheapest Brand-Name CFL	calculated w/o discounted bulbs
MinPriceCFL	Price of Cheapest CFL	calculated w/o discounted bulbs
PriceBrandPremInc	Price Brand-Name Inc/Price Inc	no change
MinPriceBrandInc	Price of Cheapest Brand-Name Inc	no change
MinPriceInc	Price of Cheapest Inc	no change
pctCareD	%CFLs that are Discount	all zeroes
MinQtyAllcfl	Min #Bulbs Per Package, All CFL	calculated w/o discounted bulbs
MinQtyBrandCFL	Min #Bulbs Per Package, Brand-Name CFL	calculated w/o discounted bulbs
MinQtyAllIncand	Min #Bulbs Per Package, All Incand	no change
MinQtyBrandIncand	Min #Bulbs Per Package, Brand-Name Incand	no change
MeanModelsI	# Comparable Incand Models	no change
MeanModelsCDisc	# Comparable Discount CFL Models	all zeroes
MeanModelsC	# Comparable CFL Models	calculated w/o discounted bulbs
ppbactual	Price-per-Bulb Paid for Package	no change (not used in regressions)
MeanDiscAmt	Avg Discount $ (comparable bulbs per store, where known)	all zeroes
MeanDiscAmt2	Avg Discount $ (comparable bulbs per store, where known)	all zeroes (not used in 'final' regressions)
MeanDiscAmt3	Avg Discount $ (comparable bulbs per store, where known)	all zeroes
ioubulbs	Presence of IOU-Discount CFLs in Store	all zeroes
PctCFLvol	% Display Volume that is CFL	scaled by ratio of #disc/#CFLs in the store
PctPremiumCtoI	Price of CFL / Price of Incandescent	calculated w/o discounted bulbs
CFLdispIdx	CFL Display Index	avg value of stores w/no program cfls
CFLpromIdx	CFL Promotion Index	avg value of stores w/no program cfls
PromoIdx	Promotional Index	avg value of stores w/no program cfls

Table 107 shows the basic CFL purchase probabilities under the program and no-program conditions estimates from the models. Also indicated in the table are the corresponding NTGR estimates calculated for basic CFLs from these probabilities.

Table 107: Estimated CFL Purchase Probabilities with and without the Program, and NTGR Calculation, by Channel Group (Basic CFLs)

Group		CFL Purchase Probability			NTGR
		with Program	without Program	Difference	
Planned	**Hardware Home Imp**	63.6%	60.8%	3.1%	4.9%
Planned	**Lg Grocery Drugstore**	57.8%	38.2%	19.5%	33.8%
Planned	**Mass Merch/Memb Cl**	59.4%	56.4%	3.0%	5.1%
Unplanned	**Hardware Home Imp**	80.4%	77.1%	3.3%	4.1%
Unplanned	**Lg Grocery Drugstore**	81.8%	80.4%	1.5%	1.8%
Unplanned	**Mass Merch/Memb Cl**	66.7%	59.7%	7.0%	10.5%

The revealed preference models provide generally low NTGR values for basic CFLs. The planned purchase models are likely to understate the program effect because a dominant driver of CFL choice among customers who planned to purchase lighting is whether they intended to buy CFLs when they came to the store. Almost all customers who arrived intending to buy CFLs did so. As a result we cannot adequately capture the effect of the program on the purchase based on characteristics observed in the stores.

Among the unplanned purchasers, the Large Grocery and Drugstore group had a very unstable model, whose coefficients changed dramatically if any additional variable was introduced. These results are therefore not reliable.

8.11.2.2 Simple Contrasts between Program and No-Program Stores (Basic CFLs)

As an alternative to the revealed preference models, we compared the sales shares among stores that did not have any IOU-discounted CFLs at the time we visited with the sales shares at stores with IOU-discounted CFLs. That is, the no-program stores serve as a baseline for program stores. Results are shown in Table 108 for basic CFLs.

Table 108: Simple Contrast NTGR Calculations from the RP Surveys by Channel Group and Lighting Purchase Intent

Channel	Planned or Unplanned	IOU Discounted Bulbs Present	N	Mean	Std Error of Mean	90% CL for Mean		P(t-test) between IOUbulbs	Difference	NTGR
Hardware/ Home Improvement	Planned	Yes	46	78.3%	8%	65%	91%	0.9%	-21.7%	-27.8%
		No	6	100.0%	0%	100%	100%			
Large Grocery /Drug	Planned	Yes	172	66.9%	6%	58%	76%	21%	16.9%	25.2%
		No	38	50.0%	12%	30%	70%			
Membership Club / Mass Merchandise	Planned	Yes	39	89.7%	6%	80%	100%	22%	56.4%	62.9%
		No	3	33.3%	31%	-19%	85%			
Hardware/ Home Improvement	Unplanned	Yes	36	66.7%	10%	51%	82%	0.49%	48.5%	72.7%
		No	11	18.2%	13%	-2%	39%			
Large Grocery /Drug	Unplanned	Yes	60	80.0%	7%	69%	91%	19%	46.7%	58.3%
		No	3	33.3%	27%	-12%	78%			
Membership Club / Mass Merchandise	Unplanned	Yes	179	60.9%	5%	53%	69%	25%	15.9%	26.1%
		No	20	45.0%	13%	24%	66%			

The NTGR estimates from the two revealed preference methods, combining planned and unplanned purchases, are summarized in Table 109.

Table 109: RP Survey NTGR by Channel, Logistic Regression Model and Simple Contrast (Basic CFLs)

Channel Group	NTGR Modeled	90% CI		NTGR Simple Contrasts	90% CI	
		Lower	Upper		Lower	Upper
Hardware/Home Improvement	5%	1%	8%	20%	15%	24%
Large Grocery/Drug	26%	15%	37%	33%	6%	60%
Mass Merchandise/Membership Club	10%	1%	18%	33%	24%	41%

8.11.2.3 Simple Contrasts between Program and No-Program Stores (Specialty CFLs)

Simple contrast models were also constructed for specialty CFLs, with results shown in Table 110. Only the mass merchandise/membership club channel group and the overall combined results are statistically significant. The hardware/home improvement and large grocery/drug channel groups are likely under-estimating the actual NTGR.

Table 110: RP Survey NTGR by Channel, Simple Contrast Model (Specialty CFLs)

Channel Group	NTGR Simple Contrasts
Hardware/Home Improvement	-21%
Large Grocery/Drug	55%
Mass Merchandise/Membership Club	73%
Combined	60%

8.12 Stated Preference Purchaser Elasticity Models

8.12.1 Detailed Method

As mentioned above, revealed preference survey respondents were asked to indicate how many CFLs they would have bought compared to their actual purchases at double the price they actually paid. Response categories were same amount, fewer, or none.

We define the relative quantity purchased Q_r/Q_1 as the ratio of hypothetical purchases Q_r at a price r times the actual price to the amount Q_1 actually purchased. The relative quantity that would be bought at double the price is 0 for response category "none," ($Q_2 = 0$, $Q_2/Q_1 = 0$) and 1.0 for response category "same" ($Q_2 = Q_1$, $Q_2/Q_1 = 1$). We assume the relative quantity that would be bought is 0.8 for response category "fewer." Sensitivity to this assumption is was also tested, as discussed below.

Table 111 below indicates the relative quantity for each response category, and the fraction of purchasers in each response.

Table 111: Relative Quantity Purchased at Double the Actual Price

Response Category	Percent who would buy this many @ 2x actual price	Fraction of observed CFLs bought @ 2x price
None	36%	0.0
Fewer	25%	0.8
Same	39%	1.0
Overall	100%	0.59

The relative quantity is the fraction of current sales that would still occur at double the price. We weight the relative quantities for each response category by the fraction of observed bulb purchases corresponding to that response category. The result is the overall estimate of the relative quantity purchased at double the price.

100% minus this amount is the relative change in quantity purchased at a 100% price increase. In the example above, 59% of observed purchases would still occur at double the price. 100% minus that amount or 41% is the change in quantity at 100% price increase.

The decrease in the quantity purchased at the non-program price is the portion of actual purchases that would not occur absent the program. This is the attributable portion of purchases. If the only effect of the program were to change prices, this attributable portion would be the net-to-gross ratio. We calculate the NTGR on this basis, recognizing that the estimate is conservative to the extent that the program has affected purchases not only via price reductions but also via expanded availability, promotions, and shelf space.

To estimate the NTGR by this method, we need the change in quantity if the purchasers had faced the non-program price rather than the price they did with the IOU discounts in place. This estimate requires extrapolation from the available price points. We considered 2 different methods for this extrapolation, linear and log. The linear method breaks down at the price ratios of interest for the NTGR calculation. We therefore relied on the logarithmic extrapolation.

Linear extrapolation

The linear method simply scales the change at 100% price increase by the price difference between non-program and with-program prices, relative to the with-program price. That is

Q_1 = quantity purchased at actual prices

Q_2 = stated quantity that would be purchased at price ratio 2 times actual prices

$(Q_r – Q_1)/Q_1$ = relative quantity change at a price ratio of r times the actual price

r-1 = relative price change for a ratio of r times the actual price.

Then for a price ratio of r times the actual price we estimate the reduction in quantity that would be purchased, relative to the observed quantity, as

$$NTGR = -(Q_r – Q_1)/Q_1 = (r-1)(1-Q_2/Q_1).$$

For example, if the no-program price is 50% above the actual price, we estimate a decrease in purchases of half of the reported 41% reduction for a price 100% above the actual, or 20.5%. That is, in this example, if the price of program bulbs were at its non-program level, 20.5% of current program bulb purchases would not occur. These are the program-attributable sales. The remaining 79.5% of current purchases would occur even at the non-program price level. These are essentially “free rider” purchases. The NTGR in this case is estimated at 20.5%.

Similarly, if the no-program price is 150% above the actual price (ie r = 2.5 times the actual) we estimate a quantity reduction of 150% times the reduction at double the price, or NTGR = 61.5%.

Log extrapolation

The logarithmic extrapolation assumes that price and quantity and log-linearly related. This relationship form is a more standard assumption. That is, we assume

$$\ln(Q_r/Q_1) = e \ln(P_r/P_1)$$

where ‘ln’ denotes natural logarithm and e is the elasticity. That is, the relative change in quantity Q is e times the relative change in price P.

The elasticity e is estimated from the quantity purchased at double the price as

$$e = \ln(Q_2/Q_1)/\ln(2)$$

In the example above, e = ln(.52)/ln(2) = -0.9.

The NTGR is still calculated as

$$NTGR = -(Q_r – Q_1)/Q_1 = 1 – Q_r/Q_1.$$

This quantity is calculated from the elasticity and the no-progrm-to-program price ratio r as

$$NTGR = 1 - Q_r/Q_1 = 1 - \exp(e \ln(r))$$

$$= 1 - \exp((\ln(Q_2/Q_1)/\ln(2)) \ln(r)).$$

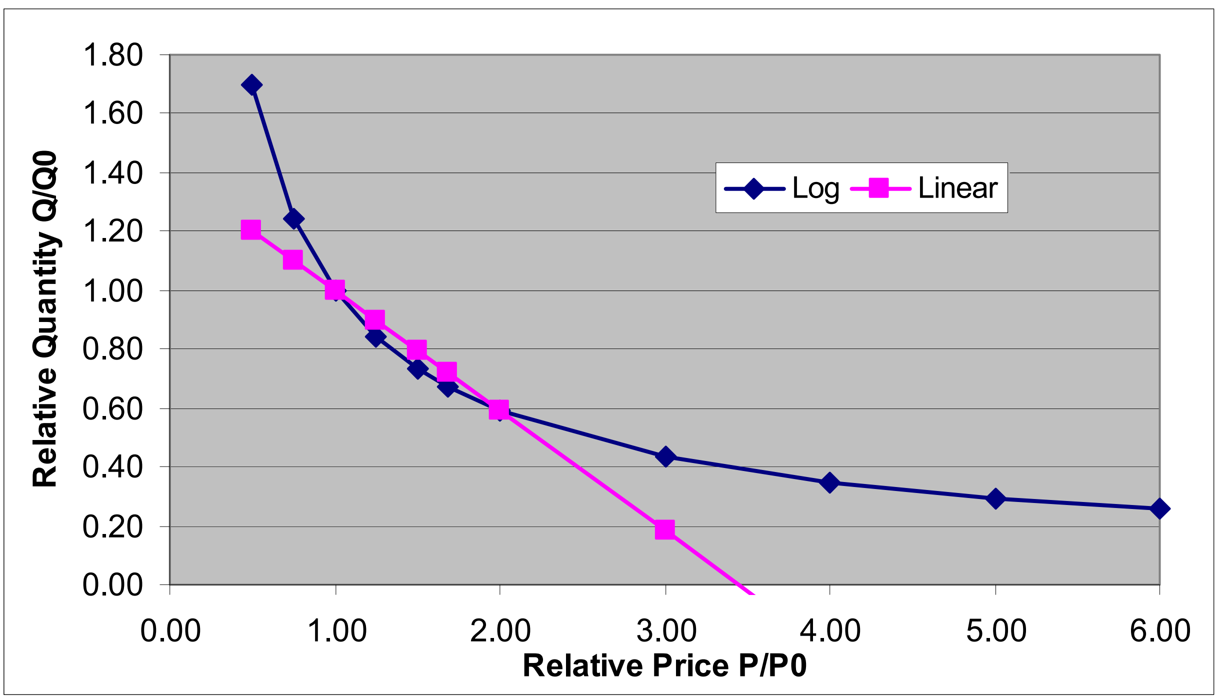
The price P_0 that would have been in place in the absence of the program is estimated from the pricing study. The relative price ratio r is the ratio of the no-program to program price. This price ratio is determined separately for each channel.

Comparison of linear and log estimation

In the example given, the elasticity estimated by the linear method is -0.41. The elasticity estimated by the log method is -0.76. As indicated in Figure 5, the two methods give the same results at price ratios of 1 (actual prices) and 2 (double the actual price). They also give similar results for price ratios between these two values or not far above or below. However, the linear method is more extreme at higher price ratios. At a price ratio around 3 the linear method indicates that the quantity purchased would be zero.

The log form gives a more natural relationship between price and quantity, and does not produce unreasonable NTGR values at higher prices. The log form is a more appropriate representation of the quantity/price relationship.

Figure 5: Estimation of Relative Quantity Purchased as a Function of Price Ratio, Linear and Log Methods



Elasticity Estimate at Lower Price

In addition to asking how many CFLs would have been purchased at twice the observed price, the revealed preference surveys also asked how many would have been purchased at half the observed price.

Possible answers were zero, same, and more. In principle, an elasticity could be calculated from these responses as well, if the average increase for the “more” respondents were known.

Across the various channels, the prices in the absence of the program ranged from 2.6 to over 6 times the actual prices with the program. Thus, the responses for double the price are more informative than those for half the actual price when extrapolating to the no-program condition.

More importantly, the half price responses cannot by themselves provide an elasticity estimate. Unlike the “fewer” category, for which the average must be between 0 and 100% of the actual amount purchased, the average for the “more” category is unbounded at the high side. We know only that it must be more than 100% of the actual amount.

As a sanity check on the elasticity based on doubling the price, we calculated the average that would need to be assumed for the more category to yield the same elasticity using the responses for the question on half the price. These averages ranged between 1.3 and 1.5. That is, those who would purchase more CFLs at half the price would have to be buying 30 to 50% more overall than they did at the actual price. This increase represents a realistic level of purchases. In this sense, the half price results indicate that the elasticities based on the doubled price are not unreasonable.

8.12.2 Detailed Results

The primary results of the elasticity calculation are given in the main text. These results correspond to the assumption that those who would buy fewer CFLs at double the price would buy 80 percent as many (20 percent fewer).

We also conducted the analysis assuming the relative quantity for "fewer" was 0.5, and assuming it was 0.8. We did not test more extreme values than 0.2 and 0.8. Given choices of none, fewer, or same, we assume that the majority of those who say they would buy fewer expect to buy a quantity that's meaningfully different from 0 and from the same quantity they did buy. Also, for the typical quantities actually purchased, averaging 4 to 5 bulbs per customer, more extreme fractions are not realistic.

In the absence of additional information, an average of 0.5 as the relative quantity for the “fewer” category seems appropriate. As noted in the main text, the lower elasticity case, corresponding to the assumption that those who say they would buy fewer would buy only 20 percent fewer, is somewhat conservative. On the other hand, customers who have just made a purchase are likely to overstate their price sensitivity somewhat. We use the conservative assumption to counterbalance this potential overstatement.

Results for the different assumptions are indicated in Table 112.

Table 112: NTGR Estimates Based on Stated Preference Purchaser Elasticity Calculation

Assumption	Relative quantity purchased by those who would buy fewer at double the price	PG&E		SCE		SDG&E		All IOUs
		Weighted-Average Estimate of IOU-Discounted CFLs Likely Purchased at 2x Price	NTGR	Weighted-Average Estimate of IOU-Discounted CFLs Likely Purchased at 2x Price	NTGR	Weighted-Average Estimate of IOU-Discounted CFLs Likely Purchased at 2x Price	NTGR	NTGR
Low elasticity	0.8	74%	**40%**	71%	**47%**	47%	**34%**	**42%**
Middle	0.5	65%	**52%**	61%	**60%**	40%	**50%**	**55%**
High elasticity	0.2	56%	**63%**	51%	**71%**	33%	**62%**	**66%**

Confidence interval calculation for stated preference purchaser elasticity NTGR

The relative quantity that would be purchased at double the actual price is calculated as

$$Q_2/Q_1 = 1p_s + fp_f + 0p_0 = p_s + fp_f$$

where p_s, p_f, and p_0, respectively, are the proportions who would buy the same, fewer, or 0 CFLs at double the actual price, and f is the assumed average relative quantity that would be purchased by those who would buy fewer.

We make the simplifying assumption that the proportion p_s who would buy the same quantity and the proportion of the remainder who would buy fewer are independent. That is, q and p_s are assumed to be independent, for

$$q = p_f/(1-p_s).$$

With this assumption, the variance of relative quantity is calculated as

$$Var(Q_2/Q_1) = Var(p_s + f(1-p_s)q) = Var(p_s + fq-fqp_s)$$

$$\simeq (1-fq)^2Var(p_s) + (f(1-p_s))^2Var(q)$$

$$= (1-fq)^2p_s(1-p_s)/n + (f(1-p_s))^2q(1-q)/(n_f + n_0)$$

$$= (1-fq)^2p_s(1-p_s)/n + (f(1-p_s))^2(p_f/(1-p_s))\ (p_0/(1-p_s))/(n_f + n_0)$$

$$= (1-fq)^2p_s(1-p_s)/n + f^2p_f\ p_0/(n_f + n_0)$$

$$SE(Q_2/Q_1) = Var(Q_2/Q_1)^{1/2}$$

The standard error of the linear NTGR is then

$$SE\ (NTGR_{linear}) = SE((r\text{-}1)(Q_2/Q_1\text{-}1))$$

$$= (r\text{-}1)SE(Q_2/Q_1)$$

The standard errror of the log NTGR is calculated as follows:

$$NTGR_{log} = 1 - \exp((\ln(Q_2/Q_1)/\ln(2))\ \ln(r))$$

$$\partial NTGR_{log}/\partial(Q_2/Q_1) \simeq (1 - NTGR_{log})\ \ln(r)\ /(\ln(2)Q_2/Q_1)$$

Therefore

$$SE(NTGR_{log}) \simeq [(1\text{-}NTGR_{log})\ \ln(r)\ /(\ln(2)Q_2/Q_1)\ ]SE(Q_2/Q_1)$$

8.13 Channel Shift

Channel shift refers to sales through one channel that, absent the program, would have occurred through another channel. That is, while the program may induce sales that would not have otherwise occurred in a particular channel, it does so at the expense of another channel, at least in part. For example, discount and small grocery stores accounted for about 34 million IOU-discounted CFLs (or nearly 37% of total shipments) and preliminary results indicate that these types of stores may not have sold program measures in the absence of the program. However, some portion of these sales may have occurred through other mainstream, "big box" distribution channels (i.e., Wal-mart, Costco, Home Depot, etc.).

To assess the potential for channel shift between the discount chains and the mainstream distribution channels, we mapped the relevant stores to determine how close to each other these potentially competing stores were located. While we cannot say with certainty whether channel shift happened between stores, we can at least rule out stores where it was unlikely to happen due to stores not being located within reasonable driving distances.

The channel shift analysis consisted of the following steps (as illustrated in Table 113):

- For each channel or group of channels, determine the subset of stores that are likely to gain or lose sales as a result of channel shift. Determine the total residential program sales in each of these subgroups.
- Determine non-program residential sales in each group by applying the ratio of total to program sales determined elsewhere. [53]
- Apply initial NTGR estimate to each channel group to determine program-attributable sales.
- Calculate sales absent the program, excluding channel shift, as the non-program sales plus the non-attributable program sales.
- For the likely gainers or recipients (i.e., discount stores), determine what fraction of stores are within a reasonable distance of a likely channel shift victim or source (i.e., big box stores). Assume that a portion of the sales from these stores have been pulled from a source store.
- Assume that these shifted sales were distributed among source stores in proportion to their estimated total sales absent the program.
- Re-calculate total sales absent the program by adding back the estimated amounts shifted from or to each channel.

[53] Both the interviews and surveys with supply-side market actors (e.g., manufacturers, retail buyers, and retail store managers), as well as revealed preference surveys completed with CFL purchasers at the time-of-purchase, were used to determine the ratio of total to program sales.

- Calculate NTGR estimate as the difference between total sales with the program and the recalculated total sales absent the program, divided by program sales.

The result provides an estimate of the impacts of the program net any indirect effects from channel shift. Table 113 is presented an illustrative example of how to apply this logic, using the recommended final NTGR estimates (row E) and arriving and at the revised estimates accounting for channel shift (row N). Given the number of and significant uncertainty around the assumptions we needed to make to provide this example, it is recommended only as a means of illustrating – not quantifying – the possible effects from channel shift.

Table 113: Illustrative Example of Method for Assessing Effects of Channel Shift on Overall NTGR Estimates

Row	Description	Basis	Hardware / Home Improvement	Large Grocery and Drug	Mass Merchandise and Membership	Small Grocery	Discount	Overall
A	Percent of IOU-Discounted CFL Shipments	IOU claims (tracking data)	15%	24%	24%	21%	16%	100%
B	IOU-Discounted CFL Sales to Residential IOU Customers	Evaluation-based adjustments to IOU claims	12.9	20.6	20.6	18.0	13.7	85.8
C	Estimate of Total Sales/IOU-Discounted CFL Sales	Evaluation estimates based on market actor estimates and revealed preference survey results	2.3	1.8	1.5	1	1	1.5
D	Non-IOU Discounted Residential CFL Sales	(C-1)*B	16.7	16.5	10.3	0.0	0.0	43.5
E	Initial NTGR (no channel shift correction)	Evaluation estimate (see discussion in Section 3.3.1 and Table 25)	36%	31%	34%	90%	90%	54%
F	Program-Attributable Residential CFL Sales	B x E	4.6	6.4	7.0	16.2	12.4	46.6
G	Total Residential Sales Absent Program (no channel shift correction)	D + B - F	25.0	30.7	23.9	1.8	1.4	82.7
H	Gains or Losses Due to Channel Shift	Evaluator assumptions	Loses	Not Affected	Loses	Gains	Gains	
I	Gains (percent shifted from other stores)	Percent of sales within reasonable proximity that would have been purchased at higher price (from stated preference purchaser elasticity models)				65%*(1-0.51)	65%*(1-.52)	

Row	Description	Basis	Hardware / Home Improvement	Large Grocery and Drug	Mass Merchandise and Membership	Small Grocery	Discount	Overall
J	Losses (percent vulnerable to shifting away)	Percent of sales within reasonable proximity that would have been affected by channel shift	33%		100%			
K	Shifted From/To Other Channels	Gains: I x F Loses: Gains allocated proportional to J x G	-2.3		-6.7	5.2	3.9	0.0
L	Total Residential CFL Sales Absent Program (including channel shift correction)	G + K	27.3	30.7	30.6	1.8	1.4	91.7
M	Net Program-Attributable Residential CFL Sales	B + D - L	2.3	6.4	0.3	16.2	12.4	37.6
N	**NTGR (accounting for channel shift)**	**M/B**	**18%**	**31%**	**1%**	**90%**	**90%**	**43%**

8.14 Total Sales (Market-Based) Approach[54]

8.14.1 Detailed Method

The total sales (or market-based) approach nets out program-influenced sales by comparing CFL sales within the California IOU service territories to an estimate of baseline sales or sales that would have happened in absence of the upstream programs. This approach was implemented as part of the CFL Market Effects Study, the results of which have helped to inform the NTGR estimates for the Residential Retrofit Evaluation.

The primary methodology for the total sales (market-based) approach was a regression model to predict CFL sales of a function of program activity, while controlling for demographic, household, and economic factors that can also influence sales. The analysis presented here was based on data from 1,034 onsite lighting inventories conducted in 11 areas in the U.S.[55] Some of these areas have no CFL programs, some have modest or newer CFL programs, and some have longstanding aggressive CFL programs.

Note that this approach in principle includes both free ridership and spillover (including both participant and non-participant spillover), as well as cumulative market effects (i.e., impacts from the cumulative history of program activity). As a result, it does not provide a direct measure of the program effect net of free riders as is necessary for the Residential Retrofit Evaluation. The method is primarily focused on 2008 impacts rather than addressing all program years, as is true of several of the other NTGR methods. Another limitation is that the final analysis, as described below, does not include any California data, making the application to California of uncertain validity.

This method is used, therefore, only as a benchmark for assessing the reasonableness of the results from the other NTGR estimates. At a minimum, it can provide a view of program-induced total effects, inclusive of all market effects. The relationship between the total sales (market-based) approach, the gross savings analysis, and the net of free ridership analysis should bare reasonable ordering and comparative magnitudes. This can be used to help verify the primary estimation approach for the NTGR estimates.

8.14.2 Detailed Results

An additional modeling approach to estimate net impacts was completed in support of the CPUC's CFL Market Effects Study. The CPUC joined other sponsoring organizations and agreed to pool telephone survey and in-home lighting inventory data for use in a multistate analysis. The collaborative effort drew

[54] This analysis was led by Nexus Market Research, with substantial support provided by The Cadmus Group and KEMA.

[55] The full multistate modeling effort incorporates data from 16 states—including California; in total over 9,300 households took part in telephone surveys and 1,400 households in onsite saturation studies.

on data from 16 states,[56] allowing for large sample sizes and the ability to take into account the national CFL market, rather than just that for any one state or electric utility service territory.

A number of factors must be kept in mind when assessing the model and resulting estimates of net impacts. First, the goal of the multistate regression analysis was to identify the total program effects – net of free ridership and spillover – that resulted from CFL program activity in 2008. [57] However, the California Evaluation Protocols allow the inclusion of free ridership, but not spillover, when calculating NTGRs. Although the goal of the CFL Market Effects Study is to examine market effects (i.e., spillover), the statistical approach utilized in the multistate models does not disaggregate these various effects. The analysis presented here, therefore, refers to the total net impact rather than the NTGR.

Second, as part of the CPUC's CFL Market Effects Study, telephone surveys and in-home lighting inventories were completed for California and three comparison states (Georgia, Kansas, and Pennsylvania) prior to the inception of the multistate modeling effort. Although the overall methods and data collection instruments were similar to those used in the other 12 states, the instruments used by the CFL Market Effects team did not ask how many CFLs they purchased in all of 2008 (dependent variable used in the model). The implication is that data from California (and its three comparison areas) were not used to develop the model presented here, and this draws into question the validity of the results for the California situation given its programmatic and socioeconomic differences from the eleven areas included in the model. We did, however, use household and demographic data from the surveys to estimate 2008 purchases and market effects in California.

Third, this effort has shown that telephone survey data are less reliable than the data collected during in-home lighting inventories by trained auditors or technicians. Therefore, the models used to estimate net program impacts in 2008 rely on in-home data on purchases in that year, although some of the socioeconomic and demographic data still come directly from the telephone surveys.

Finally, the in-home data on 2008 purchases are right skewed and, therefore, do not adhere to the normal (i.e., bell shaped or Gaussian) curve assumed by many statistical approaches; they are also count data (i.e., only whole number values are possible) with numerous cases at zero (i.e., no purchases in 2008).

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[56] The parties that authorized this study include the following: CPUC, New York State Energy Research and Development Authority, Consumers Energy in Michigan, the Connecticut Energy Conservation Management Board, Connecticut Light and Power, Northeast Utilities, The United Illuminating Company, the Cape Light Compact, NSTAR, National Grid, Unitil, Western Massachusetts Electric, Wisconsin Public Service Commission, and Xcel Energy in Colorado. Collectively, they funded data collection in California (IOU service territory), Colorado (Xcel Energy service territory), Connecticut, District of Columbia, Georgia, Indiana, Houston (Harris County, Texas), Kansas, Maryland, Massachusetts, Michigan, New York State (less New York City and Long Island), New York City, Ohio, Pennsylvania, and Wisconsin. Note that data from Colorado included in the model due to their outlier status negatively affecting the predictive capabilities of the model.

[57] While the CPUC's CFL Market Effects evaluation covers the entire 2006-2008 program cycle, the analyses conducted here focus only on 2008 due to data availability from the other sponsors.

The negative binomial regression (NBRM) approach is most frequently used to model such data, and it was used in this analysis. [58]

Table 114 summarizes the draft recommended model for 2008 CFL purchases. Because the analysis is based on NBRM, one estimates the impact of any single explanatory or independent variable on the dependent variable by multiplying it by the "impact score," not the coefficient as in ordinary least squares regression. The model suggests that 2008 program activity had a significant and positive – but small – effect on 2008 CFL purchases. Other factors driving 2008 purchases included how long the respondent has used CFLs, the number of light sockets in the home, the number of people living in the home, whether or not the respondent identified as white and the timing of the survey implementation. [59]

Table 114: Confidence Interval for the 2008 Purchase Composite Program Variable – Onsite Data

Variable	Coefficient	90% Confidence Interval		Impact Score
		Low	High	
Composite Program	0.11	0.06	0.16	0.11
Years Using CFL	0.10	0.06	0.14	0.10
Number of Sockets in Home	0.01	0.00	0.01	0.01
Number of Persons in Household	0.10	0.02	0.18	0.10
Self reported as White	0.42	0.09	0.74	0.52
Conducted During Fall Season	0.60	0.33	0.86	0.82
Constant	-0.79	-1.21	-0.38	n/a

As shown in Table 115, after computing the per-household estimates of 2008 CFL purchases in California, we summed the predicted purchases under both program scenarios across all onsite participants. We divided the totals by the number of households taking part in the onsite surveys. These calculations predicted that each California household purchased an average of 2.77 CFLs in the program scenario and 1.86 CFLs in the no-program scenario, yielding an estimate of 0.91 CFL purchases being directly attributable to the program. Dividing by the estimated number of rebated CFLs per household (including specialty CFLs) gives an estimated NTGR of 23%, which is among the lowest of the NTGR estimates presented in this report.

[58] Long, J.S and J. Freese (2006) Regression Models for Categorical Dependent Variables Using Stata. Stata Press: College Station, TX. Elhai, J.D., P.S. Calhoun, and J.D. Ford "Statistical Procedures for Analyzing Mental Health Services Data." Psychiatry Research 160(2):129-236.

[59] Some surveys were conducted in the late fall or early winter of 2008/2009 while others were conducted in the late spring and early summer of 2009.

Table 115: Multistate Regression Calculation of NTGR

Input	Estimate	90% Confidence Level	
		Low Estimate	High Estimate
Predicted Purchases with Program	169	135	296
Predicted Purchased without Program	113	79	240
Onsite Sample Size	61	61	61
Per-household Purchases with Program	2.77	2.21	4.85
Per-household purchases without Program	1.86	1.30	3.94
Net Program Purchases per Household	0.91	0.91	0.91
Incented CFLs per Household**	3.89	3.89	3.89
NTGR	23%	23%	23%

* Based on model-based predicted purchases because the onsite methodology used in the CPUC states did not ask about the number of CFLs purchased in 2008; results subject to rounding error.

** Based on final E3 calculator reports, the three IOUs incented 38,508,189 residential CFLs (including specialty bulbs) in 2008. We estimated a total of 9.9 million households in the service territory, yielding the estimate of 3.89 CFLs per household. Note this estimate does not adjust for installation rate.

The NTGR estimate of 23% is based entirely on modeled data, but the validity of this model to the California situation is tenuous because California was not used in the development of the model because 2008 purchase data were not collected as part of the in-home lighting inventories. The team, therefore, wanted to provide a NTGR estimate based on observed 2008 residential CFL sales and that also excluded spillover from the calculation of NTGR. To develop this estimate, we relied on the following equation:

NTGR = ((with-program sales) – (no program sales))/(with-program sales)

where sales are total 2008 residential CFL sales, with or without the program. The numerator of this equation is the total volume of program-attributable CFL sales in 2008. If we divided by the sales through the program only, the ratio would be a net-to-gross ratio including spillover and market effects. We divide instead by the total sales, including program and non-program sales. The result is the fraction of all CFL sales that are attributable to the program.

That is, we can't identify "free rider" bulbs and "spillover" bulbs with the market-based approach. We can just say that of all the CFLs that were bought, a certain fraction of them were attributable to the program. We apply this fraction to the program bulbs sold, and we do not try to credit the program for the corresponding fraction of non-program bulbs that are also attributable. We might speculate that attribution is higher for program bulbs than for non-program bulbs but this method does not isolate that. In that sense, this estimate is a conservative NTGR at least conceptually.

The estimate of total 2008 sales derived through the installation rate analysis (52.1 million CFLs) served as a proxy for “total residential CFL sales with the program”. However, we lacked an alternative estimate of the number of CFLs that would have been purchased in the absence of the Upstream Lighting Program, so the team relied on the modeled “no program” estimate of 1.86 CFLs per household and extrapolated to all households in the IOU service territories (9.9 million). This yielded an estimated 18.4 million “total residential CFL Sales in 2008 without the program". Finally, the team used the "total residential CFL Sales in 2008 with the program" in the denominator of the equation, as opposed to the total number of incented CFLs per household. Using the former provides an estimate of NTGR that excludes spillover, while the latter would have been inclusive of spillover. Applying these estimates, yields the following equation:

$$(52.1 \text{ million} - 18.4 \text{ million}) \div (52.1 \text{ million}) = 65\%$$

The estimated NTGR of 65% is among the higher ones calculated for this evaluation. Therefore, the team recommends that 23% and 65% be seen as the possible range of NTGR for the Upstream Lighting Program in 2008.

We can only speculate on the how well the modeled data used in both the low (23%) and high (65%) estimates of NTGR adhere to the California situation. Speculatively, given the positive relationship between program activity and prior CFL use, it is likely that the total net impacts for 2006 and 2007 were higher, although the model does not allow us to estimate how much higher. It is also the case that the model has a low level of reliability. The likelihood ratio index is just 1%, suggesting that the model does not adequately capture what is truly driving CFL sales. The addition of other variables or adjustments to current model specifications could greatly alter the results, with unpredictable effects on the estimated net impacts of program activity.

In conclusion, we believe the models provide enough evidence to suggest that CFL program activity in 2008 had positive effects on CFL purchases once one takes into account the rapidly growing and changing national CFL market. However, concerns about the validity of the results for California, the reliability of the model, and the inclusion of spillover in the (lower) estimate of net impacts suggests that the results should most likely be used only to inform the evaluation of the 2006-2008 program but not directly in the estimation of the NTGR for the program.

8.15 Upstream Fixtures Savings Parameters

Residential Fluorescent Floor/Desk/Table Lamp (non-torchiere)

Base Case: Plug-in floor (non-torchiere), desk, table lamp

Analysis Variable : wattage_tw2n

IOU	FixtureType	LampType	N Obs	Minimum	Maximum	Mean		
PGE	F/D/T LAMP	HALOGEN	114	50	500	106.35	9%	80.55
		INCANDESCI	1215	45	300	78.13	91%	
SCE	F/D/T LAMP	HALOGEN	51	45	300	113.1	4%	80.23
		INCANDESCI	1128	50	200	78.74	96%	
SDGE	F/D/T LAMP	HALOGEN	43	42	225	73.98	7%	79.75
		INCANDESCI	598	41	250	80.17	93%	

Rebated fixture wattage

F/D/T lamp	
SCE	30.33

Delta watts

F/D/T lamp	
SCE	49.89

	sce	
	Res	Nonres
UES kWh	34.60	135.21
UES kW	0.0027	0.0220

Rebated fixture wattage	Units rebated	%	
26	25	83%	
52	5	17%	
		30.33	Weighted avg rebated fixture wattage

Rebated Measures:

26 Watt Interior Fluorescent Desk Lamp, 1,600 to 1,999 Lumens
26 Watt Interior Fluorescent Table Lamp, 1,600 to 1,999 Lumens
52 Watt Interior Fluorescent Non-torchiere Floor Lamp, 3,600 to 4,599 Lumens

	HOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%
Torchiere (ancova)	**2.0**	0.3	15%	**2.2**	0.3	14%	**1.8**	0.3	18%	**2.1**	0.3	14%
Floor/table/desk lamp (a	**1.8**	0.3	16%	**2.1**	0.3	14%	**1.5**	0.3	20%	**1.9**	0.3	15%
Interior (ancova)	**1.6**	0.3	19%	**1.9**	0.3	17%	**1.3**	0.3	24%	**1.7**	0.3	18%
Interior (metered)	**1.7**	0.1	5%	**1.9**	0.1	5%	**1.4**	0.1	8%	**1.7**	0.1	3%
Overall (metered)	**1.8**	0.1	5%	**2.1**	0.1	5%	**1.5**	0.1	8%	**1.9**	0.1	3%

	Peak											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Torchiere (ancova)	**4.6%**	2.7%	57.9%	**5.5%**	2.8%	50.2%	**3.0%**	2.9%	98.8%	**4.8%**	2.7%	57.5%
Floor/table/desk lamp (a	**4.1%**	2.7%	64.4%	**5.6%**	2.7%	47.8%	**2.8%**	2.8%	102.5%	**4.6%**	2.7%	58.0%
Interior (ancova)	**4.7%**	2.8%	60.1%	**6.4%**	2.8%	44.5%	**3.5%**	3.0%	85.4%	**5.3%**	2.8%	53.9%
Interior (metered)	**4.6%**	0.7%	14.8%	**6.5%**	0.9%	14.3%	**5.3%**	1.2%	22.4%	**5.4%**	0.5%	9.4%
Overall (metered)	**5.7%**	0.8%	14.6%	**7.5%**	1.0%	12.8%	**5.4%**	1.1%	20.9%	**6.4%**	0.6%	8.7%

	pge	sce	sdge
Nonres HOU	2710	2517	2191
Nonres peak CF	0.44	0.39	0.36

Residential Exterior HW Fixtures - any

Analysis Variable : wattage_tw2n

IOU	FixtureType	LampType	N Obs	Minimum	Maximum	Mean		
PGE	Ext HW any	HALOGEN	202	45	500	105.27	22%	74.30
		INCANDESCE	704	40	200	65.41	78%	
SCE	Ext HW any	HALOGEN	168	45	500	113.11	20%	78.51
		INCANDESCE	670	40	200	69.84	80%	
SDGE	Ext HW any	HALOGEN	88	40	300	94.26	20%	69.73
		INCANDESCE	354	40	150	63.63	80%	

Rebated fixture wattage	pge	sce	sdge
Ext HW	30.51	38.07	34.24
Delta watts			
Ext HW	43.79	40.45	35.49

	pge		sce		sdge	
	Res	Nonres	Res	Nonres	Res	Nonres
UES kWh	59.14	118.67	59.05	101.80	44.04	77.75
Ues kW	0.0059	0.0193	0.0062	0.0158	0.0043	0.0128

	Units Rebated			Percent			
Fixture wattage	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E	
18	149733	83611	26260	71%	57%	65%	
23	1812	102		1%	0%	0%	
26	2884			1%	0%	0%	
65	55056	62366	13867	26%	43%	35%	
				30.51	38.07	34.24	Weighted average rebated fixture wattage

Rebated Measures:
Exterior Photo-Motion CFL Fixture 65 Watt 3,600 to 4,599 Lumens
Exterior Photosensor CFL Fixture 18 Watt 1,100 to 1,399 Lumens
Exterior Photosensor CFL Fixture 18 Watt 1,600 to 1,999 Lumens
Exterior Photosensor CFL Fixture 23 Watt 1,600 to 1,999 Lumens
Exterior Photosensor CFL Fixture 26 Watt 1,400 to 1,599 Lumens

	HOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%
Ext HW ph/m (an	**3.7**	0.3	8%	**4.1**	0.3	8%	**3.5**	0.3	9%	**3.9**	0.3	8%
Ext HW (ancova)	**3.7**	0.3	9%	**4**	0.3	8%	**3.4**	0.3	9%	**3.8**	0.3	8%
Ext (metered)	**3.6**	0.5	14%	**4.8**	0.6	13%	**2.3**	0.7	30%	**3.9**	0.4	9%
Overall (metered	**1.8**	0.1	5%	**2.1**	0.1	5%	**1.5**	0.1	8%	**1.9**	0.1	3%

	Peak											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Ext HW ph/m (an	**13.9%**	2.9%	21.1%	**15.3%**	2.8%	18.6%	**12.1%**	2.9%	24.0%	**14.3%**	2.9%	19.9%
Ext HW (ancova)	**13.5%**	2.9%	21.6%	**15.4%**	2.9%	18.7%	**12.1%**	2.9%	24.1%	**14.1%**	2.9%	20.5%
Ext (metered)	**23.6%**	7.4%	31.5%	**17.0%**	4.5%	26.1%	**6.2%**	3.7%	59.8%	**16.8%**	3.2%	19.2%
Overall (metered	**5.7%**	0.8%	14.6%	**7.5%**	1.0%	12.8%	**5.4%**	1.1%	20.9%	**6.4%**	0.6%	8.7%

	pge	sce	sdge
Nonres HOU	2710	2517	2191
Nonres peak CF	0.44	0.39	0.36

Residential Exterior HW Fixtures - photocell/motion controlled

Analysis Variable : wattage_tw2n

IOU	FixtureType	LampType	N Obs	Minimum	Maximum	Mean		
PGE	Ext HW ph/m	HALOGEN	80	45	250	86.6	47%	82.32
		INCANDESCI	91	40	150	78.56	53%	
SCE	Ext HW ph/m	HALOGEN	81	45	300	96.88	46%	94.14
		INCANDESCI	97	40	150	91.86	54%	
SDGE	Ext HW ph/m	HALOGEN	42	50	300	101.92	45%	87.99
		INCANDESCI	52	40	150	76.73	55%	

Rebated fixture wattage
Ext HW photo/motion sensor
SCE 18.77

Delta watts
Ext HW photo/motion sensor
SCE 75.37

	sce	
	Res	Nonres
UES kWh	112.79	204.25
UES kW	0.0115	0.0332

	Rebated fixture wattage:		
Rebated Measures:	Wattage	Units Rebated	%
Exterior Photo-Motion CFL Fixture 65 Watt 3,600 to 4,599 Lumens	18	95814	97%
Exterior Photosensor CFL Fixture 18 Watt 1,100 to 1,399 Lumens	23	678	1%
Exterior Photosensor CFL Fixture 18 Watt 1,600 to 1,999 Lumens	26	666	1%
Exterior Photosensor CFL Fixture 23 Watt 1,600 to 1,999 Lumens	65	1440	1%
Exterior Photosensor CFL Fixture 26 Watt 1,400 to 1,599 Lumens			18.77

	HOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%
Ext HW ph/m (ancova)	**3.7**	0.3	8%	**4.1**	0.3	8%	**3.5**	0.3	9%	**3.9**	0.3	8%
Ext HW (ancova)	**3.7**	0.3	9%	**4**	0.3	8%	**3.4**	0.3	9%	**3.8**	0.3	8%
Ext (metered)	**3.6**	0.5	14%	**4.8**	0.6	13%	**2.3**	0.7	30%	**3.9**	0.4	9%
Overall (metered)	**1.8**	0.1	5%	**2.1**	0.1	5%	**1.5**	0.1	8%	**1.9**	0.1	3%

	Peak											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Ext HW ph/m (ancova)	**13.9%**	2.9%	21.1%	**15.3%**	2.8%	18.6%	**12.1%**	2.9%	24.0%	**14.3%**	2.9%	19.9%
Ext HW (ancova)	**13.5%**	2.9%	21.6%	**15.4%**	2.9%	18.7%	**12.1%**	2.9%	24.1%	**14.1%**	2.9%	20.5%
Ext (metered)	**23.6%**	7.4%	31.5%	**17.0%**	4.5%	26.1%	**6.2%**	3.7%	59.8%	**16.8%**	3.2%	19.2%
Overall (metered)	**5.7%**	0.8%	14.6%	**7.5%**	1.0%	12.8%	**5.4%**	1.1%	20.9%	**6.4%**	0.6%	8.7%

	pge	sce	sdge
Nonres HOU	2710	2517	2191
Nonres peak CF	0.44	0.39	0.36

Residential Interior HW Fixtures - ceiling only

Analysis Variable : wattage_tw2n

IOU	FixtureType	LampType	N Obs	Minimum	Maximum	Mean		
PGE	Int HW ceiling	HALOGEN	104	40	300	74.75	4%	59.41
		INCANDESC	2524	40	300	58.78	96%	
SCE	Int HW ceiling	HALOGEN	48	45	300	77.3	2%	58.29
		INCANDESC	2261	40	250	57.89	98%	
SDGE	Int HW ceiling	HALOGEN	42	50	200	66.82	4%	58.03
		INCANDESC	1075	40	250	57.69	96%	

Installed Wattage:
Interior HW Fixture
SCE 26.65 Rebated fixture wattage

Delta Watts:
Interior HW Fixture
SCE 31.64 NonCFL wattage - Rebated fixture wattage

	sce	
	Res	Nonres
UES kWh	21.94	#REF!
UES kW	0.0017	#REF!

Rebated Measures:
Interior Ceiling Fixture 128 Watt ≥ 4,600 Lumens
Interior Ceiling Fixture 13 Watt 800 to 1,099 Lumens
Interior Ceiling Fixture 18 Watt 1,100 to 1,599 Lumens
Interior Ceiling Fixture 22 Watt 1,100 to 1,399 Lumens
Interior Ceiling Fixture 23 Watt 1,600 to 1,999 Lumens
Interior Ceiling Fixture 26 Watt 1,100 to 1,399 Lumens
Interior Ceiling Fixture 26 Watt 1,600 to 1,999 Lumens
Interior Ceiling Fixture 30 Watt 2,000 to 2,599 Lumens
Interior Ceiling Fixture 32 Watt 2,000 to 2,599 Lumens
Interior Ceiling Fixture 32 Watt 2,600 to 3,599 Lumens
Interior Ceiling Fixture 36 Watt 1,600 to 1,999 Lumens
Interior Ceiling Fixture 36 Watt 2,000 to 2,599 Lumens
Interior Ceiling Fixture 54 Watt 3,600 to 4,599 Lumens
Interior Ceiling Fixture 64 Watt 3,600 to 4,599 Lumens
Store-Bought Interior Dimmable Ceiling Fixture 40 Watt 2,600 to 3,599 Lumens

Rebated fixture wattage:

Wattage	Units Rebated	%
13	48	0%
18	86539	17%
22	77684	15%
23	1146	0%
26	224559	44%
30	55074	11%
32	33515	7%
36	1156	0%
40	2376	0%
54	9892	2%
64	15001	3%
128	246	0%
		26.65

26.65 Weighted avg rebated fixture wattage

	HOU											
	PGE			SCE			SDGE			Overall		
	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%	HOU	90% CI +/-	90% CI +/-%
Int HW ceiling (ancova)	**1.5**	0.3	21%	**1.8**	0.3	17%	**1.3**	0.3	26%	**1.6**	0.3	20%
Int HW (ancova)	**1.5**	0.3	21%	**1.8**	0.3	18%	**1.2**	0.3	26%	**1.6**	0.3	20%
Int (ancova)	**1.6**	0.3	19%	**1.9**	0.3	17%	**1.3**	0.3	24%	**1.7**	0.3	18%
Int (metered)	**1.7**	0.1	5%	**1.9**	0.1	5%	**1.4**	0.1	8%	**1.7**	0.1	3%
Overall (metered)	**1.8**	0.1	5%	**2.1**	0.1	5%	**1.5**	0.1	8%	**1.9**	0.1	3%

	Peak											
	PGE			SCE			SDGE			Overall		
	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%	Peak	90% CI +/-	90% CI +/-%
Int HW ceiling (ancova)	**4.6%**	2.9%	63.2%	**6.2%**	2.9%	47.7%	**3.6%**	3.1%	85.8%	**5.1%**	2.9%	57.1%
Int HW (ancova)	**5.0%**	2.9%	57.0%	**6.6%**	2.9%	43.7%	**3.9%**	3.0%	76.2%	**5.6%**	2.9%	51.9%
Int (ancova)	**4.7%**	2.8%	60.1%	**6.4%**	2.8%	44.5%	**3.5%**	3.0%	85.4%	**5.3%**	2.8%	53.9%
Int (metered)	**4.6%**	0.7%	14.8%	**6.5%**	0.9%	14.3%	**5.3%**	1.2%	22.4%	**5.4%**	0.5%	9.4%
Overall (metered)	**5.7%**	0.8%	14.6%	**7.5%**	1.0%	12.8%	**5.4%**	1.1%	20.9%	**6.4%**	0.6%	8.7%

	pge	sce	sdge
Nonres HOU	2710	2517	2191
Nonres peak CF	0.44	0.39	0.36

Residential Interior HW Fixtures - any

Analysis Variable : wattage_tw2n

IOU	FixtureType	LampType	N Obs	Minimum	Maximum	Mean		
PGE	Int HW any	HALOGEN	163	40	300	79.55	5%	57.86
		INCANDESC	3429	40	300	56.83	95%	
SCE	Int HW any	HALOGEN	79	45	300	81.97	2%	57.21
		INCANDESC	3146	40	250	56.59	98%	
SDGE	Int HW any	HALOGEN	89	40	500	80.04	5%	56.41
		INCANDESC	1542	40	250	55.05	95%	

Rebated fixture wattage	pge	sce	sdge
Ext HW	28.51	20.84	25.95
Delta watts			
Ext HW	29.35	36.37	30.47

	pge		sce		sdge	
	Res	Nonres	Res	Nonres	Res	Nonres
UES kWh	18.21	79.54	25.22	91.54	15.57	66.75
Ues kW	0.0016	0.0129	0.0020	0.0142	0.0016	0.0110

	Units Rebated			Percent			
							Rebated Measures:
Fixture wattage	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E	235043-Interior Hardwired Fixtures (30 watt) >=1,100 Lumens
13	108			0%	0%	0%	235074-Interior Hardwired Fixtures (18 watt) >= 1,100 Lumens
18	67950	924	19984	30%	73%	30%	235128-Interior Hardwired Fixtures- Pin Based (25 watt) >=1,600 Lumens
22	17880			8%	0%	0%	CFL INT INTEGRAL COVERED-NO REFLCTR -18 WATT >= 720 LUMENS
23	7360	72		3%	6%	0%	INTERIOR CF FIXTURE - 128 WATT >= 8000 LUMENS
25			5412	0%	0%	8%	INTERIOR CF FIXTURE - 13 WATT
26	49889			22%	0%	0%	INTERIOR CF FIXTURE - 18 WATT >= 1,100 LUMENS
30	24448	270	40454	11%	21%	61%	INTERIOR CF FIXTURE - 22 W >=1,100 LUMENS
32	10290			5%	0%	0%	INTERIOR CF FIXTURE - 23 W >=1,400 LUMENS
38	922			0%	0%	0%	INTERIOR CF FIXTURE - 23 W >=1,400 LUMENS
40	32157			14%	0%	0%	INTERIOR CF FIXTURE - 26 WATT <1,600 LUMENS
45	384			0%	0%	0%	INTERIOR CF FIXTURE - 26 WATT >=1,600 LUMENS
54	2024			1%	0%	0%	INTERIOR CF FIXTURE - 30 WATT
55	168			0%	0%	0%	INTERIOR CF FIXTURE - 32 WATT
64	12602			6%	0%	0%	INTERIOR CF FIXTURE - 38 WATT
128	379			0%	0%	0%	INTERIOR CF FIXTURE - 40 WATT
				28.51	20.84	25.95	INTERIOR CF FIXTURE - 45 WATT
							INTERIOR CF FIXTURE - 54 WATT
							INTERIOR CF FIXTURE - 55 WATT
							INTERIOR CF FIXTURE - 64 WATT >= 4,000 LUMENS
							Interior Fixture 18 Watt 1,100 to 1,399 Lumens
							Interior Non-Ceiling Fixture 23 Watt 1,600 to 1,999 Lumens
							Interior Non-Ceiling Fixture 30 Watt 2,000 to 2,599 Lumens

	HOU											
	PGE			**SCE**			**SDGE**			**Overall**		
	HOU	90% CI +/-	90% CI +/-%	**HOU**	90% CI +/-	90% CI +/-%	**HOU**	90% CI +/-	90% CI +/-%	**HOU**	90% CI +/-	90% CI +/-%
Int HW ceiling (ancova)	**1.5**	0.3	21%	**1.8**	0.3	17%	**1.3**	0.3	26%	**1.6**	0.3	20%
Int HW (ancova)	**1.5**	0.3	21%	**1.8**	0.3	18%	**1.2**	0.3	26%	**1.6**	0.3	20%
Int (ancova)	**1.6**	0.3	19%	**1.9**	0.3	17%	**1.3**	0.3	24%	**1.7**	0.3	18%
Int (metered)	**1.7**	0.1	5%	**1.9**	0.1	5%	**1.4**	0.1	8%	**1.7**	0.1	3%
Overall (metered)	**1.8**	0.1	5%	**2.1**	0.1	5%	**1.5**	0.1	8%	**1.9**	0.1	3%

	Peak											
	PGE			**SCE**			**SDGE**			**Overall**		
	Peak	90% CI +/-	90% CI +/-%	**Peak**	90% CI +/-	90% CI +/-%	**Peak**	90% CI +/-	90% CI +/-%	**Peak**	90% CI +/-	90% CI +/-%
Int HW ceiling (ancova)	**4.6%**	2.9%	63.2%	**6.2%**	2.9%	47.7%	**3.6%**	3.1%	85.8%	**5.1%**	2.9%	57.1%
Int HW (ancova)	**5.0%**	2.9%	57.0%	**6.6%**	2.9%	43.7%	**3.9%**	3.0%	76.2%	**5.6%**	2.9%	51.9%
Int (ancova)	**4.7%**	2.8%	60.1%	**6.4%**	2.8%	44.5%	**3.5%**	3.0%	85.4%	**5.3%**	2.8%	53.9%
Int (metered)	**4.6%**	0.7%	14.8%	**6.5%**	0.9%	14.3%	**5.3%**	1.2%	22.4%	**5.4%**	0.5%	9.4%
Overall (metered)	**5.7%**	0.8%	14.6%	**7.5%**	1.0%	12.8%	**5.4%**	1.1%	20.9%	**6.4%**	0.6%	8.7%

	pge	sce	sdge
Nonres HOU	2710	2517	2191
Nonres peak CF	0.44	0.39	0.36

8.16 Upstream LED Savings Parameters

Table 116: Summary of Ex-ante and Ex-post UES Assumptions for Upstream LED Measures

IOU	Measure Type	E3 Measure Name	Ex-ante Gross (from E3)	Assumptions	Ex-post Gross	Assumptions
PG&E	LED Holiday Lights – Resi-dential	LED LIGHT – SEASONAL (res)	0.31 kWh/yr (0.0000 kW)	**Base case:** C7 (7w) or mini-incand (0.45w), assumes 15%/82%/3% distribution for existing C7/mini-light/LED; used for 225 hrs/year (no justification or further explanation of how this was determined – seems to be about ~10-12 hrs/day for ~20 days/yr) **Workpaper EEM**: 0.043w per LED *(Seasonal LED EEM Work Paper v5.xls - LED seasonal Res tab))*	0.53 kWh/yr (0.0000 kW)	**Recommended base case:** Assume 15% C7(avg6w) and 85% mini-light(avg 0.408w) as base case, operating for 37 days/year (# of days between weekends after Thanksgiving weekend and New Years) for 12 hours/day, compared to program measure (Greenlite, 100L/4.8w LED string) yields 0.53 kWh/yr; usage during coincident summer peak periods is assumed to be zero **Rebated measure:** Greenlite LED Holiday Lights, model # indicates mostly 100-LED strings at 4.8w per string (0.048w per LED)

IOU	Measure Type	E3 Measure Name	Ex-ante Gross (from E3)	Assumptions	Ex-post Gross	Assumptions
PG&E	LED Holiday Lights – Nonresi-dential	LED LIGHT – SEASONAL (nonres)	5.16 kWh/yr (0.0014 kW)	**Base case:** C7 (7w) or mini-light (0.45w), assumes 15%/82%/3% distribution for existing C7/mini-light/LED (so overall 1.4w saved); assumes 3744 avg hrs/year (approx. 70% of avg 5269 hrs/year total operating hours from survey of Placerville businesses using decorative light strings ~15 hrs/day, ~7 days/wk) **Workpaper EEM:** 0.043w per LED *(Seasonal LED EEM Work Paper v5.xls - LED seasonal Comm tab)*	0.86 kWh/yr (0.0000 kW)	**Recommended base case:** Assume same base case as residential (see above) due to upstream nature of program, type of product rebated, and timing of program promotions (holiday period) – therefore, use 15% C7(avg 6w) and 85% mini-light(avg 0.408w) as base case, operating for 37 days/year (# of days between weekends after Thanksgiving weekend and New Years) for ~19 hours/day (assume on for 12 hours at night plus avg hours during day while business is open from current Itron study for all upstream nonresidential participant hours – 2710 hours/year for PG&E) compared to program measure (Greenlite, 100L/4.8w LED string) yields 0.86 kWh/year; usage during coincident summer peak periods is assumed to be zero. **Rebated measure:** Greenlite LED Holiday Lights, model # indicates mostly 100-LED strings at 4.8w per string (0.048w per LED)
SDG&E	LED Holiday Lights – Resi-dential	235146-LED Holiday Lights (Per LED) (res)	0.02 kWh/yr (0.0000 kW)	**Base case:** C7 (5w x 25 lamps) or mini-incand (1w x 100 lamps) used 12 hours/day for 45 days/year **Workpaper EEM**: 0.043w x 35 lamps x 3 strings *(Christmas Lights.doc)*	0.53 kWh/yr (0.0000 kW)	**Recommended base case:** Assume 15% C7(avg6w) and 85% mini-light(avg 0.408w) as base case, operating for 37 days/year (# of days between weekends after Thanksgiving weekend and New Years) for 12 hours/day, compared to program measure (Greenlite, 100L/4.8w LED string) yields 0.53 kWh/yr; usage during coincident summer peak periods is assumed to be zero **Rebated measure:** Greenlite LED Holiday Lights, model # missing but assume similar to PG&E (mostly 100-LED strings at 4.8w per string, or 0.048w per LED)

IOU	Measure Type	E3 Measure Name	Ex-ante Gross (from E3)	Assumptions	Ex-post Gross	Assumptions
SDG&E	LED Holiday Lights – Nonresidential	n/a	n/a	n/a	0.86 kWh/yr (0.0000 kW)	**Recommended base case:** SDG&E assumed holiday lights would be purchased/used in residential applications only; ex-post assumes 5% nonresidential use; see base case assumptions described above for PG&E LED holiday lights - nonresidential **Rebated measure:** Greenlite LED Holiday Lights, model # indicates mostly 100-LED strings at 4.8w per string (0.048w per LED)
PG&E	LED Night Light – Residential	LED NIGHT LIGHT EEM - 0.3 WATTS (res)	29.42 kWh/yr (0.0000 kW)	**Base case:** 16% A-lamp/84% C7 **Workpaper EEM:** 0.6w LED night light (0.255w power draw) *(LED Night Light EEM Workpaper v3.xls)*	23.84 kWh/yr (0.0000 kW) – res and nonres	**Recommended base case:** 100% replacement of incand night lights (avg 5.09W, operating 4666.1 hours/year, per 2006 LBNL/PIER plug-load study[1]) yields 23.84 kWh/yr **Rebated measure:** 0.3w at 100% rated power (even though PG&E model number data is unreliable, and look-ups for similar measures rebated by SCE didn't conclusively verify this product wattage)
PG&E	LED Night Light – Nonresidential	LED NIGHT LIGHT EEM - 0.3 WATTS (nonres)	72.88 kWh/yr (0.0000 kW)	**Base case:** 80% A-lamp/20% C7 **Workpaper EEM:**0.6w LED night light (0.255w power draw) *(LED Night Light EEM Workpaper v3.xls)*	23.84 kWh/yr (0.0000 kW) – res and nonres	**Recommended base case:** 100% replacement of incand night lights (avg 5.09W, operating 4666.1 hours/year, per 2006 LBNL/PIER plug-load study[60]) yields 23.84 kWh/yr **Rebated measure:** 0.3w at 100% rated power (even though PG&E model number data is unreliable, and look-ups for similar measures rebated by SCE didn't conclusively verify this product wattage)

[60] 1) Meier, A., et al., Low Power Mode Energy Consumption in California Homes, 2008, California Energy Commission, Public Interest Energy Research Program, Report No. CEC-500-2008-035: Sacramento, Calif. (http://www.efficientproducts.org/documents/Plug_Loads_CA_Field_Research_Report_Ecos_2006.pdf). Results were mined from the data collected by KEMA (formerly RLW Analytics) for the joint study that produced these two papers. The papers do not directly report on LED night lights.

IOU	Measure Type	E3 Measure Name	Ex-ante Gross (from E3)	Assumptions	Ex-post Gross	Assumptions
SCE	LED Night Light	LED NIGHT LIGHT EEM - 1 WATT	27.57 kWh/yr (0.0000 kW)	**Base case:** 16% A-lamp/84% C7 **Workpaper EEM:** 0.6w LED night light (0.255w power draw) *(Calculation-lighting night light.doc)*	23.84 kWh/yr (0.0000 kW) – res and nonres	**Recommended base case:** 100% replacement of incand night lights (avg 5.09W, operating 4666.1 hours/year, per 2006 LBNL/PIER plug-load study[1]) yields 23.84 kWh/yr **Rebated measure:** 0.3w at 100% rated power (model number lookup revealed PG&E's data is unreliable; in this case, the model # for this measure matched with a 0.3w LED night light, not a 1w LED night light)
SCE	LED Night Light	Plug-in Electro-Luminescent 1.4 Watt Night Light	23.652 kWh/yr (0.0000 kW)	**Base case:** 6.8w (weighted average of 4 different base case wattages) at 12 hours/day, 365 days/year **Workpaper EEM:** 1.4w LED night light (100% power draw) *(WPSCRELG0029 Revision.1 doc and xls)*	19.02 kWh/yr (0.0000 kW) – res and nonres	**Recommended base case:** 100% replacement of incand night lights (avg 3.99W, operating 4666.1 hours/year, per 2006 LBNL/PIER plug-load study[1]) yields 19.02 kWh/yr **Rebated measure:** 1.4w at 100% rated power (model # look-up confirmed that these are 3-pack 1.4w fluorescent "super mini night lights", not LED like E3 measure name suggests)
SCE	LED Night Light	Plug-in Electro-Luminescent 0.6 Watt Night Light	27.156 kWh/yr (0.0000 kW)	**Base case:** 6.8w (weighted average of 4 different base case wattages) at 12 hours/day, 365 days/year **Workpaper EEM:** 0.6w LED night light (100% power draw) *(WPSCRELG0029 Revision.1 doc and xls)*	23.84 kWh/yr (0.0000 kW) – res and nonres	**Recommended base case:** 100% replacement of incand night lights (avg 5.09W, operating 4666.1 hours/year, per 2006 LBNL/PIER plug-load study[1]) yields 23.84 kWh/yr **Rebated measure:** 0.3w at 100% rated power (model # look-up revealed some products were incorrectly recorded as 0.6w, and others were actually two-packs of 0.3w and the unit is lamp not package)
SCE	LED Night Light	LED Plug-in Night Lights (0.3 Watt)	28.47 kWh/yr (0.0000 kW)	**Base case:** 6.8w (weighted average of 4 different base case wattages) at 12 hours/day, 365 days/year **Workpaper EEM:** 0.3w LED night light (100% power draw) *(WPSCRELG0029 Revision.1 doc and xls)*	23.84 kWh/yr (0.0000 kW) – res and nonres	**Recommended base case:** 100% replacement of incand night lights (avg 5.09W, operating 4666.1 hours/year, per 2006 LBNL/PIER plug-load study[1]) yields 23.84 kWh/yr **Rebated measure:** 0.3w at 100% rated power (even though model number look-up can't conclusively verify this product wattage)

IOU	Measure Type	E3 Measure Name	Ex-ante Gross (from E3)	Assumptions	Ex-post Gross	Assumptions
SCE	LED Night Light	Plug-in 0.05 Watt Electro-Luminescent Night Light	29.565 kWh/yr (0.0000 kW)	**Base case:** 6.8w (weighted average of 4 different base case wattages) at 12 hours/day, 365 days/year **Workpaper EEM:** 0.05w LED night light (100% power draw) *(WPSCRELG0029 Revision.1 doc and xls)*	23.84 kWh/yr (0.0000 kW) – res and nonres	**Recommended base case:** 100% replacement of incand night lights (avg 5.09W, operating 4666.1 hours/year, per 2006 LBNL/PIER plug-load study[1]) yields 23.84 kWh/yr **Rebated measure:** 0.3w at 100% rated power (model # look-up revealed actual wattage is 0.3w not 0.05w as E3 measure name suggests)
SDG&E	LED Night Light	235086-LED Bulbs (.3 watt)	73.58 kWh/yr (0.0000 kW)	**Base case:** 80/20 split but calculated differently than PG&E does above [ΔkWh = (80% * (0.06 kW Old * 1,460 RH Old1) – ((0.0006 kW New * 1,460 RH Old) + (.0006 kW New * 2,920 RH NE))) + (20% * (.007 kW Old - .0006 kW New) * 4,380 RH Old2) = 73.584 kWh per night light] **Workpaper EEM:** 0.6w LED night light (100% power draw) *(Residential Night Light.doc)*	23.84 kWh/yr (0.0000 kW) – res and nonres	**Recommended base case:** 100% replacement of incand night lights (avg 5.09W, operating 4666.1 hours/year, per 2006 LBNL/PIER plug-load study[1]) yields 23.84 kWh/yr **Rebated measure:** no product information available in tracking, assume same as SCE/PG&E = 0.3w at 100% rated power
SCE	LED Open/ Close Signs	5 Watt LED Open-Closed Sign (res)	159.5 kWh/yr (0.03 kW)	**Base case:** 46w neon sign, see workpaper and supporting Emerging Tech (ET) study for more detail **Workpaper EEM:** 15w LED sign *(WPSCRELG0070.0 – LED Open Sign Replacing Neon Open Sign – doc and xls)*	78.03 kWh/yr (0.0121 kW)	**Recommended base case:** SCE incorrectly assigned savings from these measures to residential, ex-post adjusts to 100% nonresidential; ex-post assumes same 46w neon sign as baseline; operating hours = 2517 and peak CF = 39% from Itron study of upstream program participants **Rebated measure:** rebated measure is 5w (compared to 15w assumed in ex-ante); Lights of America (model #5000LEDOC sold at Costco), product info no longer available per Lights of America or Costco websites), found product for sale on ebay, amazon.com, craigslist.com, etc. but could not verify wattage

IOU	Measure Type	E3 Measure Name	Ex-ante Gross (from E3)	Assumptions	Ex-post Gross	Assumptions
SDG&E	LED Open/ Close Signs	235147-LED Open/Close Signs	54.75 kWh/yr (0.05 kW)	**Workpaper:** base case neon sign is 55w operated 12 hrs/day, 365 days/yr (4380 hrs/yr); when compared to EEM, yields 166.44 kWh/year (not matching E3 claim) and 0.05 kW **Workpaper EEM:** 8.5w LED sign and neon base case is 55w, both assumed to operate 4380 hours/yr *(LED Open and Closed Sign.doc)*	67.92 kWh/yr (0.0112 kW)	**Recommended base case:** we don't have an explanation for why E3 estimate is different than the workpaper ex-ante; SCE ex-ante estimate represents more reliable and conservative approach because it was based on ET study and it compared 15W LED sign to 46W neon sign (compared to SDG&E's 8.5w LED v. 55w neon workpaper comparison); ex-post assumes same 46w neon sign as baseline; operating hours = 2191 and peak CF = 36% from Itron study of upstream program participants **Rebated measure:** rebated measure is 5w; Lights of America (model #5000LEDOC sold at Costco), product info no longer available per Lights of America or Costco websites), found product for sale on ebay, amazon.com, craigslist.com, etc. but could not verify wattage
SCE	LED Table/ Desk Lamps	1 Watt LED Plug-in Desk Lamp	0 kWh/yr	n/a	0 kWh/yr	**Recommended base case:** 0 savings assumed due to usage of rechargeable batteries as only power source (no plug) and relatively high $/kWh for battery use (v. IOU-delivered kWh); in addition, one model we saw was sold with a rechargeable battery recharger which even if not used to recharge batteries for LED lamp it could be adding plug-load that might be greater than the savings from the LED lamp use **Rebated measure:** E3 measure name implies 1w but model # indicates 1.5w

IOU	Measure Type	E3 Measure Name	Ex-ante Gross (from E3)	Assumptions	Ex-post Gross	Assumptions
SCE	LED Table/ Desk Lamps	2.4 Watt LED Plug-in Desk Lamp	0 kWh/yr	n/a	0 kWh/yr	**Recommended base case:** 0 savings assumed due to usage of rechargeable batteries as only power source (no plug) and relatively high $/kWh for battery use (v. IOU-delivered kWh); in addition, one model we saw was sold with a rechargeable battery recharger which even if not used to recharge batteries for LED lamp it could be adding plug-load that might be greater than the savings from the LED lamp use **Rebated measure:** E3 measure name implies 2.4w but model # indicates 1.5w
SDG&E	LED Table/ Desk Lamps	235148-LED Task Lamp	19.75 kWh/yr	**Base case:** 25w incand operating 2.28 hours/day **Workpaper EEM:** 1w LED task lamp *(LED Task Light.doc)*	0 kWh/yr	**Base case:** 0 savings assumed due to usage of rechargeable batteries as only power source (no plug) and relatively high $/kWh for battery use (v. IOU-delivered kWh); in addition, one model we saw was sold with a rechargeable battery recharger which even if not used to recharge batteries for LED lamp it could be adding plug-load that might be greater than the savings from the LED lamp use **Rebated measure:** Found online at http://www.viewpoints.com/Greenlite-LED-Desk-Lamp-review-0d020, but no wattage info on packaging

9. Appendix C – Errata

This document was posted to CMS on December 18, 2009 and reflects changes to the original draft Upstream Lighting Program evaluation report posted to CMS on December 10, 2009.

1. **Page i, second paragraph, first sentence should read:**

Statewide annual net savings for the Upstream Lighting Program are estimated to be about 1,325 GWh and net peak demand reductions were determined to be nearly 134 MW (25% and 20% of the ex-ante estimates respectively).

2. **Table 1 should be replaced with the version attached.**
3. **Table 3 should be replaced with the version attached.**
4. **Table 4 should be replaced with the version attached.**
5. **Table 5 should be replaced with the version attached.**
6. **Table 12 should be replaced with the version attached.**
7. **Table 18 should be replaced with the version attached.**
8. **Table 25 should be replaced with the version attached.**
9. **Table 26 should be replaced with the version attached.**
10. **Table 27 should be replaced with the version attached.**
11. **Table 29 should be replaced with the version attached.**
12. **Table 30 should be replaced with the version attached.**
13. **Table 31 should be replaced with the version attached.**
14. **Table 32 should be replaced with the version attached.**
15. **Table 33 should be replaced with the version attached.**
16. **Table 34 should be replaced with the version attached.**
17. **Table 35 should be replaced with the version attached.**

18. **Page 65, first paragraph, second and third sentences should read:**

As shown, about 1,325 GWh in net annual energy savings were achieved as a result of the measures rebated through this program. Net peak demand reductions amounted to nearly 134 MW.

19. **Page 68, first set of bullets should read:**

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

Table 1: Ex-post Net Annual Energy and Peak Demand Impacts from the 2006-2008 Upstream Lighting Program

All IOUs	**Expost Net Annual Energy Impacts (kWh/yr)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	233,553,499	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%	**25%**
All IOUs	**Expost 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	**Expost 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	**607,596,705**	9%	27%	**20%**
PG&E	**Expost 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	**62,159**	8%	26%	**16%**
SCE	**Expost 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	**Expost 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%	**26%**
SDG&E	**Expost 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	**Expost 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%**

Table 3: Reported Number of Upstream Lighting Program Rebated Units by IOU, Product Type and Sector (2006-2008)

Program ID	Sector	CFLs	Fixtures	LEDs	All Products
PGE2000/ PGE2080	Nonresidential	5,234,370	42,438	987,653	6,264,461
	Residential	47,704,381	410,125	9,101,886	57,216,392
	Total	52,938,751	452,563	10,089,539	63,480,853
SCE2501	Nonresidential	3,518,478	244,677	0	3,763,155
	Residential	31,766,209	512,277	1,812,352	34,090,838
	Total	35,284,687	756,954	1,812,352	37,853,993
SDGE3016	Nonresidential	0	0	1,034	1,034
	Residential	7,611,804	105,977	3,638,976	11,356,757
	Total	7,611,804	105,977	3,640,010	11,357,791
All IOUs	Nonresidential	8,752,848	287,115	988,687	10,028,650
	Residential	87,082,394	1,028,379	14,553,214	102,663,987
	Total	95,835,242	1,315,494	15,541,901	112,692,637
Percentage by Sector					
Program ID	Sector	CFLs	Fixtures	LEDs	All Products
PGE2000/ PGE2080	Nonresidential	10%	9%	10%	10%
	Residential	90%	91%	90%	90%
SCE2501	Nonresidential	10%	32%	0%	10%
	Residential	90%	68%	100%	90%
SDGE3016	Nonresidential	0%	0%	0%	0%
	Residential	100%	100%	100%	100%
All IOUs	Nonresidential	9%	22%	6%	9%
	Residential	91%	78%	94%	91%

Table 4: Reported Net Energy and Demand Impacts by IOU, Product Type and Sector (2006-2008)

Net Annual kWh						
Program ID	**Sector**	**CFLs**	**Fixtures**	**LEDs**	**All Products**	**Total Portfolio**
PGE2000/ 2080	Nonresidential	1,250,100,941	14,126,385	12,879,616	1,277,106,941	
	Residential	1,715,558,531	45,349,481	30,608,896	1,791,516,908	
	Total	2,965,659,471	59,475,866	43,488,512	3,068,623,850	5,254,423,907
	Percent of Total Portfolio	**56%**	**1%**	**1%**	**58%**	
SCE2501	Nonresidential	529,182,704	32,656,476	0	561,839,180	
	Residential	1,236,987,908	35,688,372	35,022,908	1,307,699,188	
	Total	1,766,170,612	68,344,848	35,022,908	1,869,538,368	3,263,648,649
	Percent of Total Portfolio	**54%**	**2%**	**1%**	**57%**	
SDGE3016	Nonresidential	0	0	45,289	45,289	
	Residential	279,077,392	6,155,341	23,467,063	308,699,796	
	Total	279,077,392	6,155,341	23,512,352	308,745,085	849,277,220
	Percent of Total Portfolio	**33%**	**1%**	**3%**	**36%**	
All IOUs	Nonresidential	1,779,283,644	46,782,861	12,924,905	1,838,991,411	
	Residential	3,231,623,831	87,193,194	89,098,867	3,407,915,892	
	Total	5,010,907,475	133,976,056	102,023,772	5,246,907,303	9,367,349,776
	Percent of Total Portfolio	**53%**	**1%**	**1%**	**56%**	
Net Peak kW						
Program ID	**Sector**	**CFLs**	**Fixtures**	**LEDs**	**All Products**	**Total Portfolio**
PGE2000/ 2080	Nonresidential	226,951	1,409	941	229,301	
	Residential	162,854	1,055	0	163,909	
	Total	389,805	2,464	941	393,209	845,662
	Percent of Total Portfolio	**46%**	**0%**	**0%**	**46%**	
SCE2501	Nonresidential	129,595	0	0	129,595	
	Residential	108,628	2,163	96	110,888	
	Total	238,223	2,163	96	240,483	592,508
	Percent of Total Portfolio	**40%**	**0%**	**0%**	**41%**	
SDGE3016	Nonresidential	0	0	41	41	
	Residential	27,461	295	0	27,756	
	Total	27,461	295	41	27,797	147,360
	Percent of Total Portfolio	**19%**	**0%**	**0%**	**19%**	
All IOUs	Nonresidential	356,546	1,409	982	358,937	
	Residential	298,943	3,513	96	302,552	
	Total	655,489	4,922	1,079	661,489	1,585,530
	Percent of Total Portfolio	**41%**	**0%**	**0%**	**42%**	

Table 5: Ex-ante Savings Parameters by IOU, Product Type and Sector (2006-2008)

Parameter	CFLs			Fixtures			LEDs		
	PGE2000/ 2080	SCE2501[1]	SDGE3016	PGE2000/ 2080	SCE2501[1]	SDGE3016	PGE2000/ 2080 [2]	SCE2501	SDGE3016
Rebated Units	52,938,751	35,284,687	7,611,804	452,563	756,954	105,977	10,089,539	1,812,352	3,640,010
Percent Residential	90%	90%	100%	91%	68%	100%	90%	100%	100%
Residential									
Installation rate	76%	90%	90%	100%	100%	100%	100%	100%	100%
UES (kWh/yr)	59.15	57.62	50.92	138.22	91.61	72.60	4.18	24.16	8.06
UES (kW)	0.0056	0.0051	0.0050	0.0032	0.0056	0.0035	0.0000	0.0001	0.0000
NTGR	80%	75%	80%	80%	76%	80%	80%	80%	80%
Nonresidential									
Installation rate	76%	90%	n/a	100%	100%	n/a	100%	n/a	100%
UES (kWh/yr)	327.34	222.55	n/a	346.74	175.62	n/a	14.34	n/a	54.75
UES (kW)	0.0594	0.0545	n/a	0.0346	0.0000	n/a	0.0012	n/a	0.0500
NTGR	96%	75%	n/a	96%	76%	n/a	80%	n/a	80%

[1] SCE NTGR for basic CFLs is 76% and for specialty CFLs is 78%. For plug-in fluorescent fixtures, NTGR is 80%.
[2] PG&E NTGR for LEDs varied by product type: holiday lights is 80%, and night lights is 80%, 90% and 96%.
Note: Ex-ante UES values have been adjusted to exclude installation rates.

Source: 4Q08 E3

Table 12: Final Adjustments to Quantity of Measures Rebated -- Screw-in CFLs

Adjustment	PG&E	SCE	SDG&E
Invoice/Application Verification	96%	99%	96%
2008 Shipments Sold in 2008	88%	87%	87%
Leakage	99%	96%	93%
Final Adjustment	**86%**	**90%**	**85%**
Percent Residential	94%	94%	95%

Table 18: Final Gross Savings Inputs – Nonresidential

Gross Savings Input	Source[1]	PG&E	SCE	SDG&E	Overall
Installation Rate	Nonresidential Customer Upstream CFL telephone surveys and site visits	73%	81%	76%	76%
Annual HOU	Metered sample	2,710	2,517	2,191	n/a
Peak CF	Metered sample	44%	39%	36%	n/a
Delta Watts	Pre-program avg non-CFL W estimates minus observed avg rebated CFL W	44.6	41.9	45.1	n/a

Table 25: Ex-post Savings Parameters – Upstream Screw-in CFLs

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-POST UNITS SOLD 06-08							
CFL	Globe	163,216	2,557,053	29,111	456,079	11,724	222,764
	Reflector	81,608	1,278,527	54,836	859,095	15,642	297,190
	Twister/A-lamp	2,475,445	38,781,972	1,825,330	28,596,836	294,608	5,597,549
	All CFLs	2,720,269	42,617,551	1,909,277	29,912,010	321,974	6,117,502
EX-POST RES/NONRES							
CFL	Globe	n/a	n/a	n/a	n/a	n/a	n/a
	Reflector	n/a	n/a	n/a	n/a	n/a	n/a
	Twister/A-lamp	n/a	n/a	n/a	n/a	n/a	n/a
	All CFLs	6%	94%	6%	94%	5%	95%
EX-POST INSTALLATION RATES							
	All CFLs	73%	67%	81%	77%	76%	67%
EX-POST UES KWH/YR							
CFL	Globe	n/a	23.09	n/a	24.55	n/a	19.05
	Reflector	n/a	36.82	n/a	36.27	n/a	28.96
	Twister/A-lamp	n/a	32.73	n/a	33.15	n/a	26.77
	All CFLs	121.00	30.72	105.30	31.07	98.70	24.31
EX-POST UES PEAK KW							
CFL	Globe	n/a	0.0021	n/a	0.0023	n/a	0.0022
	Reflector	n/a	0.0034	n/a	0.0033	n/a	0.0034
	Twister/A-lamp	n/a	0.0030	n/a	0.0031	n/a	0.0031
	All CFLs	0.0196	0.0028	0.0161	0.0029	0.0163	0.0028
EX-POST NTGR							
CFL	Globe	n/a	49%	n/a	64%	n/a	48%
	Reflector	n/a	49%	n/a	64%	n/a	48%
	Twister/A-lamp	n/a	49%	n/a	64%	n/a	48%
	All CFLs	49%	49%	64%	64%	48%	48%

Table 26: Realization Rates – Upstream Screw-in CFLs

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-POST NET KWH/YR							
CFL	Globe	n/a	19,386,585	n/a	5,517,732	n/a	1,364,972
	Reflector	n/a	15,456,872	n/a	15,355,366	n/a	2,768,152
	Twister/A-lamp	n/a	416,763,073	n/a	467,157,199	n/a	48,195,545
	All CFLs	117,737,877	451,606,531	104,222,710	488,030,297	11,592,911	52,328,670
EX-POST NET PEAK KW							
CFL	Globe	n/a	1,789	n/a	509	n/a	160
	Reflector	n/a	1,426	n/a	1,417	n/a	324
	Twister/A-lamp	n/a	38,461	n/a	43,112	n/a	5,634
	All CFLs	19,072	41,677	15,935	45,038	1,915	6,117

	Realization Rates					
	PG&E		**SCE**		**SDG&E**	
	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW
All CFLs	19%	16%	34%	26%	23%	29%

Table 27: Final Adjustments to Quantity of Measures Rebated – Energy Efficient Fixtures

Adjustment	PG&E	SCE	SDG&E
Invoice/Application Verification	96%	99%	96%
2008 Shipments Sold in 2008	88%	87%	87%
Leakage	99%	96%	93%
Final Adjustment	**87%**	**92%**	**86%**
Percent Residential	94%	94%	95%

Table 29: Ex-post Savings Parameters – Upstream Fixtures

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-POST UNITS SOLD 06-08							
Fixtures	Desk/Table/Floor Lamp	0	0	1	23		
	Exterior HW (no control)	10,814	169,413	8,069	126,415	1,735	32,957
	Exterior HW (control)	0	0	5,457	85,496		
	Interior HW (ceiling)	0	0	27,883	436,838		
	Interior HW (unspecified)	11,850	185,649	70	1,090	2,813	53,441
	Torchiere	855	13,402	203	3,184		
	All Fixtures	23,519	368,464	41,684	653,046	4,547	86,398
EX-POST RES/NONRES							
Fixtures	Desk/Table/Floor Lamp			6%	94%		
	Exterior HW (no control)	6%	94%	6%	94%	5%	95%
	Exterior HW (control)			6%	94%		
	Interior HW (ceiling)			6%	94%		
	Interior HW (unspecified)	6%	94%	6%	94%	5%	95%
	Torchiere	6%	94%	6%	94%		
	All Fixtures						
EX-POST INSTALLATION RATES							
	All Fixtures	100%	100%	100%	100%	100%	100%
EX-POST UES KWH/YR							
Fixtures	Desk/Table/Floor Lamp			125.58	34.60		
	Exterior HW (no control)	118.67	59.14	101.80	59.05	77.75	44.04
	Exterior HW (control)			189.71	112.79		
	Interior HW (ceiling)			79.64	21.94		
	Interior HW (unspecified)	79.54	18.21	91.54	25.22	66.75	15.57
	Torchiere	260.74	59.70	190.65	52.53		
EX-POST UES PEAK KW							
Fixtures	Desk/Table/Floor Lamp			0.0195	0.0027		
	Exterior HW (no control)	0.0193	0.0059	0.0158	0.0062	0.0128	0.0043
	Exterior HW (control)			0.0294	0.0115		
	Interior HW (ceiling)			0.0139	0.0017		
	Interior HW (unspecified)	0.0129	0.0016	0.0142	0.0020	0.0110	0.0016
	Torchiere	0.0423	0.0052	0.0295	0.0041		
EX-POST NTGR							
Fixtures	Desk/Table/Floor Lamp			80%	80%		
	Exterior HW (no control)	80%	80%	80%	80%	80%	80%
	Exterior HW (control)			80%	80%		
	Interior HW (ceiling)			80%	80%		
	Interior HW (unspecified)	80%	80%	80%	80%	80%	80%
	Torchiere	80%	80%	80%	80%		
	All Fixtures						

Table 30: Realization Rates – Upstream Fixtures

		PG&E Nonresidential	PG&E Residential	SCE Nonresidential	SCE Residential	SDG&E Nonresidential	SDG&E Residential
EX-POST NET KWH/YR							
Fixtures	Desk/Table/Floor Lamp	0	0	149	645	0	0
	Exterior HW (no control)	1,026,641	8,015,316	657,149	5,971,865	107,892	1,161,106
	Exterior HW (control)	0	0	828,205	7,714,504	0	0
	Interior HW (ceiling)	0	0	1,776,481	7,668,322	0	0
	Interior HW (unspecified)	754,060	2,704,923	5,096	21,996	150,202	665,590
	Torchiere	178,435	640,072	31,001	133,817	0	0
	All Fixtures	1,959,136	11,360,311	3,298,080	21,511,148	258,094	1,826,696
EX-POST NET PEAK KW							
Fixtures	Desk/Table/Floor Lamp	0.00	0.00	0.02	0.05	0.00	0.00
	Exterior HW (no control)	166.69	801.23	101.82	629.91	17.73	113.21
	Exterior HW (control)	0.00	0.00	128.33	788.72	0.00	0.00
	Interior HW (ceiling)	0.00	0.00	310.55	597.10	0.00	0.00
	Interior HW (unspecified)	122.43	235.40	0.79	1.71	24.68	70.34
	Torchiere	28.97	55.70	4.80	10.42	0.00	0.00
	All Fixtures	318.09	1,092.34	546.32	2,027.91	42.41	183.55

	Realization Rates					
	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW
All Fixtures	22%	57%	36%	119%	34%	77%

Table 31: Final Adjustments to Quantity of Measures Rebated – LEDs

Adjustment	PG&E	SCE	SDG&E
Invoice/Application Verification	96%	99%	96%
2008 Shipments Sold in 2008	88%	87%	87%
Leakage	99%	96%	93%
Final Adjustment	**84%**	**92%**	**80%**
Percent Residential*	94%	94%	95%

* Except open/closed signs, 100% nonresidential.

Table 32: Summary of Ex-post Gross Savings Inputs for LEDs

	PG&E	**SCE**	**SDG&E**
Residential/Nonresidential Installation Rate	100%	100%	100%
Residential HOU (average annual HOU)			
Holiday Lights	444		444
Night Lights	4380	4380	4380
Table/Desk Lamp		n/a	n/a
Residential Peak CF (% use on peak)			
Holiday Lights	0%		0%
Night Lights	0%	0%	0%
Table/Desk Lamp		n/a	n/a
Nonresidential HOU (average annual HOU)			
Holiday Lights	719		666
Night Lights	4380	4380	4380
Table/Desk Lamp		n/a	n/a
Open/Close Signs		2,517	2,191
Nonresidential CF (% use on peak)			
Holiday Lights	44%		36%
Night Lights	0%	0%	0%
Table/Desk Lamp		n/a	n/a
Open/Close Signs		39%	36%
Residential/Nonresidential Delta Watts (watts)			
Holiday Lights	1.20		1.20
Night Lights	5.09	5.08	5.09
Table/Desk Lamp		n/a	n/a
Open/Close Signs		31	31

Table 33: Ex-post Savings Parameters – Upstream LEDs

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-POST UNITS SOLD 06-08							
LEDs	Holiday Lights	437,463	6,853,583			128,204	2,435,873
	Night Light	68,319	1,070,332	84,393	1,322,153		
	LED Bulb					17,214	327,073
	Signage			199	3,120	43	817
	Table/Desk Lamp			15,282	239,414	515	9,793
	All LEDs	505,782	7,923,915	99,874	1,564,687	145,977	2,773,555
EX-POST RES/NONRES							
LEDs	Holiday Lights	6%	94%			5%	95%
	Night Light	6%	94%	6%	94%		
	LED Bulb					5%	95%
	Signage			100%	0%	100%	0%
	Table/Desk Lamp			6%	94%	5%	95%
EX-POST INSTALLATION RATES							
	All LEDs	100%	100%	100%	100%	100%	100%
EX-POST UES KWH/YR							
LEDs	Holiday Lights	0.86	0.53			0.86	0.53
	Night Light	23.84	23.84	23.80	23.80		
	LED Bulb					23.84	23.84
	Signage			78.03		67.92	
	Table/Desk Lamp			0.00	0.00	0.00	0.00
EX-POST UES PEAK KW							
LEDs	Holiday Lights	0.0000	0.0000			0.0000	0.0000
	Night Light	0.0000	0.0000	0.0000	0.0000		
	LED Bulb					0.0000	0.0000
	Signage			0.0121		0.0112	
	Table/Desk Lamp			0.0000	0.0000	0.0000	0.0000
EX-POST NTGR							
LEDs	Holiday Lights	80%	80%			80%	80%
	Night Light	80%	80%	80%	80%		
	LED Bulb					80%	80%
	Signage			80%		80%	
	Table/Desk Lamp			80%	80%	80%	80%

Table 34: Realization Rates – Upstream LEDs

		PG&E		SCE		SDG&E	
		Nonresidential	Residential	Nonresidential	Residential	Nonresidential	Residential
EX-POST NET KWH/YR							
LEDs	Holiday Lights	301,532	2,918,350	0	0	88,368	1,037,228
	Night Light	1,302,778	20,410,191	1,606,729	25,172,084	0	0
	LED Bulb	0	0	0	0	328,261	6,236,958
	Signage	0	0	12,430	0	2,336	0
	Table/Desk Lamp	0	0	0	0	0	0
	All LEDs	1,604,310	23,328,540	1,619,159	25,172,084	418,964	7,274,186
EX-POST NET PEAK KW							
LEDs	Holiday Lights	0.00	0.00	0.00	0.00	0.00	0.00
	Night Light	0.00	0.00	0.00	0.00	0.00	0.00
	LED Bulb	0.00	0.00	0.00	0.00	0.00	0.00
	Signage	0.00	0.00	1.93	0.00	0.38	0.00
	Table/Desk Lamp	0.00	0.00	0.00	0.00	0.00	0.00
	All LEDs	0.00	0.00	1.93	0.00	0.38	0.00

	Realization Rates					
	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW	Net kWh/yr	Net Peak kW
All LEDs	58%	0%	76%	2%	33%	1%

Table 35: Ex-post Net Annual Energy and Peak Demand Impacts from the 2006-2008 Upstream Lighting Program

All IOUs	**Expost Net Annual Energy Impacts (kWh/yr)**			**Realization Rates**		
	Nonresidential	Residential	Total	Nonresidential	Residential	Total
CFLs	233,553,499	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%	**25%**
All IOUs	**Expost 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	**Expost 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	**607,596,705**	9%	27%	**20%**
PG&E	**Expost 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	**62,159**	8%	26%	**16%**
SCE	**Expost 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	**Expost 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%	**26%**
SDG&E	**Expost 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	**Expost 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%**

10. Appendix D – Response to Comments

This section presents responses to comments on the draft Upstream Lighting Program Evaluation Report posted to CMS on December 10, 2009.

Comment ID	Author	Subject 1	Subject 2	Original Reference Page	Comment	Evaluator Response
20	PG&E Company	Delta Watts	Baseline	19	Can you clarify exactly what you did to determine pre-CFL baseline wattage per lamp location? It appears you took average of homes without CFLs and assumed those homes were similar enough to those that now had CFLs? Did you do the same with non-res? Is this a valid assumption? Were there other options? Why didn't you use data from previous lighting surveys in homes (CLASS 2005)?	For nonresidential, self-report data was collected onsite to estimate the wattage of pre-existing equipment. This was possible since the sole purpose of the nonresidential onsite survey was to isolate IOU-discounted CFLs for ex-post measurement. For residential, the purpose of the onsite survey was much broader and conducting the whole-house inventory was a higher priority than collecting self-reported baseline wattages (which, given 2008-2009 CFL saturation levels would have produced fairly unreliable estimates). Instead, as discussed in the Upstream Lighting Program evaluation plan, to determine the pre-CFL baseline wattage for residential CFLs, we calculated the average wattage of non-CFL equivalents by lamp shape and room type. We then averaged the room-type non-CFL wattages, weighting by the room-type distribution of CFLs of that shape. That is, for each rebated CFL product type, the average wattage of corresponding non-CFLs was weighted by the distribution across room types for that particular CFL product type or lamp shape. For example, MSB incandescent A-line shaped lamps were weighted by the room type distribution of observed MSB twister/a-line shaped CFLs, and MSB incandescent globes were weighted by the room type distribution of observed MSB CFL globes.

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						To the point about needing to adjust baseline wattages for changes in CFL saturation rates, we found no empirical evidence of decreasing replacement wattages over time for CFLs. Using CLASS data, the average incandescent wattage in 2005 was 55.2 and the average A-line incandescent wattage in 2005 was 64.1, both of which are lower than the values we used for baseline incandescent wattage in the delta watts calculation. We also found no empirical evidence of decreasing watts replaced with increasing CFL saturation. As described in the text, we calculated baseline wattage by roomtype and CFL bulb type equivalents, and produced average delta watts weighted by the observed CFL distribution by room type and bulb type. Once the combination of roomtype and bulb type was accounted for, we found no systematic pattern of increasing or decreasing average non-CFL watts with increasing CFL saturation.
21	PG&E Company	Delta Watts	Baseline	19	Where are the data that describe the determination of pre-existing nonresidential wattages using regression techniques?	We will add references to the specific section and page numbers in the Small Commercial Contract Group report that describe the determination of pre-existing nonresidential wattages. We have added the pre-existing wattage results to the text in Section 8.7.
22	PG&E Company	Delta Watts	Res/Nonres fixtures	20	You appear to have assumed the same base-case light for Res and NonRes, yet it is typical to see higher wattages in NonRes where bright lights are	The base case for fixtures was assumed to be the same for both residential and nonresidential applications since the types of fixtures rebated implied a similar

Comment ID	Author	Subject 1	Subject 2	Original Reference Page	Comment	Evaluator Response
					assumed to lead to more sales. How did you account for the potential differences between Res and NonRes base cases?	relationship between base case and installed wattage/application. We did not have any evidence to indicate otherwise.
58	PG&E Company	Delta Watts	Baseline	141	Is the CFL wattage distribution for lamps in storage consistent with the onsite observation of installed lamp wattages (i.e., do people have an observed propensity to store higher wattage lamps)?	Yes, it is consistent (actually the overall number is exactly the same, or 18.1 watts. See Appendix C for additional clarification on stored CFLs.
59	PG&E Company	Delta Watts	Installed CFL wattages	142	Does the difference in delta watts from the program tracking database and the observed IOU-discounted CFL average wattage suggest a bias introduced in the development of the onsite sample?	Both the residential and nonresidential onsite samples were developed based on random recruitment methods using the IOU customer base as the sampling frame. Neither sample appears to be biased in such a way as to have specifically affected the observed program-discounted CFL wattages. The residential sample was weighted to better represent IOU household and housing characteristics; the nonresidential sample was weighted to reflect business type characteristics.
67	SCE	Delta Watts	Baseline		The delta watts calculation relies on a methodology that significantly biases the result to a lower value.	See response to comment #20 for a description of the method used to determine baseline wattages for residential and non-residential CFLs.
75	SCE	Delta Watts	Other	xi	a very large portion of the reduction in savings is due to the change in the delta watts calculation, but this is not mentioned in the list of key factors	Correct, we have added this point to the 4th bullet on page xi of the Executive Summary.
89	SCE	Delta Watts	Baseline	19-20	This is not appropriate methodology for estimating the delta watts for two reasons. First, it is comparing bulbs that have been changed (the installed wattage) to bulbs that have not (which are called the base case wattage, but in reality are not). What needs to be	See response to comment #20 for a description of the method used to determine baseline wattages for residential and non-residential CFLs.

Comment ID	Author	Subject 1	Subject 2	Original Reference Page	Comment	Evaluator Response
					compared are the installed to the actual base, which is what previously existed. The fact that some incandescents remain when some have been changed implies that there is a real difference between the remaining incandescents and what the actual base case was. This is essentially like testing the effect of medical school by looking at the difference in medical knowledge between doctors and the general population, rather than students entering medical school and students graduating from medical school. Students entering medical school are likely to have higher proclivities to medical knowledge than the general population, much as incandescents that were replaced by CFLs had higher proclivities to being replaced.	
90	SCE	Delta Watts	Baseline	19-20	Second, these results are likely to be downwardly biased. Research suggests that the prime motivators of installing energy efficiency equipment, including CFLs, are saving money, and saving energy. These are both related not only to the time a light is used, but the wattage of the light. Therefore, we would expect that high wattage lights would be changed out first, as would high usage lighting. There is clear evidence to suggest this is true in the results of lighting metering studies which show declining hours of operation for CFLs over time. The same is likely true for wattages, which is indeed suggested by comparing	See response to comment #20 for a description of the method used to determine baseline wattages for residential and non-residential CFLs.

Comment ID	Author	Subject 1	Subject 2	Original Reference Page	Comment	Evaluator Response
					results from the present study to results from the CLASS study in 2005.	
91	SCE	Delta Watts	Baseline	19-20	Self-reported information about bulbs was gathered as part of the net savings analysis; likewise, some information should have been gathered about self-reported base wattages, where available at least as a check on the assumptions in this methodology. Otherwise, if this methodology is to be used, it should be adjusted based on previous average wattages, and saturation rates, available from previous studies such as the CLASS study. This would allow the wattages that were actually changed during the intervening years to be estimated. See below for further comments on section 3.2.5.	See response to comment #20 for a description of the method used to determine baseline wattages for residential and non-residential CFLs.
108	SCE	Delta Watts	Baseline	44	As mentioned above in comments on section 2.2.4, the methodology used to calculate delta watts will underestimate the true delta watts because of the effects of the decreasing wattages replaced over time. The average incandescent wattage (including halogen) in 2005 (from CLASS) was 64.3 W, in 2008 it was 61.7; average CFL in 2005 was 18 W, in 2008 it was 17.2. We can use these values, as well as the saturations, to make a better estimate of the delta watts because difference between the 2005 and 2008 values represents the wattages that were replaced or installed in the intervening years, that is, the program years. This adjustment indicates the	See response to comment #20 for a description of the method used to determine baseline wattages for residential and non-residential CFLs.

Comment ID	Author	Subject 1	Subject 2	Original Reference Page	Comment	Evaluator Response
					delta watts is 57.3 W.	
19	PG&E Company	HOU	Detailed Results	20	How different were the ANCOVA-based vs direct expansion results for CFLs? Which one did you pick to use and why?	See Section 3.2.3.1, Section 3.2.4.1, and Table 18 for the relevant discussion of the recommended HOU and peak CF values. Also see detailed discussion in Sections 8.5 (HOU) and 8.6 (peak CF), as well as comparison of results in Tables 83-84 (HOU) and Tables 88-89 (peak CF).
56	PG&E Company	HOU	HOU	120-121	Why do the HOU for Program and Non-program categories differ significantly given the high rates of free ridership implied by most NTG assessment methods? Program and Non-program CFL users should show little difference.	Reasons for the observed differences are not clear. A general difference is that program bulbs have necessarily all been installed in 2006 or later, and most of them in 2007 or later, while non-program bulbs may have been installed earlier. As a result, the distribution of locations (room type, fixture type) is different for the two types of bulbs, in ways that vary across the programs. This is true regardless of the NTGR value.
68	SCE	HOU	Overarching		The hours of use model appears to have significant specification errors.	Don't know how to respond if this is the extent of the comment.
87	SCE	HOU	Model fitting	16	A sinusoidal fitting is not appropriate for estimating hours of lighting use because the probability of a light being on is related not only to the presence or absence of daylight, which is reasonably approximated sinusoidally, but also people being in the home and desiring to use the light. Getting dark at 4:30 versus 5 won't affect people who don't get home from work until 6. Nor will it getting light at 5 versus 5:30 for people who don't wake up until 7, or who go the gym every morning from 6 to 7.	The sinusoid was chosen based on its empirical similarity to the observed usage patterns in the aggregate data. We agree with the commenter that lighting usage depends both on the availability of daylight and whether someone is home. The sinusoid provided a good empirical fit to the net effect of these factors, for most of the loggers.
129	SCE	HOU	HOU	108-109	The effect of the imputation for poor fits may be harmless, however it should be	The "poor fits" did not have initially higher initial HOU than the "good" fits. The

Comment ID	Author	Subject 1	Subject 2	Original Reference Page	Comment	Evaluator Response
					noted that these loggers' "poor fits" generally included substantially larger explained variation in HOU (R-square), and substantially larger initial HOU. This is worrisome: suggesting that the reduction in HOU from previous studies may be related to the annualization technique itself. At any rate, what remains for the ANCOVA/regression approach to account for is day-length normalized, and does not itself take into account other effects, such as room type by season effects. The remaining work would have profited (at minimum been validated) by an approach which took day length (or the sun's angle at the given housing coordinates) directly into account in a model explaining daily HOU. In other words, it would be better to include day length in the model accounting for use, and then extrapolate from that model.	imputation was designed to preserve the observed HOU level for each of the "poor fit" loggers, and assigned the average observed seasonality by room type. The idea of fitting a pooled model across time periods and loggers jointly is an interesting one but unwieldy given the structure and magnitude of the data. The data are available for these alternate approaches to be explored in future studies.
130	SCE	HOU	HOU	115-116	It appears that by some criterion, probably involving Type I explained variance assessments, and quite possibly stepwise procedures that are essentially indefensible in evaluation contexts, variables like dwelling type, fixture type, lamp type, and IOU discount were determined not to be "significant" net determinants of normalized HOU. The model settled upon includes a number of highly collinear (statistically and logically) variables including "CFL Saturation," the count of applicable sockets, and CFLs in the household (nominally	Stepwise regression was not used for the ANCOVA analysis. We started with a model including all factors that we anticipated it would be important to be able to make accurate estimates for, and deleted those that appeared to offer no explanatory value in the presence of the others. As noted in the report, this does not mean there is no variation associated with these dimensions, but that the variation is captured in the other variables included in the model. In a few cases we tested inclusion of an additional variable in the otherwise

Comment ID	Author	Subject 1	Subject 2	Original Reference Page	Comment	Evaluator Response
					categorized), as well as tenure, dwelling type, presence of children, two indicators of dwelling size, education of the respondent, room type, and fixture type. Without proper labeling, the report indicates the procession of variance-explained increases and their significance over time. It is only after the procession includes fixture type, room type, and two aspects of CFL saturation (socket count and categorical specification of number of CFLs), that "CFL saturation" itself emerge	complete model, and determined that its effect was already captured in the variables already present. The significance and direction of CFL saturation is not dependent on the sequence of other variables included. Both categorical CFL count and saturation were included because the relationship between usage and CFL count was not observed to be monotonic for small numbers of CFLs, and both terms were found to be significant. The purpose of the model was not to uncover causal drivers of lighting use but to create a basis for characterizing subgroups defined by 3 to 4 dimensions. Any subgroup as finely specified as the contrary examples indicated by the comment would not be expected to have a meaningful estimate, and the model is not intended for such a purpose. At the IOU level, the ANCOVA results are generally consistent with the direct expansion results, with the exception of some smoothing of high-variability results and cell-filling for small-sample cells provided by the ANCOVA. The ANCOVA results are expected to have minimal bias and to provide meaningful estimates for the subgroups presented, within the confidence bounds indicated. It is to be expected that many of the characteristics of interest are correlated. However, excluding a variable simply because it has correlation with another

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						could lead to biased estimates for the dimensions of interest.
131	SCE	HOU	HOU	119	Not enough has been done to sort through the meaning of this very consequential specification. Because of the logical and statistical multicollinearity in the specification, some anomalies are the following: A ceiling CFL in an SDGE household with 9 CFLs, 20 sockets, no children, a hall location, with the house including a single bedroom, a single bathroom, a high school graduate respondent will have an HOU of -2.63 hours. Moving to SCE territory will increase the estimate to about negative 2.2 hours, adding a bedroom will (as one might expect) decrease HOU by about 35 minutes, and providing the respondent a college degree will reduce it by a further 12 minutes. To get positive HOU from the ANCOVA model, it helps to have very low saturation, a small house with many bedrooms, to locate in SCE territory, and be neither a college dropout nor a PhD. Moving the bulb outside will help the most (adding two hours).	See response to comment #130
132	SCE	HOU	HOU	119	It is not unreasonable for a regression model to produce some impossible values when evaluated over the range of possible population outcomes, and it would be unfair to criticize the approach based on the occasional extreme result. The point to be made here is that there is so much collinearity, much of it simply based on	Comment: “the analysis found that direct expansion yields lower variance estimates for some types of estimates, while the ANCOVA-plus-multiplier weights produce better estimates with reasonable variance for others. This is partly an effect of the proportional sampling that typically short-changes SDGE territory.”

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					simple logic, and remediable with proper specification, that the regression is degraded substantially. The model essentially says that any bulb contributing itself to high saturation (9 CFL household) in SDGE territory will need to be outside a house with one bathroom and/or many bedrooms in order to get use. An effort to specify an a priori model that incorporates saturation, possible nonlinearities in saturation's impact, a reduced set of room types, and interaction of saturation with room types, along with an expression of household size – against which additional specification might be tested, appears to be a more reasonable way to handle this very important aspect of the evaluation. Pur	Response: The proportional sampling doesn't "shortchange" the SDG&E territory. It provides a proportional share. The fact that the direct estimation provides lower variance estimates for some groups/subgroups and the model provides lower variance estimates for others is not a result of the sample allocation across service territories. If the allocation were different, there would be some changes to which method had lower variance for specific situations, but the general statement would still be true. Comment: ", the report indicates that in aggregating over subsidized vs. non-subsidized bulbs, there is 90/10 precision supporting subsidized bulbs' generally lesser HOU. The difference in Table 85 (now Table 83) appears to be 6 minutes, and the precision information indicates that the program and non-program bulbs come from the same population with respect to HOU. That is, the reported difference is not significant." Response: Across all 3 IOUs ("Overall") the results in Table 83 shows a difference of 0.2 hours per day (12 minutes) and the difference is statistically significant at better than 90 percent confidence. The direct expansion estimates in Table 83 have lower variance than the ANCOVA estimates in Table 84. The lack of statistical significance for the Table 84 results simply reflects the worse precision for that estimation method for this level of

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						aggregation. It does not imply that the two types of bulbs effectively come from the same population.
15	PG&E Company	Install Rate	Installation Rate	15	Install rates - set as of Dec 31, 2008. While this definition was set by Commission, did you make any attempt to determine the impact of slippage from 2005 efforts into 2006? If not, why not?	If by "slippage" you mean CFLs rebated in 2004-2005 but installed post-2005, then, yes, we accounted for these installations as part of the installation rate analysis described in Section 3.2.2 and Section 8.4. However, savings from these CFLs (i.e., CFLs discounted through the 2004-2005 program but installed post-2005) were accounted for as part of the evaluation of the 2004-2005 program.
17	PG&E Company	Install Rate	Installation Rate	19	Table 10 --shows some meter data still being captured. Also pleased to see that you had 3-4 k meters at any given time for most of the period of data gathering. Did you contrast install rates for CFLs before and after taking out meters? What did you do with sockets that saw changes in lighting tech installed? What if it was partial (i.e. affected part of the bulbs on the same switch but not all)? Did you give homeowners specific instructions regarding the metered sockets and bulbs being used?	We captured changes in pre/post socket-bulb characteristics for each metered socket. Sample sizes for sockets where there was a change pre/post were too small to be useful in analyses. Participants in the metering study were instructed to leave the metering equipment undisturbed unless the bulbs burned out and/or the bulbs needed to be modified for other reasons.
47	PG&E Company	Install Rate	Storage	68-69	How do storage rates for incandescent lamps compare with your CFL storage rate estimates? Does your methodology give consistent results for both types of lamps given what you have seen installed?	Please see Appendix C for further clarifiation on storage results. Households tend to store both incandescents and CFLs and the more CFLs installed, the more CFLs in storage.
54	PG&E Company	Install Rate	Installation Rate	102	Table 53, row 8 shows burnouts/breakage increasing rapidly. Please explain this given the relatively long life of CFLs and given the much	Burnout/breakage rates are calculated as (1/(measure life)) x (number in use the prior year). Increasing numbers burned out are directly the result of increasing numbers in

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					lower shipment numbers in 2004-2006 relative to 2007-2008? Also please explain why only a six year assumed lamp life is employed given that the 1.8 hours/day operation accounts for under 4000 hours in six years - significantly less than the purported life of CFLs?	use. The 6 year life has 2 bases. One is an ex-ante estimate of 12 years, adjusted by a factor of 0.5 to account for cycling time, according to the latest DEER. This measure life also results from calibrating the model to the numbers of CFLs in use at the end of the program period. That is, we know the numbers of bulbs in homes at the end of 2005 (from the CLASS study) and the numbers observed in place at the end of 2008 in the present evaluation. We also know the total numbers of bulbs shipped, from which we derive the total bulbs sold to residential customers during the 2006-08 period. With a 6-year measure life, essentially all the shipped bulbs are accounted for. If the measure life is longer, so that burnout/breakage is less, we would need to have seen more bulbs per home than were observed in the 2008 and 2009 onsite inventories.
55	PG&E Company	Install Rate	Installation Rate	102	Table 53, row 7 shows total CFLs acquired by residential customers. A significant drop-off is shown for 2009. While this may be only partial year data the number is still troubling. Please explain how the 2009 number is so low given the purported incidence of free-ridership, particularly from the participant self-report assessment. Also, please describe the storage rates for incandescent bulbs, which should be falling given the changeover to CFLs.	The installation analysis assumes that the ratio of non-program to program bulbs was the same in 2009 as in 2008. As the comment notes, this is not a good assumption given the low estimated NTGR value. The estimated 2009 sales does not affect the 2006-2008 program estimates. The 2009 column is included to fill out the projection of time to installation of the remaining 2006-08 program bulbs. The commenter speculates that storage rates would be expected to decline as CFL use increases. We have no data that supports that assumption. Over the 5 waves of survey data collection and the 3 waves of onsite data collection, we found a fairly

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						consistent ratio of bulbs stored to bulbs in use.
62	Natural Resources Defense Council (NRDC)	Install Rate	Market effects		The Kema/Cadmus "Residential Lighting Metering Study – Preliminary Results" (Metering Study) shows that the typical California household has just over 10 installed CFLs. Only 21% of current sockets in California have a CFL.2 In other words, roughly 4 out of 5 sockets in California still have an inefficient light source. As CFLs provide roughly 75% savings compared to incandescents, and since the majority of sockets still contain an inefficient incandescent bulb, we urge the Commission to continue supporting utility programs that target this vast cost-effective energy savings opportunity. While the results of this study indicate a need to include various lighting technologies in order to overcome the unique challenges presented by different types of sockets (e.g., three-way, dimmable, etc.), we see no result that indicates a need to end CFL subsidies altogether. The Metering Study indicates that most sockets seem to require only basic CFLs3 and we therefore support continued support for basic CFL programs base	Please refer to Appendix C for the updated socket and saturation information.
66	SCE	Install Rate	Overarching		The installation rate analysis seems to be seriously flawed because the attempt to model cumulative installation rate yields the same result as the shipment volume-weighted first-year installation rate.	Table 20 shows that the cumulative installation rate in year 2 and 3 is different from the first-year installation rate. In year 1, they are by definition the same. Cumulative means cumulative over the program to date; in year 1 cumulative and

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						first year are the same.
74	SCE	Install Rate	Overarching		There are a number of conceptual issues and inconsistencies involving installation rates. There is an inconsistency affecting the non-residential installation rate, which in turn affects the residential/non-residential split. The residential/non-residential split is determined by installation rates and returns to contribute to the residential accounting model that certifies somewhat different installation rates. That accounting model contains some anomalous processes when viewed from an interannual change perspective. It appears that patterns of growth in shipments have affected annual estimates of installation rates that are censored at year end, and that the use of “cumulative installation rate” is at best misleading.	The residential/nonresidential split was calculated using a consistent definition of installation rate for both the residential and nonresidential programs. This was the 2008 surviving installation rate, which was available for both sectors. The residential analysis uses time steps of 1 year, which is the finest granularity consistently available for the data in the model. Some terms in the analysis such as purchases are cumulative totals for the year, while others such as number in use or in storage are snapshot observations. This is not a censoring issue. “Cumulative installation rate” is explicitly defined in the text and the rationale for using this measure for the residential analysis is given. The structure of the nonresidential data and analysis did not permit a corresponding calculation to be made for the nonresidential sector.
85	SCE	Install Rate	Installation Rate	15	The concept of installation rate and the storage rate (the alleged complement) is at best ambiguous in the case of a staple item like a bulb. It is reasonable to consider that (a) a reasonable number of additional unused bulbs are part and parcel of effective performance of the measure – like other staple items in a home that secure continuity of performance, (b) stored bulbs will eventually be used, (c) a stored bulb has a remarkable resemblance to a December 2008	According to policy and protocols developed for the 2006-2008 impact evaluations, the IOUs were only credited for impacts associated with measures installed and operable within IOU service territories by year-end 2008.

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					installation of an efficient air conditioner or window film – the savings will not begin to occur until next year (when activated), and yet in the air conditioner and window film cases, a 2008 program would be credited with savings.	
86	SCE	Install Rate	Installation Rate	16	Estimating a trajectory may not be appropriate due to fluctuations in program output. Installation of a program bulb requires purchase of a program bulb, which in turn requires that program bulbs be available.	The trajectory calculated is based on the actual shipments, i.e. availability, adjusted for leakage, shipments not sold, and residential vs nonresidential sales.
104	SCE	Install Rate	Installation Rate	42	It seems implausible that the first year installation rates in 2008 would be significantly higher than the cumulative installation rates for the program. This is especially true given the significant increase in program volume over the course of three years. Using statewide relative program volume between the years and only first-year installation rates (i.e. no installations after the first year) yields essentially the same result as this methodology. If, on the other hand, we assume second-year installation rates are equal to first-year installation rates of the following year, results jump to 92%, 84% and 86% for SCE, PG&E and SDG&E respectively. The main point is that the modeling exercise yields results that are implausibly low for the cumulative value because it essentially equals the first-year-only value.	The first-year installation rates were incorrect. The calculation has been corrected in the revised report in Section 8.4. The error in first-year calculation rates did not affect the cumulative installation rates reported.
105	SCE	Install Rate	Installation Rate	42	Furthermore, according to D05-04-051: Counting only the installations in a	There were different rules in place for 2004-2005 v. 2006-2008. According to

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					given year in calculating the performance basis, regardless of the year in which any given installation was funded, is consistent with the approach we adopted in D.04-09-060 for the way the IOUs should account for progress towards adopted savings goals. Moreover, this approach avoids the need for an additional true-up process (between commitments and actual installations), thereby allowing for a more timely calculation of performance basis for a given program cycle. However, there are important transition issues to address in moving from counting "commitments and actuals" to "actuals only." (p. 55) That is, the IOUs should also be credited with installation of 2004-05 bulbs that were installed during the 2006-08 program years.	policy and protocols developed for the 2006-2008 impact evaluations, the IOUs were only credited for impacts associated with measures installed and operable within IOU service territories by year-end 2008. Savings from CFLs discounted through the 2004-2005 program but installed post-2005 were accounted for as part of the evaluation of the 2004-2005 program.
106	SCE	Install Rate	Installation Rate	42	As done for residential CFLs, the installation rate for nonresidential CFLs should include bulbs that were installed and subsequently burned out. The EUL (median lifetime) for these bulbs is only about 2.2 years, so over a three year cycle, many would be assumed to burn out legitimately. That is, the overall installation rates for the IOUs should be adjusted upward.	According to policy and protocols developed for the 2006-2008 impact evaluations, the IOUs were only credited for impacts associated with measures installed and operable within IOU service territories by year-end 2008. This does not include burned-out CFLs.
128	SCE	Install Rate	Installation Rate	102	A major constraint upon the accounting analysis is the "snapshot" residential storage value of 24% -- in other words, acquisitions, acquisitions replacing burnouts, burnouts, net acquisitions, and installation rates are controlled to the implied snapshot value of 76% from	The stable storage rate assumption is consistent with our observations across 3 waves of onsite observations and 5 waves of user surveys that the fraction of bulbs in storage has not changed over time. The burnouts in each year are calculated as 1/6 the number in place at the end of the prior

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					the CFL User Survey. The problematic 2006 installation rate, as it flows through the accounting, may be partially responsible for some of the anomalies that are observed in the Table 53. While estimated acquisitions increased by 17.5% from 2006 to 2007, and by 23.2% from 2007 to 2008, storage totals among new acquisitions increased in a pattern running counter to increased saturation (59.2%, 38.0%), and burnout replacement increased more steeply (24.2%, 59.7%) than would be expected from most survival curves with an EUL of six years. These are not impossible, but are implausible implications of the accounting model.	year, based on the 6-year measure life.
146	SDGE	Install Rate	Installation Rate		The installation rate analysis was supposed to be based on “three inter-related models” (diffusion model, purchase model, and installation model). However, these models were deemed as not useful because of poor data quality (see page 16). Instead what was used was a much simpler and less reliable “trajectory” analysis. This approach is based on simple accounting and does not allow for any changes in behavior or estimated parameters over time. This is a serious problem when attempting to transform the market and casts major doubt on the results of the evaluation. In addition, this section of the report is just one of many examples where the	The evaluation of the upstream lighting program had to address a number of issues for which standard methods do not exist in this context. The research design therefore laid out approaches that were conceptually reasonable, but whose practical effectiveness had not been tested. As is common in complex research, alternative analysis methods had to be developed when the initial approach was not successful. The installation rate analysis would allow for changing behavior or parameter estimates over time, and does incorporate the information available for each year. However, due to the timing of the study, some kinds of data were not available

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					report promised to conduct a specific investigation but instead did something completely different using readily available but not appropriate data and modeling methods. This is unacceptable and the modeling should be rejected	except at a single point in time. It was therefore necessary to make assumptions about earlier years based on the 2008-09 data. The analysis as presented is intended for ex-post analysis of the 2006-08 program, and not for broader market transformation assessment or projection.
45	PG&E Company	Invoice/Application Verification	Quantity Adjustment	67	The report claims that our invoices did not match up. Can you provide more detail regarding what steps the evaluators undertook before they reached this conclusion?	In order to compare PG&E invoice documentation with PG&E tracking data, it was first necessary to ensure that PG&E tracking data matched PG&E's reported E3 savings claims. There was considerable back-and-forth between PG&E and the evaluation team trying to get the various tracking databases to match up (initially, the tracking data supplied by PG&E was off by more than 17 million Upstream Lighting Program products). Ultimately, the tracking data did not match 100% but PG&E indicated it was as close as they could get. This set of tracking data was then used as the basis for the invoice verification task discussed in Section 2.1.1 and 8.3.1. The results discussed in these sections show how PG&E tracking data was still not very well-aligned with the invoice documentation, and how the quality of the documentation was not very reliable.
53	PG&E Company	Invoice/Application Verification	Invoice/Application Verification	99-100	What steps were taken with IOU staff to resolve invoice verification issues?	In order to compare PG&E invoice documentation with PG&E tracking data, it was first necessary to ensure that PG&E tracking data matched PG&E's reported E3 savings claims. There was considerable back-and-forth between PG&E and the evaluation team trying to get the various

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						tracking databases to match up (initially, the tracking data supplied by PG&E was off by more than 17 million Upstream Lighting Program products). Ultimately, the tracking data did not match 100% but PG&E indicated it was as close as they could get. This set of tracking data was then used as the basis for the invoice verification task discussed in Section 2.1.1 and 8.3.1. The results discussed in these sections show how PG&E tracking data was still not very well-aligned with the invoice documentation, and how the quality of the documentation was not very reliable.
119	SCE	Invoice/Application Verification	Invoice/Application Verification	67	It is unclear how the document quality scores were actually used. Please provide some information on this.	Please read sections 2.1.1 and 8.3.1 for further discussion.
127	SCE	Invoice/Application Verification	Invoice/Application Verification	98	It is unclear how exactly the invoice quality scores were determined or used. Does a 0.90 mean that 90% of bulbs in that shipment were likely to show up at the retailer?	Please read sections 2.1.1 and 8.3.1 for further discussion. Ultimately they were not used. A 0.90 would indicate a level of confidence in the shipment data actually reflecting what took place. The lack of confidence is due to poor or unsuitable documentation.
9	PG&E Company	Leakage	Leakage	13	How valid is assumption in footnote 6? How many of the CFLs were IOU-rebated product? Is it a good assumption to assume IOU product leaks as much as non-IOU product? How do their prices compare? Who bought IOU vs. non-IOU?	The results from IOU-discounted CFL purchasers were compared to the results from all CFL purchasers, but the sample size was too small to be used as the basis for leakage assessment. Generally, we didn't see much of a difference in shopping patterns between different types of purchasers.
10	PG&E Company	Leakage	Leakage	13	Did you indeed find that stores within 10 miles of a non-IOU utility were more prone to leakage? By how much? How many of these were leakage within CA vs. outside? Given that CA typically	Stores within ten miles of non-IOU areas were more prone to leakage, as discussed in Section 3.1.4. The GHG perspective was outside the scope of this evaluation.

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					has lower C-intensity in its electric mix, wouldn't we be better off from a GHG perspective if leakage was higher--in essence helping achieve more of the GHG goals of the CPUC and CA?	
11	PG&E Company	Leakage	Leakage	13	How valid is the assumption that leakage for CFLs applies also to LEDs and fixtures? Why do this downward correction without any real evidence?	Since we see no evidence to the contrary, we assumed that sales of IOU-discounted fixtures and LEDs would sell through similar channels with similar patterns as sales of IOU-discounted CFLs.
12	PG&E Company	Leakage	Leakage	13	Were any attempts made to determine leakage "into" the IOU territories from adjacent areas? Was this possibility taken into account in establishing the final leakage numbers?	Leakage into the IOU service territories was not explicitly addressed in this evaluation, nor was it considered as part of our assessment of leakage. That said, if there was significant leakage into the state, it would have shown up as part of the installation rate analysis.
36	PG&E Company	Leakage	Leakage	38	Leakage was negligible for PG&E, especially considering the potential for bias among intercept surveys. Given that these CFLs ended up at best in SMUD or another POU, is this such a critical issue?	The opportunity for bias in the intercept results was low and therefore shouldn't affect the results. Shoppers were asked to indicate if PG&E provided their electricity service and, if not, zip codes were used. The GHG perspective was outside the scope of this evaluation.
64	Natural Resources Defense Council (NRDC)	Leakage	Leakage		A leading goal of the IOU upstream lighting program is “market transformation,” which includes not just increased energy savings, but a long term shift in available technologies toward more and more efficient options. Given this goal, NRDC is concerned that the Draft Report subtracts 100% of the savings from bulbs sold to non-IOU customers. While it is certainly true that bulbs used outside of IOU territory do not reduce energy generation needs for the IOU,	According to policy and protocols developed for the 2006-2008 impact evaluations, the IOUs were only credited for impacts associated with measures installed and operating within IOU service territories by year-end 2008. The CPUC policy is to not count spillover in 2006-2008. due to it's speculative nature (see Finding of Fact 27 of D. 05-04-051). In regards to market transformation and effects, the commission addresses the issue in D.07-10-032 where it directs the Energy Division to assess whether market

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					these bulbs still represent saved energy, reduced pollution and forward movement toward “market transformation.” As demonstrated in the map at right, 6 CFL’s continue to represent a largely underutilized efficiency resource and California still leads the nation in CFL penetration. This is the result of the use of bulbs inside and outside IOU territory. Use of CFLs outside IOU territory represents one of the most direct “spillover” benefits of IOU CFL programs and this benefits should not be entirely ignored in evaluation of the program.	effects should be counted in 2009-2011: "We direct our staff, under the direction of the assigned Commissioner and working with parties during the evaluation of 2006-08 programs, to assess our existing EM&V protocols, the availability of data, the credibility of estimating savings, the gain from doing so relative to any incremental evaluation costs, to determine if there are participant spillover market effects that should be attributed to ratepayer-supported programs beginning with the next program cycle (2009-2011).”
81	SCE	Leakage	Leakage	13	In the in-store customer intercept surveys 41 drug stores were visited but only 21 surveys were conducted at drug stores. Please comment on the possible reasons for this and how this might affect the results for that channel.	Lighting purchase patterns in drug stores are different (i.e., lower) than other channels. In the revealed preference models, drug stores were combined with grocery stores to account for the smaller sample size.
144	SDGE	Leakage	Leakage		The “leakage” estimates rely on a vulnerability index defined by stores that stock the product and are within ten miles of non-IOU areas. SDG&E receives a large leakage penalty due to the proximity of Mexico to the SDG&E service territory. Again, this analysis is limited to screw-in CFLs with no information offered about other lighting products. In addition, the vulnerability measure is completely ad hoc, there is absolutely no discussion of how results are altered if another distance is used (i.e., robustness), and it is never tested as to whether or not vulnerability is transferable across IOU areas again	SDG&E receives a large leakage penalty that is based on high levels of leakage near the border with Mexico. That is the only large draw for leakage, and is a real issue. We feel that 10 miles is an appropriate range (especially for SDG&E because there are high levels of leakage found at stores between 5 and 10 miles from the border, and not a high number of stores between 0 and 5 miles of the border). The issue of transferability of leakage across IOU areas is mute for SDG&E, as leakage rates for the "between 0 - 10 miles" portion of SDG&E stores are the ones experiencing the high levels of leakage near the border with Mexico. We did not

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					casting doubt on the results of the analysis. A more appropriate model would be a spatial model of the diffusion/leakage process. Finally, the report ignores the possibility of "reverse leakage" in which products from non-IOU programs leak into IOU areas.	"transfer" this leakage rate to other portions of SDG&E territory. This analysis was done spatially, creating separate "buffer" regions around non-IOU areas in order to estimate leakage for those different areas - and the IOU as a whole - based on CFL purchase-weighted leakage rates found at the stores surveyed. Reverse leakage was not addressed in this study.
164	DRA	Leakage	Overarching		DRA has an overarching concern regarding the continuing lack of information and transparency in the ULP Process that the Draft Evaluation Report for 2006-08 Upstream Lighting Programs (Report) fails to resolve.	Due to the upstream nature of the program, the details are less clear than for other efforts. See also response to comments 165-171.
165	DRA	Leakage	Leakage		are the IOUs negotiating with international manufacturers or local distributors?	The interviews with the participating lighting manufacturers indicated that all but a small percentage of CFLs sold in the U.S. are manufactured overseas, primarily in China. Even large U.S. lighting companies like GE and Sylvania do their CFL production in China through partnerships with Chinese firms. Therefore nearly all the companies that the IOUs are negotiating with are "international manufacturers." It is not clear what the commenter means by "local distributors". The interviews with manufacturers and high-level retail buyers indicated that all the Upstream Lighting Program shipments are from manufacturer or branded importer to the participating retailer with no U.S. distributor middlemen beyond the retailer's own distribution centers. Some of the store or lighting product managers with grocery and lighting/electronic stores did report getting

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						their Upstream Lighting Program products from unaffiliated distributors. However, we think the information provided by the manufacturers and retail buyers is more reliable on this issue. The lighting manufacturers who participate in the Upstream Lighting Program do vary as to whether they have U.S.-based warehousing capacity or whether they have to "direct ship" their IOU-discounted CFLs from China. The larger participating manufacturers have the US-based warehousing and therefore can deliver the IOU-discounted CFLs much faster after receiving the order.
166	DRA	Leakage	Leakage		How many middlemen are there between the point of rebate/buy-down and the retailer?	The interviews with manufacturers and high-level retail buyers indicated that all the Upstream Lighting Program shipments are from manufacturer or branded importer to the participating retailer with no U.S. distributor middlemen beyond the retailer's own distribution centers. Some of the store or lighting product managers with grocery and lighting/electronic stores did report getting their Upstream Lighting Program products from unaffiliated distributors. However, we think the information provided by the manufacturers and retail buyers is more reliable on this issue. The lighting manufacturers who participate in the Upstream Lighting Program do vary as to whether they have U.S.-based warehousing capacity or whether they have to "direct ship" their IOU-discounted CFLs from China. The larger participating manufacturers have the US-based warehousing and therefore can deliver the

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						IOU-discounted CFLs much faster after receiving the order.
167	DRA	Leakage	Leakage		What are the obligations of retailers to return CFL products that they do not sell directly to their customers?	The IOUs would better be able to comment on what their agreements with participating suppliers say regarding returned CFLs. However, the Upstream Lighting Program process evaluation did ask retail buyers and PG&E/SCE store managers what they did with unsold IOU-discounted CFLs. 14% of the retail buyers and less than 1% of the store managers said they return their unsold IOU-discounted CFLs to the manufacturer.
168	DRA	Leakage	Leakage		What is the process/resistance of manufacturers to taking such returns?	We were not aware that the manufacturers were resisting taking unsold CFLs. The IOUs would better be able to comment on any policies or procedures for manufacturers taking returned bulbs.
169	DRA	Leakage	Leakage		To the extent that rebates are made directly at the retail level, how do IOU program managers ensure that rebates /products are returned to the IOUs rather than sold-off to other retail outlets?	The Upstream Lighting Program process evaluation describes the various steps that the IOUs are taking to minimize CFL leakage. These include bulk purchase limits, monitoring of websites like eBay for sales of IOU-discounted CFLs, reduced allocations of IOU-discounted CFLs to zip codes that might be at risk of overstock, and secret shopper investigations where program staff attempt to purchase more IOU-discounted CFLs than the Upstream Lighting Program bulk purchase limits allow.
170	DRA	Leakage	Leakage		There is no context that considers the extent to which large volume leakage has resulted in arbitrage opportunities as a secondary, non-controlled CFL market.	Due to data source limitations, we were not able to adequately study supply-side leakage.
171	DRA	Leakage	Leakage		The Report's silence on the issue of	Due to data source limitations, we were not

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					large volume leakage (for the purpose of these comments referred to as “arbitrage”) leaves a gaping hole in the overall analysis of the ULP’s achievements. Without this context, it cannot be determined the extent to which: • The ability to track ratepayer-subsidized CFLs has been compromised. • Discount stores are receiving CFL merchandise through a backdoor channel. • Subsidized CFLs end-up in other states or countries. The Report seems to track sales by asking retail buyers and managers to estimate the amount of subsidized CFLs that were “sold through” by the end of the 2008 program cycle. However, there is no clear indication that “sold through” means that they were actually sold directly to residential customers (sometimes non-residential) who installed them in their light sockets. In the absence of any research into the clear arbitrage occurrences, it cannot be assumed that retail entities are not selling-off subsidized CFL products to secondary market aggregat	able to adequately study supply-side leakage. We agree that supply-side leakage is something that should be investigated in future studies. In the supplier interviews that we completed as part of the 2006-2008 Upstream Lighting Program impact and process evaluations, we did ask these market actors a number of questions related to CFL leakage. These included: (1) Whether they had seen any evidence of leakage -- whether with their own products or those of another Upstream Lighting Program participant; (2) Where in the distribution chain CFL leakage might be occurring; (3) What happened to IOU-discounted CFLs that remained unsold for a long period of time; (4) Whether they had any problems with deliveries of IOU-discounted CFLs such as shipments being larger than expected or arriving at unexpected times (overstocks might encourage leakage); (5) Whether they were aware of "anti-leakage" program rules -- such as bulk purchase limits -- that had been introduced by the IOUs in late 2007 and what they were doing to help enforce these. In terms of where in the CFL distribution chain that leakage may be occurring participating, the most common responses of the suppliers was that it was a result of customers reselling the products after

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						buying them at retail stores (post-retail resale) or due to retailers trying to get rid of some overstock (retailer resale). We assume this latter category is the arbitrage that the commenter is most interested in. We did not ask these suppliers to estimate the percentage of their IOU-discounted CFLs that were lost to leakage. However, in discussing the evidence of CFL leakage that they had seen, many of the interviewees said that the quantity was very small. In addition, we were able to use 1) supplier estimates of the quantity of unsold ULP-discounted CFLs 2) store manager reports of what typically happens to unsold ULP-discounted CFLs; and 3) supplier reports of where in the distribution chain CFL leakage might be occurring; to come up with a very rough estimate of the magnitude of CFL leakage. This estimate was 5% -- which we considered to be a high estimate because it made a number of assumptions that would inflate this leakage number -- such as the assumption that all leaked CFLs from retailer resale would end up installed outside the IOU service territories. Finally, it is important to point out that the IOUs participating in the ULP did introduce in 2007 a number of measures designed to discourage and mitigate the leakage problem. Some of these measures -- such as the bulk purchase limits, secret shoppers, and the policing of websites such a eBay -- were designed to

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						discourage post-retail resale. However, others -- such as moving allocations of IOU-discounted CFLs away from retailers in zip codes where there was a danger of oversupply -- were designed to discourage the other potential cause of leakage -- retailer resale. Since the IOUs investigated many of these incidences of CFL leakage, they may able to shed additional light on the likely magnitude of these leakage problems.
3	PG&E Company	NTGR	NTGR	xii	Please provide another table in addition to table 1 that shows gross realization rates and NTGR before the final results. This would help clarify what key assumptions changed significantly between ex-ante and ex-post and helps focus future program enhancement efforts	Tables 26-27, 30-31, and 34-35 have been updated to show both ex-ante and ex-post results.
5	PG&E Company	NTGR	Results by channel	3	Table 2 implies that the retail channel was a key parameter that affected the significant differences between the 3 IOUs net savings results. Is there a significant difference in the attitudes and appliance use patterns between individuals that shop at these different retail channels or, alternatively, are consumers similar across the State, but retail channel choice is driven by availability? Is it true that the customers of these stores differ regarding HOU, install rates, NTGR, etc. Additionally, how different are the customers/households doing these purchases in 2006-07 vs. 2008, when CFLs increased significantly and PG&E had ramped down sales in big-box	We did not conduct analysis of differences in attitudes/lighting usage patterns according to retail channel. We also did not analyze differences in HOU and install rates according to retail channel. There were significant differences in NTGR by retail channel as discussed in the report.

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					stores.	
24	PG&E Company	NTGR	NTGR	20	As a matter of terminology, we should be using NOFR or NTFR rather than NTGR. The analysis does not include spillover. This is a key difference between the terminology and the evaluation approach used in other jurisdictions. It is important that this point is clear to reviewers without having to reference CPUC past rulings. It is misleading to label it NTGR.	The evaluation is using the definition of NTGR estimate as defined by CPUC for these programs. The report has been updated to include this definition.
25	PG&E Company	NTGR	NTGR	21	Self report method - were interviews carried out each of the 3 years? You seem to imply this. How did the results vary year-on-year and vs. 2004-05? What is the uncertainty and how was that determined?	Interviews were not carried out in each of the three years. Rather, respondents were asked to answer questions about sales during the 2006-2008 period. The NTGR estimates provided by manufacturers and retail buyers were generally higher for the 2006-2008 Upstream Lighting Program than those provided for the 2004-2005 program. (Store managers were not interviewed in the 2004-2005 evaluation.) The channel-level reported NTGR estimates were higher for every channel except Grocery. The average channel-level change, weighted by the 2006-2008 channel mix, was an increase of 10 percentage points. That is, if the channel mix had been the same in 2004-2005 as it was in 2006-2008, the channel-weighted NTGR estimates (based on manufacturers and retail buyers only) would have shown an increase of 10 percentage points between the two studies, from 62% to 72%. (The 2004-2005 NTGR estimate from supplier self-reports was 66%; the change in channel mix from 2004-

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						2005 to 2006-2008 resulted in a decrease in the overall NTGR estimate.) The overall increase in reported NTGR estimates at the channel level could be attributed to several factors: • Suppliers interviewed in successive studies may become increasingly savvy ""gamers"" as some parties have suggested. • With the decline in the state of the economy, consumers are more price-conscious and therefore buydown rebates are all the more important for moving sales. Some of the suppliers said as much in the in-depth interviews. • The 2006-2008 program may have been more effective at changing customer choices, in part because of its scale (approximately 95 million v. approximately 19 million), as compared to the 2004-2005 program. Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results
26	PG&E Company	NTGR	NTGR	22	Did you contrast results of retailers who only carried IOU product with those who carried a mix? What can we learn from their answers as to the validity of the SRA?	Most retailer types carried a mix of program and non-program CFLs. The two exceptions were the $1/99 cent stores in the Discount channel and certain chains of discount grocery stores in the Grocery channel. These stores said that they do not sell CFLs when the IOU-discounted CFLs are not available, and this was reflected in their self-reported NTGR

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						estimates. For example, Table 23 showed that the suppliers in the Discount channels (based on manufacturer and high-level retail buyer estimates) gave a NTGR estimate of 100%.
27	PG&E Company	NTGR	NTGR	22	Why were you only able to get responses from 127 of 242 retail store owners in 2009? What percent of sales did these stores represent and how varied were they across the various store types you had also looked at earlier as part of the process evaluation? What was the uncertainty of these results?	About 10% of the store managers in the sample were filtered out (from 242 to 218) because they said that their store did not sell the IOU-discounted CFLs. Of the 218 who said that their store sold IOU-discounted CFLs, only about 60% (the 127) of these were willing to estimate by what percentage their CFL sales would change in the absence of the program. These 127 store managers represented a little over 2% of 2006-2008 Upstream Lighting Program program sales.
28	PG&E Company	NTGR	NTGR	22-24	The questions asked were negatives. How would the answers have changed if you had asked: "how much did you sell because of the program? What proportion of all sales were these?" These are also very convoluted questions, part of much larger surveys that may have confused respondents. Given all the societal noise from CFLs becoming everybody's green symbol - in part as spillover from past programs -- the signal to noise ratio for attribution is huge. How do you propose dealing with this? Or are we to simply take it as a given that SRA somehow is not affected by this? You talk about the green retailer bias and how DEER 2008 adjusted upwards because of it. What adjustments did you do here? Please provide specifics on how the	We did ask manufacturer and retailer representatives what percentage of their 2006-2008 California CFL sales were IOU-discounted CFLs. These answers were generally consistent with their responses to the NTGR questions in terms of their decline in sales in absence of the program. Both the 2008 and 2009 supply-side interviews asked them about other drivers of CFL sales besides the rebate programs such as green campaigns by retailers such as Wal-Mart and Home Depot and consumer concerns about global warming. Their responses are summarized in the CPUC's CFL market effects report. These responses indicated that the supply-side market actors were well aware of these trends, but generally did not think them as important drivers of CFL sales as the

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					golden goose and green bias adjustments were made and how it affected the overall results?	Upstream Lighting Program rebates. The overall NTGR estimate from the supplier self-report of 74% indicates that they did not give great weight to these other possible drivers of CFL sales. Since the golden goose and green retailer bias work in opposite directions, our approach to controlling for these biases were to average together the manufacturer, high-level retail buyer, and store manager NTGR estimates for many of the channels.
29	PG&E Company	NTGR	NTGR	23	You discuss consistency checks, but don't say how often you encountered possible outliers nor how you dealt with these. How often, how far were these outliers? What criteria was used to identify these responses as problematic? You also point to doing this to identify self-serving biased answers to keep IOU-rebates going. Yet there could have been valid market dynamics going on (availability of product, newspaper stories about CFLs and mercury and/or cancer or quality issues, price wars, etc.) that could also explain their responses.	1) If we encountered NTGR estimates that were very different from other NTGR estimates in a given market actor/retail channel/product type subgroup (e.g., if a NTGR estimate from a manufacturer for non-specialty CFLs in the grocery channel was very different than other manufacturer NTGR estimates for non-specialty CFLs in the grocery channel) we would first check for transcription or calculation errors. If none were found, we usually checked the manufacturer's or high-level buyer's "pie estimate." This was their estimate of what percentage of their total California CFLs sales were IOU-discounted CFLs. This usually explained most differences in estimates. For example, a more diversified supplier that sold both IOU-discounted and non-program CFLs would give lower NTGR estimates than a supplier that was very dependent on the Upstream Lighting Program for their CFL sales. 2) We did not try to second-guess any of the individual supplier NTGR estimates by

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						adjusting them downwards or upwards because of suspicions of gaming. Because we did not know the magnitude of these possible biases, we thought a more prudent approach was to average the NTGR estimates of manufacturers, high-level retail buyers, and store managers across a given retail channel. This is because in theory the biases of the manufacturers and high-level retailers would work in opposite directions. We also expect that the store managers would be less likely to game their responses so incorporating their NTGR estimates would further dilute any gaming effects.
30	PG&E Company	NTGR	NTGR	26-27	Part 1 of 2 Asking shoppers to tell you what they would have done had the price been double is not an accurate way of developing a NTGR. People are in a rush, will answer anything to get rid of interviewers (so hopefully got same number of negatives as positives--though psychologists tell you people prefer to give positive answer). Individuals may have also been heavily influenced by program marketing efforts that champion the benefits of switching to CFLs, creating a perception that energy savings will outweigh even large product price increases. You acknowledge a downward bias in NTGR but don't say how large you think this bias might have been. Your conjoint analysis reinforces this finding. Yet, you do not say how large the bias may have been nor seem to have corrected for it.	Customers who have just made a purchase are in a better position than nonpurchasers or prior purchasers to consider how a change in price or other attribute might have affected their purchase. The conjoint exercise was conducted in a different context. We do not have a basis for correcting for nor estimating the size of the possible bias.

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31	PG&E Company	NTGR	NTGR	26-27	Part 2 of 2 You also acknowledge that the study was carried out in 2008-09 and that the results may reflect a very different market situation from that in 2006-07. Why didn't you try to do something in 2006 or 2007? Or at least interpolate between 2004-05 and 2008 results and apply these to those years? How large may this impact have been given that in 2008 CFL rebates were as large as 2006-07 together, that the climate change had become daily news and CFLs were being touted as the cure in 2008 whereas not so in 2006-07?	The evaluation formally began in 4th quarter 2007. With respect to the NTGR estimates, see Section 6 and the CFL Market Effects Study for a discussion of the challenges conducting this type of research during 2008-2009. IOU E3 claims for 2006-2007 suggest that >50% of rebated units were claimed >2008 but, unfortunately, program tracking data does not provide consistent and reliable information on actual shipment dates such that interpolating results from 2008-2009 to 2006-2007 was not possible.
32	PG&E Company	NTGR	NTGR	29	Did any of the evaluator's surveys collect data that would allow them to evaluate the impact of PG&E's advertising on CFLs? The primary focus of the econometric work seems to consider price point impacts, but little else the program does to encourage customers to purchase and install CFLs. PG&E ran a ~$6 million Better Bulb campaign in 2006 - 08 to educate consumers. How was this factored into the various assessments?	The intercept surveys asked about factors other than price that influenced purchase decisions. These factors included store environment, prior usage, awareness of IOU discount, etc. We also asked questions about the key drivers in purchase decisions (including advertising seen prior to entering the store, as well as the relative influence such advertisting had on purchase decisions). Very few respondents indicated that seeing IOU advertisting had directly influenced purchase decisions, although it is possible that some factors (e.g., new bulb features) could be indirectly attributed to the campaign messages.
33	PG&E Company	NTGR	NTGR	30-31	Revealed preference - you point out the limitations. Also, the signal to noise was smaller by the time you did this and it ignores the fact that CFLs were the green symbol by the time you captured this data. Additionally, you cannot assume that the ULP did not	The fact that CFLs were a green symbol is reflected in the revealed preferences and does not need to be explicitly accounted for in the analysis for that point in time. The text acknowledges that to the extent the program increased total purchases (of CFLs and non-CFLs combined) the NTGR

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					affect total sales-given the huge number of CFLs incented which were a significant portion of total sales.	estimate calculated by this method understates the program effect.
38	PG&E Company	NTGR	NTGR	45-47	How many CFLs were reported as having replaced previous CFLs in any of the surveys you conducted?	CFLs replacing CFLs was not something explicitly accounted for in the impact evaluation (see discussion in Section 3.2.6).
39	PG&E Company	NTGR	NTGR	47	There are huge NTG variations in Table 22 (and the variation widens if some of the additional NTG estimates in Section 8 are included). How can anyone posit one is better than another? The range goes from 0.06 to 1.0 depending on vendor type and method. Neither extreme makes sense - as a NTGR of 0.06 would imply that CFLs are available, affordable, and accessible at absolutely every store that sells lighting products, as well as full awareness of all customers about them. However, we know that is not the case. Other studies show that ~ 10% still are unaware. And these don't even include spillover. The table shows strong evidence that NTGR cannot be calculated reliably. How should these results be used to inform planning for 2010 and beyond?	It is true that NTGR estimates were developed using multiple methods which produced a range of results. We considered the validity of each method/estimate, at the channel level where available, and assessed which had the greatest validity in each case. We present arguments for the relative strengths and weaknesses of each in Table 24. The final estimates represent the evaluators' best judgment based on a preponderance of evidence. Recommendations for how evaluation results should be used for future planning activities is beyond the scope of this report.
40	PG&E Company	NTGR	NTGR	51	After stating rather strongly why you believe that the NTGR estimates in Table 24 are the best estimates for 2006-08 you then express doubt that these are the best estimates moving forward, (i.e., for the 2010-12 program cycle) what values are the best to employ for 2010-12 program implementation? Your statement that	This statement is made because the nature of the future Upstream Lighting Program designs is uncertain. For example, if the Upstream Lighting Program became a lower volume, more targeted program, we would not expect our results to be directly transferable.

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					they may not be the best estimates going forward greatly weakens confidence in your purported "best estimates" for 2006-08.	
41	PG&E Company	NTGR	Channel Shift	52	Please clarify why the report states that there is not enough data on which to adjust or recommend a NTGR based on channel shifts, yet, it appears that an adjustment is made in Table 2-4? This paragraph and/or wording is confusing.	We have added clarifying text throughout the report, including Section 3.3.2 and Table 25. The NTGR applied for the 2006-2008 Upstream Lighting Program does not include any adjustment for channel shift.
42	PG&E Company	NTGR	NTGR	54	The NTG analysis seems to be based primarily on 2008-09 data applied to 2008 ULP, which begs the question--what were the NTGR's for 2006-07 and shouldn't yearly values be applied given the huge changes in the CFL market in CA over these 3 years? This is borne out by your statement that "the total net impacts for 2006-07 were higher."	The statement is referring to speculations about the likely effects prior to 2008-2009 that the model cannot estimate. Annual NTGR estimates were not possible given the timing of when the study was conducted, and the limitations within the program tracking data regarding actual shipment dates.
49	PG&E Company	NTGR	NTGR	75	NTGR - you acknowledge that you were unable to triangulate--something the IOUs pointed out in Nov 2005. A SEMPRA staffer asked how were you going to get the final result if the three different methods gave very disparate results. In this case you apparently ignored the results of two of these and chose to average the results of the revealed preference method, essentially landing on a set of numbers that feel right to you. Do you believe we should use NTGR or shift to other performance metrics (e.g., sales and sales "lift" or customer saturation) to track the incremental effect of the ULP	It is true that NTGR estimates were developed using multiple methods which produced a range of results. Triangulation is a broad term. The final estimates provided were developed by a form of triangulation. We considered the validity of each method/estimate, at the channel level where available, and assessed which had the greatest validity in each case. We present arguments for the relative strengths and weaknesses of each in Table 24. The final estimates represent the evaluators' best judgment based on a preponderance of evidence. The question of what metric should be

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					on the CFL market?	used to track the effects of future programs is outside the scope of this evaluation.
60	PG&E Company	NTGR	NTGR	183	Please verify that the values in Table 98 are calculated correctly (e.g., row D does not appear to be equal to (B-1)/C).	The values are calculated correctly, but there is a typo in the cited calculation. It should be (C-1)*B. This has been corrected in Table 113 in the report.
61	Natural Resources Defense Council (NRDC)	NTGR	NTGR		The Report recommends substantial reductions in the Net to Gross ratio for basic CFLs. We have substantial concern with the methodology and conclusions of the report. The report includes sophisticated modeling efforts, but these modeling efforts often fail to match collected data.1 The resulting recommendation that NTG ratios be reduced to an average of .54 seems out of place, given the continued predominance of incandescent bulb sales. NRDC asked the Energy Center of Wisconsin to analyze the Draft Report's recommended adjustments to Net-to-Gross (NTG) ratios. We agree with the concerns they raise with the modeling of Net to Gross ratios. We have attached ECW comments as "Appendix 1" to these comments. 1While the modeling of installation rates suffers from some of the same deficiencies, the final recommendation suggests about a third of bulbs are stored rather than installed immediately, which seems reasonable given that multipacks are the lowest alternative.	There is no inherent inconsistency between having most bulb sales be incandescent and having half of the bulbs purchased through the program being purchases that would have been made without the program. The ECW report cited argues for use of approaches that will lead to asymmetric errors -- ie a tendency to retain ex-ante values in the absence of compelling evidence to the contrary. This requirements of this evaluation were to provide estimates that are designed not to err more on one side or another. The ECW report also argues for use of methods that provide credit for all market effects. This evaluation was required to provide savings net of free ridership, not comprehensive market effects. Finally, the ECW report raises substantial issues with the conjoint analysis. This analysis was not used as the basis for the recommended NTGR estimate.
69	SCE	NTGR	Overarching		The elasticity analyses are based on incorrect definitions of elasticity, the wrong elasticities, or misusing	Elasticity can refer to the percentage change in quantity or market share resulting from a percentage change in

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					elasticities with respect to the observed price reduction.	price. In the NTGR analysis the percent change in market share is converted into quantities of CFLs (i.e., to calculate the program induced increase in CFL quantities that were sold). The report has been updated to use the term "market share elasticity" where appropriate.
71	SCE	NTGR	Overarching		Multiple analyses appear to rely on stepwise regressions, which is unacceptable and unwise as it does not necessarily produce the best fit due to its vulnerability to specification and measurement error.	Stepwise regression was used only for some of the revealed preference logistic regressions. They were used primarily to choose among alternate proxies for related concepts. Models that were not stable under alternative orderings for the stepwise regression were rejected. No final estimates or recommendations were based on the results of the revealed preference logistic regressions.
73	SCE	NTGR	Channel-specific estimates		Analysis by sales channel was a method identified in the 2004-05 evaluation. The main purpose of this was to be able to calculate utility specific values more clearly and organize information more coherently. Unfortunately, at times in this evaluation, “channelization” seems to have become the desired end, rather than a means to the desired end of utility level results. This led the analysis in directions that weakened them.	We may not completely understand this comment, but we feel strongly that NTGR estimates vary considerably by channel and also by IOU. Our method produced results by channel that were then applied to the IOUs accordingly to their channel-specific distributions. We disagree that this weakens the resulting estimates.
92	SCE	NTGR	Net Savings Analysis	20	The net savings analysis is attempting to estimate the net-of-freeriders ratio (NOFR), not the net-to-gross ratio (NTGR) because it is not accounting for spillover.	The evaluation is using the definition of net-to-gross as defined by CPUC for these programs. The report has been updated to include this definition.
93	SCE	NTGR	Threats to Validity	24-25	A source of bias not mentioned is that retail store managers are likely to understate the effects of the program in	Comment noted

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					order to attribute relatively more sales to their skills as managers. This is related to the “green retailer bias”, but has nothing to do with the “greenness” of the company and everything to do with the quality the manager wants to project, and likely feels he or she demonstrates.	
94	SCE	NTGR	Threats to Validity	25	A further type of type of lack of market knowledge is that these are all estimates of what would have happened under alternate circumstances that in fact did not occur. Even a completely unbiased survey respondent does not know what would have happened in these alternate circumstances.	Comment noted
95	SCE	NTGR	Econometric Models	26-27	An additional problem in this methodology is that prices may have changed by something other than a factor of two. In fact, the pricing model estimated that the non-ULP is slightly over 3-times as much as the ULP price. Additionally, purchases require that the price of the CFL be acceptable to the consumer and that the CFL be available for sale. As in the example above of the discount store managers, the consumer has a lack of market knowledge.	The methodology does not require that prices have changed by the exact factor respondents were asked about. The methodology uses the pricing study estimate of actual price change attributable to the program, for each channel. The elasticity estimate is applied to this price change. The commenter is correct that this analysis understates the total effect of the program on sales, because it addresses price responsiveness only, and not the effect of the program on availability and retailer and customer awareness. These points are made in the discussion of the methods in the report.
96	SCE	NTGR	Pricing Model		The pricing model is a very valuable piece of analysis and should be used more extensively with the revealed	The revealed preference analysis uses the pricing study estimate of actual price change attributable to the program, for

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					preference purchase model.	each channel.
97	SCE	NTGR	Conjoint	29	A further threat to validity is that a description of the available products may not convey the same information that a prospective purchaser has. Many retailers have lighting displays that show customers what bulbs look like.	Comment noted
98	SCE	NTGR	Revealed Preference Elasticity Model	32	This modeling exercise is heavily determined by the decision to posit that purchasing less means purchasing 80% as much. Essentially you have stated that purchasers have elasticity of 0, -1 and -0.2 in the appropriate range and the exercise is then finding weights for the results. This is not an appropriate method for determining elasticity because the results depend so heavily on the 80% assumption. You state, “there could be a bias toward higher price sensitivity given they just made a purchase at a particular price”, but the respondent has in no way indicated what the specific extent of the sensitivity is, just whether it is total, non-existent or somewhere in between. Furthermore, the “appropriate range” here is problematically large and stagnant, given the elasticity is dependent both the change in price and the price.	The effect of alternative assumptions is provided in Table 112. The methodology is not a standard way of calculating elasticity, but is a reasonable method that makes it possible to take advantage of the information collected from the revealed preference survey respondents. The respondents do in fact indicate a level of price sensitivity when they indicate if they would reduce or eliminate their purchases at the higher price. Reasons for bounding the appropriate range at 0.2 and 0.8 are given in section 8.12.2. The “stagnant” comment presumably refers to the fact that we produced a single elasticity value and did not explore a relationship between elasticity and the actual price. The pricing study provided a single price relationship for each channel. A more complex elasticity model would not have resolved the uncertainty as to the interpretation of "fewer" and would have required additional assumptions for application of the pricing study results.
109	SCE	NTGR	Final Recomme nded NTGR Estimates	51	As stated above, the Revealed Preference Elasticity Model results are highly dependent on the exogenous value of 0.80 as the portion of bulbs that would still be purchased under higher prices.	The draft report notes this limitation. A discussion of this point has been added to section 8.2.

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110	SCE	NTGR	Final Recommended NTGR Estimates	51	The final recommended NTGR is significantly lower than the Supplier self-report methodology. Given that there are two opposing biases hypothesized, in order to completely disregard the Supplier value, we would have to assume the gaming bias overwhelms the green retailer bias enough to change the results by 37% (from the recommended value of 0.54 up to the Supplier value of 0.74). It seems unlikely that this is the case.	With respect to the supplier self-report method/results, we do not know how the gaming/green retailer biases affected the results. See discussion of channel-specific results in Section 8.8.5.5.
111	SCE	NTGR	Final Recommended NTGR Estimates	52	The weak empirical foundations of the revealed preference models, as well as their lack of connection to the pricing analysis. It is unclear why only Discount and Small Grocery received posited values when other channels also seem to have similar lack of clarity.	While we agree the revealed preference models have limitations (as discussed in the report), the revealed preference analysis did use the pricing study estimate of the actual price change attributable to the program, for each channel. See Section 3.3.1 for discussion of the rationale behind the discount and small grocery channel final recommended NTGR estimates.
112	SCE	NTGR	Final Recommended NTGR Estimates	52	Finally, the only result for the Lighting and Electronics channel in Table 22 is 0.83, and yet the final recommended value is 0.36. Where did this result come from?	The 0.83 NTGR for the lighting & electronics channel is based on 4 manufacturers and 4 retail store managers. The final NTGR for this channel (0.36) is the average of the recommended NTGR for the hardware and home improvement channels. This result was used since lighting and electronic stores were not included in the intercept sample. Lighting and electronics stores represent about 1% of the total volume of Upstream Lighting Program discounted products.
113	SCE	NTGR	Low and High	53	It's a little unclear whether program bulbs or all bulbs were used as the	This is clarified in the final report in Section 3.3.4. "With the program" includes both

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			NTGR Estimates from Multistate Regression		"with the program" number, but I believe it includes bulbs purchase outside the program. If not, these need to be added to the analysis.	program and non-program CFLs
120	SCE	NTGR	Channel-specific estimates by IOU estimates	75	The report emphasizes the importance having channel-specific NTGR estimates. But the point of those estimates is to be able to construct IOU-level NTGRs, which are more important. Channel-specific results are not necessary for themselves.	Channel-specific estimates were used in this analysis to develop IOU-level NTGR estimates.
123	SCE	NTGR	Revealed Preference Survey	92	The report says that "For the RP modeling, accuracy of the estimated NTGR is given by the standard error of the ratio of modeled program to modeled non-program CFL purchase probability. For the simple contrast NTGR estimates, accuracy is given by the standard error of the ratio of observed CFL shares in stores with IOU discounted CFLs present to the CFL sales share in stores without IOU-discounted CFLs." What are these standard errors?	The standard errors for the two sets of estimates are provided in Table 109. A cross-reference to the table has been added to Section 8.1.3 (which is the section referenced in the comment).
124	SCE	NTGR	Threats to Validity	94	Probably the most significant source of measurement error is that the surveys are asking people to speculate about a hypothetical situation. People provide estimates to these questions, not true values.	Comment noted.
125	SCE	NTGR	Threats to Validity	95	A major source of collection error is that elasticity questions were asked at fixed intervals that do not match the effect of the program. Effects must then be extrapolated from a 100% (asked	The draft report notes this limitation. A discussion of this point has been added to section 8.2.

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					about) change in price to a 200% change in price (the effect of the program), but elasticities are likely not constant over this range.	
126	SCE	NTGR	Threats to Validity	96	A very important source of described error in the Revealed Preference Elasticity Model was imposition of a 20% decline in purchases if customers would have purchased fewer.	The draft report notes this limitation. A discussion of this point has been added to section 8.2.
135	SCE	NTGR	Econometric Models	163	Elasticity is the percent change in quantity demanded with respect to the percent change in price, or the change in quantity demanded divided by the change in price times the ratio of the price to the quantity of d(Ln(Q))/d(Ln(P)), not Ln(market shares)/Ln(price). It absolutely is not the change in market share for each dollar reduction in price. Furthermore, the program tries to encourage people to buy more CFLs. It is not to decrease sales of incandescent or shift sales from one type of CFL to another. What is need is the "own-price elasticity of demand", how much the quantity demanded will change if a CFL's price changes. This discussion has completely missed the core of what the analysis needed to be.	Elasticity can refer to the percentage change in quantity or market share resulting from a percentage change in price. In the NTGR analysis the percent change in market share is converted into quantities of CFLs (i.e., to calculate the program induced increase in CFL quantities that were sold). Regarding the program theory, the purchase of a program CFL presumably offsets the sale of an incandscent, the assumed baseline in the gross savings analysis, so market share (CFLs vs. the equivalent incandescent) would be a relevant comparison.
136	SCE	NTGR	NTGR	164	Again, the -.07 elasticity has nothing to do with what is needed here. Neither is the -0.69 elasticity precisely correct.	Elasticity can refer to the percentage change in quantity or market share resulting from a percentage change in price. In the NTGR analysis the percent change in market share is converted into quantities of CFLs (i.e., to calculate the program induced increase in CFL quantities that were sold).

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137	SCE	NTGR	Logistic Regressions (Basic CFLs)	172	A great deal of effort went into characterizing stores for this analysis, and the approach taken to estimating the models is unfortunate given this effort, as well as the consequential impact of the results. Models were fit separately by channel group, and also for persons who intended to purchase lighting versus those who did not. This segregation, as opposed to development of an overall modeling strategy involving all channels, and terms reflecting planning of purchases, is problematic. Per channel/intent status it appears that the analysis relies on stepwise regressions, and then, based on the variables chosen (which only once included "Presence of IOU-Discount CFLs in Store"!), compared the program to no-program conditions based on averages on variables for stores where subsidies existed in that channel group, vs. where the subsidies weren't in force for existing stock. This leads to very unstable understandings of the determinants of CFL purchases, and undoubtedly highly sample-dependent estimates of NTG	We agree that the channel-level regressions did not produce useful characterizations of the purchase decisions. For this reason, the recommended NTGR values are not based on these results.
138	SCE	NTGR	Econometric Models	175	This method is conservative not only because it only examines price effects of the program, but more importantly, it only looks at cutting the price in half, not cutting the price into a third, as the program did.	We recognize, as noted in the text, that the method understates the NTGR estimate by capturing the program effect on price only, and not other program effects that could increase CFL purchases. It is not true that the method only looks at cutting the price in half. The method looks at the actual program effect on prices for each channel. This effect ranged from cutting the price by

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						a factor of 2.6 for the Home Improvement channel to cutting by a factor of 6 for the Hardware channel. See these results in Figure 3, Section 8.9.2. The effect at double the price is used to project the effect of these greater price changes estimated for each channel.
139	SCE	NTGR	NTGR	177	If Figure 5 is based on the actual numbers, it shows an NTGR of around .6, not .4.	Figure 5 has been corrected.
140	SCE	NTGR	Detailed Methods	178	The sanity check to try to keep a constant elasticity does not make sense because there is no reason that the elasticity must be constant.	The sanity check does not affect the final answer, and was included only to assess whether the responses were roughly consistent.
141	SCE	NTGR	Detailed Results	179	Table 97 indicates that over all IOUs, the assumption of what “fewer” means to the respondent is crucial to the resulting log-based elasticity estimate and the NTGR itself.	We agree that the assumed value for the "fewer" response affects the results. For this reason we considered what ranges are reasonable in the context of the purchases observed, and provided the sensitivity analysis shown in Table 112. As described in the text preceding Table 111, we assume that those who say they would buy fewer rather than 0 or the same mean that they would buy a quantity that's meaningfully different from 0 and from the same quantity they did buy. Fewer but not 0 or equal would need to mean at least one fewer and at least one bulb. Given that the typical quantities actually purchased average 4 to 5 bulbs per customer, this would mean somewhere between 20% and 80%. While this range is wide, the resulting NTGR estimates are less wide, and the effect on the final NTGR estimate that blends this estimate with others is even less. As noted in the text, we took the somewhat conservative assumption of low

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						elasticity (20% fewer at double the price) to counterbalance the likely overstatement of price sensitivity by respondents who have just made a purchase at a particular price
147	SDGE	NTGR	Econometric Models		The consumer self-report study asks consumers only one hypothetical question – would you select CFLs if they cost twice as much. Answers to this question are beset with potential bias (the authors agree on page 27 "hypothetical, out-of-context purchase decisions are not reliable predictors of actual behavior"). As such, self-reported survey responses need to be calibrated with other information or the analysis should be deemed as unreliable and rejected.	NTGR estimates were developed using multiple methods which produced a range of results. The limitations (including potential bias) with the stated preference questions were discussed in the report. We considered the validity of each NTGR method/estimate, at the channel level where available, and assessed which had the greatest validity in each case. We present arguments for the relative strengths and weaknesses of each in Table 24. The final estimates represent the evaluators' best judgment based on a preponderance of evidence.
148	SDGE	NTGR	hedonic price model		Application of the hedonic price method requires a large data base of the price of closely related products and their corresponding characteristics. For example, it is not uncommon to have several hundred thousand observations of home prices and characteristics in order to have the confidence to place an economic value of a specific characteristic. The number of observations used in this report was never specified. In addition, the estimation results are not provided. The only suggestion is that the hedonic price on the variable "IOU Discount" is not different from the evidence from the summary statistics. This suggests a poorly structured model that is inconsistent with a very large literature	This effect is estimated from the hedonic pricing model. The hedonic model was developed as part of the CFL Market Effects report, which is expected to be released in February, and will contain a far more comprehensive discussion and presentation of the model. Note that between the CFL Market Effects and Residential Retrofit efforts in-store shelf stocking was conducted in over 560 stores, including 135 in Pennsylvania, Kansas, and Georgia. In total, over 1 million bulbs (including incandescents and specialty bulbs) were counted. The hedonic pricing model was ultimately based on 6,000 CFL packages, representing over 14,000 CFLs. The fact that the statistical model and difference of means approach came up with similar results reflect the fact that the

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					and that does not provide meaningful results. As such this study should not contribute to the preponderance of evidence and should be eliminated from the report.	sample was representative of the general population (i.e., even when controlling for multipacks, distribution channel, and other factors the results were nearly identical). Both results indicated that a multiplier effect existed, whereby manufacturers and retailers were offering rebates in addition to those offered through the Upstream Lighting Program, those lowering the retail price even further. The NTGR estimate based on the conjoint analysis is not used as a basis for the final NTGR recommendations. The NTGR analysis does rely on the effect of the program on CFL price. This effect is estimated from the hedonic pricing model.
149	SDGE	NTGR	Conjoint		the conjoint analysis is supposed to provide stated-preference information about the purchase of lighting products. However, the process as described is not consistent with a large and growing literature (much of it used to value non-market goods) which uses multiple questions to triangulate answers and ensure statistical reliability. In addition, the actual survey and choice set design are not provided for review. It seems that the work is based on a software product that the researchers are unfamiliar with. The important choice question, which follows an extensive education process, obviously leads to biased responses that are meaningless. This study should not contribute to the preponderance of evidence and should be eliminated from the report.	The limitations of the conjoint analysis, particularly the assumption that the respondent has access to full and complete information regarding measure payback, are discussed in the report. These are also reasons that conjoint analysis is not used as a basis for the final NTGR recommendations.

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150	SDGE	NTGR	NTGR	75	There are many concerns with these NTGR estimates. First, it should be noted that the authors directly acknowledge the limitations of these estimates.	It is true that NTGR estimates were developed using multiple methods which produced a range of results. We considered the validity of each method/estimate, at the channel level where available, and assessed which had the greatest validity in each case. We present arguments for the relative strengths and weaknesses of each in Table 24. The final estimates represent the evaluators' best judgment based on a preponderance of evidence.
151	SDGE	NTGR	NTGR	75	Thus, the author's note that the only NTGR estimate that was defined as representative of the full 2006-2008 program effect was based on the supplier self-reported approach, yet in the end, the authors disregard those estimates and never use them to calculate their recommended NTGR estimates.	The supplier self-reported results were a basis for the NTGR estimates recommended for two of the channels (discount and small grocery) as discussed in Section 3.3.1.
152	SDGE	NTGR	NTGR- Revealed Preference Purchase Models		What was the R-square values of the various regressions and therefore how reliable are these estimates?	See Tables 105, 108 and 109 for statistical significance results from revealed preference purchase models. In particular, the p-values indicate the statistical significance levels of the estimated coefficients. R2 is not a relevant metric for this type of model and is not calculated
153	SDGE	NTGR	NTGR- Revealed Preference Purchase Models		Regressions seem very ad hoc – based on stepwise regression techniques and ad-hoc assumptions about having "well determined coefficients."	The RP regressions were not used as the basis for final NTGR recommendations The regressions started from a set of general factors that would be expected to influence purchases, and explored which proxies for those factors performed best for each channel.
154	SDGE	NTGR	NTGR- Revealed		The authors construct estimates of the	This is one of the reasons this approach

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			Preference Purchase Models		NTGR based on coefficients from the logistic regression and average values of independent variables with and without the program. However, the average values of the independent variables with and without the program are nearly identical (see Table 90) and thus very little is learned from the exercise or the calculation of the NTGR.	was not used for the final recommended NTGR values.
155	SDGE	NTGR	NTGR- Revealed Preference Purchase Models		The estimated coefficient on the average price of a CFL is positive, implying higher average price increases probability of purchase in hardware home improvement category. This seems very counterintuitive and suggests substantial model misspecification.	While this relationship is counter-intuitive it was observed in several types of analysis for this channel. There is probably a key factor unobserved that accounts for the observed relationship. This is one of the reasons this approach was not used for the final recommended NTGR values.
156	SDGE	NTGR	NTGR- Revealed Preference Purchase Models		Many of the estimated coefficients make no sense and furthermore, specifications cannot be compared since they include different variables.	The revealed preference purchase models were not used for the final NTGR estimates.
157	SDGE	NTGR	NTGR		In their final calculation of the NTGR based on this method, the authors make the unrealistic assumption that total CFL sales are not substantially changed by the program. Essentially, the authors are assuming that lowering the price of CFLs with the discount does not affect the total number of CFLs sold, implying that customers are unresponsive to price. This seems particularly unrealistic given that in their revealed preference elasticity model results they find that 61% of customers surveyed stated that they would have purchased fewer bulbs if the price of	The assumption is not that total CFL sales are unaffected by the program. Rather the assumption is that the total of CFL and non-CFL equivalent bulb sales are unaffected by the program. To the extent the program increases total bulb sales, the resulting NTGR estimate is an understatement of program effect, as noted in the text. The revealed preference regression models were not used for the final recommended NTGR values.

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					bulbs were doubled. Because of the author's assumption that total CFL sales are not changed by the program, the author's calculation of the NTGR represents a lower-bound of the actual NTGR. That is, this assumption leads to a conservative estimate of the NTGR.	
158	SDGE	NTGR	Econometric Models		The first big concern here is that this really is NOT a revealed preference approach. Rather it is more like a stated preference approach, and therefore suffers from all the problems associated with stated preference analysis (problems the authors use to discount the results of stated preference estimates of the NTGR). Specifically, the authors did not set up an experimental design whereby consumers were offered CFLs at one price and then another price that was double the original and then observed the purchasing behavior of those consumers. Such a design would be a revealed preference approach. Rather, the authors simply asked consumers what they WOULD purchase IF the price were double – this is fundamentally a stated preference approach to estimating willingness to pay.	The final report has been corrected to refer to this method as a "stated preference purchaser" elasticity approach.
159	SDGE	NTGR	Econometric Models		the authors make the ad hoc assumption that if a respondent reported they would purchase fewer CFLs if the price doubled the authors coded those individuals as having been willing to purchase 80% of the number	The rationale for using the value of 0.8 is given in Section 8.12.

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					of CFLs they had originally. This assumption appears completely ad hoc in nature and serves to drive down the final estimates of the NTGR. For example, for SDG&E, assuming individuals would have purchased 80% of the CFLs they had originally leads to an estimated NTGR of 34%. In contrast, assuming individuals would only have purchased 20% as many CFLs as they did originally would lead to an estimated NTGR of 62%, or nearly double the alternate estimate.	
160	SDGE	NTGR	Econometric Models		the revealed preference modeling does not provide reliable estimates of net-to-gross and does not contribute to the preponderance of evidence. This section should be eliminated from the report.	The revealed preference purchase models were not used for the final NTGR estimates.
161	SDGE	NTGR	NTGR-Total Sales Approach	185	One major concern with this approach (and there are many) is that California is NOT included in the regression sample. Thus, the estimates for California obtained from this method are all out-of-sample estimates. Such estimates can be very unreliable, particularly if the underlying regression model is incorrectly specified. Another concern is that no details are provided concerning the econometric model used to obtain the estimates, nor the actual estimated coefficients or their standard errors. Thus, no assessment can be made about the reliability of the regression model used in the study. A third concern is that the authors make use of data from one year, namely	We agree that these are all limitations of the multistate regression approach, and these are discussed in the report. These are also reasons that the model is is not used as a basis for the final NTGR recommendations. Note the model was developed as part of the CFL Market Effects report, which is expected to be released in February, and will contain a far more comprehensive discussion and presentation of the model, including showing coefficients and confidence intervals for each variable, and responds to the other concerns as well.

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					2008. Thus, the model can not estimate the program impacts over the relevant time frame, namely 2006-2008. A fourth concern is that, given that that authors utilize data from only one year, the regression model is simply based on cross sectional data (i.e., data for one year from and different states). This calls into question the internal v	
162	SDGE	NTGR	Channel Shift	181	The conclusion regarding channel shift is unreliable. Unfortunately, the authors cannot determine channel shift or the lack thereof because they do not have any real data pertinent to the question. Rather, the channel shift analysis is based entirely on distance between stores. This is a completely ad hoc exercise that does not, in any manner, add to the discussion regarding substitution between stores. This section of the report should be eliminated and the utilities should suffer no reduction in claimed sales/savings due to this hypothetical effect.	We understand and share your concern with the channel shift analysis. None of the results were used to adjust program results. Distance between stores was included in the analysis to rule out stores where channel shift was unlikely to happen. In the end, no adjustment was made to NTGR for channel shift. However, we respectfully disagree that our analysis does not add to the discussion regarding substitution between stores, and therefore included it in the draft report.
1	PG&E Company	Other	Installs >2008	xi	Regarding 13% adjustment due to CFLs not sold -- What is the consultant's recommendation (and the CPUC staff recommendation) as to when and how credit is provided for these units? Most of these CFLs will get used elsewhere and result in societal savings, the overwhelming majority within CA.	Comment noted. According to policy and protocols developed for the 2006-2008 impact evaluations, the IOUs were only credited for impacts associated with measures installed and operating within IOU service territories by year-end 2008. Recommendations on this policy is outside the purview of the evaluation.
2	PG&E Company	Other	2006-2008 program, data	xi	Operating hours, install rates, wattages, CFL for CFL, NTGR all were time dependent. 1/2 of the CFLs were	Install rates -- The residential install rate analysis explicitly accounts for shipments in each program year. The 2008 cumulative

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			collected in 2008-2009		rebated in 2006-07 so we can expect all of these parameters to have changed significantly between 2005 and 2008-2009 when most of the analyses were done. Did you seek to adjust the values you found in 2008-09 with those of pre 2006 to develop estimates for what values to assume for 2006-07? It seems excessively conservative to assume that the values found in late 2008 and 2009 to have been applicable to 2006-07 CFL rebates, which comprised about 1/2 of PG&E's total 2006-08 rebates. Also, the validity of the results seems questionable given that you ignored spillover and that this affects the baseline going forth. Did you subtract spillover from previous years to develop your baseline?	installation rate used in calculating the program credit includes all program bulbs estimated to have been installed over the life of the program. We found only slight and non-systematic changes in the ratios of bulbs in storage to bulbs in use over the time frame of our user survey and onsites. This timeframe covered roughly half the program period and over half the bulbs distributed, and corresponded to a period of substantial change in CFL saturation. The installation analysis that assumes a roughly stable ratio of numbers storage to numbers in use therefore provides meaningful estimates for all program years. If installation rates were substantially higher in earlier program years, a shorter measure life or higher leakage rate would be required to account for the disposition of the program shipments. HOU - The HOU reported in this study represents an average over all program bulbs in use as of the end of 2008. This average includes bulbs installed in all three program years. This study shows that HOU tends to be lower for CFLs in homes with higher CFL saturation. It is not necessary to account explicitly for the fact that bulbs installed earlier may have gone into higher-use locations than bulbs installed later, since bulbs installed in all 2006-08 periods are included in the reported average. Also, some of the difference from prior studies may reflect differences in sampling and expansion methods. The present study was a larger and geographically more

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						comprehensive random sample, and included a more sound annualization method compared to the earlier study. Delta watts - see response to comment #20. NTGR - See Section 6 and the CFL Market Effects Study for a discussion of the challenges conducting this type of research during 2008-2009.
4	PG&E Company	Other	Recommendations	xiii	Please provide more specifics in your recommendations. Many of the general recommendations are already being done so without additional specificity; it is hard to know what additional action is warranted. For example, PG&E regularly monitors online sites that at times have sold CFLs to check for leakage. Do you have other recommendations on how to minimize this problem beyond this and other actions the ULP team uses?	For the specific recommendation discussed, PG&E should provide documentation for the effort they have taken to monitor online sales (how often, which sites, what was searched for, etc.) and the results of these efforts (e.g., documenting what was done in cases where online sales were discovered). Quarterly reports on results of these efforts should be provided to the Energy Division as part of their program management reporting function.
6	PG&E Company	Other	2006-2008 program, data collected in 2008-2009	4	Can Table 3 results be produced by year? That would allow you to better estimate true savings, as the analysis should be done on a yearly basis rather than being based on 2008-09 data. Did you consider interpolating between the pre 2006 and 2008-09 data to get yearly estimates for key variables (HOU, install rates, prices, NTGR, etc) and do yearly calculation to then get overall 2006-08 results?	See response to comment #2. Table 14 has been added and provides a count of the total number of rebated screw-in CFLs by E3 program year.
8	PG&E Company	Other	Sampling	13	Table 9 - shows that at best there were 4 completed surveys/store and slightly	Response rates per store were not low (we completed revealed preference surveys

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					over 2 on average. While we commend you for attempting surveys at so many stores it is unclear why response rates were so low at each store. Could the exceedingly low response rates be indicative that the 1-4 customer intercepts are not truly representative of the shoppers of the products at those stores?	with 75% of the eligible shoppers). Lighting shopping patterns were low in some stores, resulting in the ~2 surveys/store average. While it is true that the resulting sample size of revealed preference surveys is low in some channels, we collapsed channels when conducting the NTGR analysis using revealed preference data. The results of 867 revealed preference surveys conducted at 378 stores throughout the IOU service territories over the 2008-2009 period (at different times of day, different days of the week) is representative of all lighting purchases made at these stores.
16	PG&E Company	Other	Reference s other reports	16	We request that you include referenced sections of other reports (e.g., the small commercial report) rather than asking readers to look around elsewhere for parts used here. If that is not feasible please provide page cita	We included references to specific sections and page numbers from the Small Commercial Contract Group report.
18	PG&E Company	Other	Results by CZ	18-20	How many CFLs did you have in each CZ subsample? Did you see any differences by CZ in the results? If so please explain the differences?	Tables 85 and 90 present HOU and peak CF results (respectively) by climate zone.
23	PG&E Company	Other	Fixtures/L EDs, HOU/peak CF	20	Why wasn't any wattage data collected for fixtures? Also, for CFLs why didn't you do the analysis using the specific averages per room so as to best capture the UES and peak load contributions rather than use the average of the entire population?	Our metering sample was randomly selected from the population. There was only a small number of fixtures rebated and it wasn't possible to identify program fixtures in our inventory. For CFLs, see discussion in Sections 2.2.2 and 2.2.3 on how room type distributions were used to determine HOU and peak CF.
43	PG&E Company	Other	Realizatio n Rate	56, 60, 64	Please add the ex-ante net kwh and kw to Tables 26, 30, and 34 so we can determine how the net realization rates were determined.	Tables 26-27, 30-31, and 34-35 have been updated to show both ex-ante and ex-post results.
44	PG&E	Other	Realizatio	56, 60, 65	In addition to the overall realization	Residential and nonresidential realization

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	Company		n Rate		rate, add the realization rates for nonresidential and residential to Tables 26, 30, and 34. The top portion of the tables show data by nonresidential and residential, but the realization rates at the bottom of the tables only show overall realization rate.	rates (where applicable) are shown in Table 1 and 36.
48	PG&E Company	Other	2006-2008 program, data collected in 2008-2009	69-73	HOU decreased by 20% relative to the 2004-05 survey. Have hours of use actually decreased over that time frame? If so a trended value for hours of use should be applied to 2006 and 2007. If the hours of use have not changed why has there been such a significant reduction in HOU between the two surveys? This could also apply to delta watts and peak usage.	The difference from the 2005 study is likely the result of a combination of factors. First, CFL saturation has increased. This study shows that HOU tends to be lower for CFLs in homes with higher CFL saturation. The HOU reported in this study represents an average over all program bulbs in use as of the end of 2008. This average includes bulbs installed in all three program years. A second possible reason for the difference is a difference in sampling methodology. The present study was a large and geographically more comprehensive random sample, and included a more sound annualization method compared to the earlier study.
50	PG&E Company	Other	Recomme ndations	77-78	Wonderful, clear and detailed list of what documentation is needed going forth. Thanks!	N/A
51	PG&E Company	Other	Recomme ndations	78	Again-clear and concise recommendations on how to minimize leakage, change product mix and stores where these are sold to minimize FR. Thanks! Would be helpful to see recommendations on how many CFLs of each type the evaluators believe are still available in residential and non-residential contexts, if possible by CZ or IOU at least. This will further enhance the capability of programs to	This comment is consistent with the evaluation team's recommendation for future research studies that could be conducted leveraging the onsite data collected through this evaluation. See Section 6.2.3.

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					align allocations to the still untapped needs in homes and businesses. The on-site efforts of this evaluation should be used for this. KEMA has done preliminary analyses of this type with the first 600 homes cohort for PG&E. It should definitely carry it forth again now that it has the full 1200 homes of data.	
52	PG&E Company	Other	Recommendations	76-81	Missing in the recommendations are stronger statements about the lessons learned during this effort regarding the California impact evaluation process itself. What efforts were worthwhile and which did not provide credible results? What efforts cost more than they were worth? What could have been done easier, cheaper, better and how? Ratepayers paid a great deal of money for this effort. It is in everyone's interest to have a public discussion of how future evaluators can do more for less and get more credible results. This includes recommendations on how to improve the entire process--for example, how to collaborate more with the IOUs so that their databases are set up and populated with the correct information, so that as evaluators carry out their work IOUs and others can be kept abreast of what is going on, voice their opinions on what may be useful to investigate further or less and/or how to possibly get the answers sought via other methods or data already available.	Some of these items are addressed in the report's recommendations, others are outside of the purview of the evaluation. In the Commission's energy efficiency rulemaking (A0807021), the CPUC is examining the best structure for performing evaluations of the 2010-2012 programs.
63	Natural	Other	Multi-pack	52	The draft report recommends	Comment noted.

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	Resources Defense Council (NRDC)		sales and storage rates		eliminating subsidies at "big-box" retails stores. While NRDC has no pre-determined preference for any retail outlet, we caution that eliminating subsides from the lowest cost retailers will likely reduce sales volumes. In particular, retailers that sell multipack CFLs can often offer lower per-bulb costs than outlets that offer only single bulb packs. The primary goal should remain maximizing sales of the most efficient technologies, and hypothetical consumer preference studies should not undermine offering CFLs at the lowest cost possible. Multipack sales may increase bulb storage and reduce the short term marginal benefits of increased CFL sales, stored bulbs still provide future savings. The results of the Lighting Metering Study, as well as common sense, indicate that bulb storage is common, whether incandescent or CFL. While switching out still-functional inefficient bulbs may be cost-effective, it isn't surprising that many prefer to wait until the current bulb is burnt out.	
65	Natural Resources Defense Council (NRDC)	Other	Federal Lighting Efficencey Standards		There is significant potential to capture lighting-related energy savings both in advance of the onset of Federal standards, as well as beyond 2020, when the standards are fully phased in. Federal standards will require new bulbs sold in California to use 25 to 30% less energy than today's common incandescent light bulb by 2012-2014 (phasing in over two years) and at least	Comment noted.

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					60% less energy by 2020. In 2011, the first phase of the Federal Energy Independence and security Act of 2007 (EISA) lighting efficiency standards7 is slated to go into effect in California for bulbs with the same light output as today's 100 watt (W) incandescent lamps. In 2013, the new standards will apply to bulbs that give off as much light as today's 60W incandescent bulbs. By 2020, with few exceptions, all screw-based bulbs will have to meet a minimum efficiency of 45 lumens per watt (the final levels will be set during a future DOE rulemaking). This efficiency level would require CFL-like performance or better and we anticipate CFLs,	
70	SCE	Other	Report organizatio n		The organization of the report into four sections (methodology, results, recommendations, and technical appendices) that each discuss the same issues often made it very difficult to information that could be in any of 4 places. It will also make it somewhat tedious to follow the comments by page number.	The ED established a standard format for the draft report to make the reports be as consistent as possible across all contract groups.
72	SCE	Other	Confidenc e Intervals		The report does not clearly state confidence intervals for many of the results in the main body of the report. These are very important for interpreting results. In cases were determinations were made on preponderance of evidence or professional judgment, and thus statistical confidence is not applicable, it would still be good to know how well	Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results.

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					the estimate is known.	
77	SCE	Other	Confidence Intervals	11	Discussion of the invoice sampling does not include a justification for the stratified proportional sampling approach, which leaves SDG&E with higher variance estimates on a very critical measurement parameter, and improperly distributes divergent standard errors between channels. Weighting to overcome the various non-proportional maneuvers including minimum cell size and allowance for un-received PG&E documentation should be discussed.	Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results.
82	SCE	Other	Confidence Intervals	13	The report relies on store intercept data for 867 CFL purchasers, over 378 stores (2.3 per store) to estimate the leakage rate. Leakage rates were determined for each store based on these data, but this would be exceedingly imprecise with so few data points per store. It appears that border and non-border stores were aggregated, customer intercept leakage rates based on reported zip code were determined for these aggregates (with the approach to zip codes split by utility boundaries left unclear), and then these rates were globally applied to vulnerable and invulnerable stores and weighted by total shipments. It is not clear what kind of precision was obtained from the "post-stratification" addition to the study design. Nor is it clear how the CFL User Survey contributed to the leakage estimation, although this is claimed on	The leakage results determined for the 2006-2008 Upstream Lighting Program were not based on the CFL User Survey results. Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results.

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					page 14. Note that this is one aspect of the study in which it seems reasonable to apply CFL-based estimates to other technologies/products.	
99	SCE	Other	Quantity Adjustmen t	35	It is unclear how the final adjustments are determined.	The final adjustment includes the invoice verification adjustment discussed in Section 3.1.2, the shipments v. sales adjustment discussed in Section 3.1.3 and shown in Table 14, and the leakage adjustment discussed in Section 3.1.4 and shown in Table 15.
114	SCE	Other	Confidenc e Intervals	55	What are the confidence intervals for the UES estimates? What are the confidence intervals for the other estimates in Table 25?	Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results.
115	SCE	Other	Confidenc e Intervals	56	What are the confidence intervals on the realization rate estimates?	Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results.
121	SCE	Other	Recomme ndation for Improving Program Design and Operation al Performan ce.	78	The report recommends “the IOUs should continue to monitor the market (i.e., checks on e-Bay, amazon.com, etc.) for evidence of leakage both prior to and after sales. IOUs should report on a quarterly basis on the results of these efforts (e.g., products searched for, number of sites contacted, screen shots, dates of search, etc.)”. To whom would this be reported, and what would be done with it? This is an issue of program management, not regulation.	IOUs should provide documentation for the effort they have taken to monitor online sales (how often, which sites, what was searched for, etc.) and the results of these efforts (e.g., documenting what was done in cases where online sales were discovered). Quarterly reports on results of these efforts should be provided to the Energy Division as part of their program management reporting function.
122	SCE	Other	Confidenc e Intervals	86	While it is true that statistical confidence intervals are not applicable for all estimates, it would be helpful from the standpoint of understanding results to have a sense of professional confidence in the values even if	Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results.

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					statistical measures are not possible.	
134	SCE	Other	Lack of market knowledge	147	This section is blank.	Missing text was added to Section 8.8.4.2.
142	SDGE	Other	Fixtures/LEDs		Analysis was focused primarily on screw-in CFLs with little or no independent evaluation of non screw-in CFLs. There is no comparative analysis to indicate to the reader that CFL results can be reliably extrapolated to other lighting products	Invoice verification results were applicable to fixtures and LEDs, as these products were included in this assessment. Leakage rates, shipments v. sales adjustments, and most res/nonres adjustments for fixtures and LEDs were the same as CFLs since, as stated in the report, we assumed that sales of IOU-discounted fixtures and LEDs would sell through similar channels with similar patterns as sales of IOU-discounted CFLs. The one exception is LED open/close signs which were assumed to be 100% nonres. Ex-ante installation rates (100%) were retained for fixtures and LEDs. Fixture HOU, peak CF and delta watts values were derived from the metering study for comparable wattages/applications. LED HOU, peak CF and delta watts values were derived based on a review of workpapers and updated assumptions. DEER default values were used for ex-post NTGR.
143	SDGE	Other	Fixtures/LEDs		The results from the analysis used to estimate the number of CFLs “not sold” was used exclusively to estimate the “not sold” sales of the other lighting products as well. This clearly is not appropriate. No independent analysis was done on either Fixtures or LEDs which are completely different products. This is a major flaw in the overall report and must be corrected in the final report. Otherwise the SDG&E	Invoice verification results were applicable to fixtures and LEDs, as these products were included in this assessment. Leakage rates, shipments v. sales adjustments, and most res/nonres adjustments for fixtures and LEDs were the same as CFLs since, as stated in the report, we assumed that sales of IOU-discounted fixtures and LEDs would sell through similar channels with similar patterns as sales of IOU-discounted CFLs. The one exception is LED

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					should receive full credit for its reported Fixtures and LEDs.	open/close signs which were assumed to be 100% nonres. Ex-ante installation rates (100%) were retained for fixtures and LEDs. Fixture HOU, peak CF and delta watts values were derived from the metering study for comparable wattages/applications. LED HOU, peak CF and delta watts values were derived based on a review of workpapers and updated assumptions. DEER default values were used for ex-post NTGR.
163	SDGE	Other	Overarchin g		The report is filled with promises of what we are/were going to do but never actually did. Moreover, the work actually performed is completely ad hoc, devoid of any theoretical or empirical foundation. Very little, if any, of the work corresponds to the current literature or protocols established for completing these types of evaluations. The study should be completely re-worked, eliminating all the analysis incorrectly done or not done at all. If this is not done, the Joint Utilities recommend that this study not be accepted as reliable or used for updating DEER or used to measure utility performance in the ERT and VRT process.	The evaluation of the upstream lighting program had to address a number of issues for which standard methods do not exist in this context. The research design therefore laid out approaches that were conceptually reasonable, but whose practical effectiveness had not been tested. As is common in complex research, alternative analysis methods had to be developed when the initial approach was not successful.
34	PG&E Company	Peak CF	Peak	34	Is it possible to revisit the hours that have been designated for Peak since so much involved in determining use for the hottest days of the year that have been chosen for the analysis?	The definition of peak was determined through CPUC policy (D.06-06-063; ordering paragraph 1).
57	PG&E Company	Peak CF	Peak	133	Tables 73 and 74 - Why do the coincidence factors for Program and Non-program categories differ	Reasons for the observed differences are not clear. A general difference is that program bulbs have necessarily all been

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					significantly given the high rates of free ridership implied by most NTG assessment methods? Program and Non-program CFL users should show little difference.	installed in 2006 or later, and most of them in 2007 or later, while non-program bulbs may have been installed earlier. As a result, the distribution of locations (room type, fixture type) is different for the two types of bulbs, in ways that vary across the programs. This is true regardless of the NTGR value.
88	SCE	Peak CF	Peak	18	Table 10 shows that 2570 meters were not collected until December of 2010. How were these results incorporated into the study that was presented in draft form to ED in November and to the public in early December?	Metered data was downloaded from these loggers in September-October 2009 such that all available information could be used in the analysis completed for this evaluation. The additional metered data (November-December 2009) is available for future analyses.
107	SCE	Peak CF	Pgm/ nonpgm	44	We agree with the argument that subsidized and unsubsidized bulbs come from the same population vis-à-vis CF (see table 75), which makes the interpretation regarding HOU (Table 70) all the more puzzling.	See response to comment #56
116	SCE	Peak CF	Peak	58	The CF for exterior fixtures in surprisingly high. To what do you attribute this high peak value?	Exterior lights are used more hours overall as well as more often during peak periods. This may be due to the higher percentage of exterior lights being used 24 hours/day.
133	SCE	Peak CF	Peak	128	Many of the comments relating to the development and use of the HOU regression specification apply to the CF work, and don't bear repeating for the same set of regressors. The coefficients are (approximately) scaled-down versions of the coefficients in the HOU, as one might expect.	Responses to the comments on the HOU analysis therefore also respond to this comment.
13	PG&E Company	Res/NonRes split	Res/Nres	14	R/C split: how many of the in-store intercepts were done in big-box stores during the business only times? Asking residential customers about how many	Neither the CFL User Survey, nor the intercept results, were used in the determination of the res/nonres split. As indicated on page 39, the onsite surveys

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					CFLs they installed in businesses obviously biases the C split downward. Finally, extrapolating from the small commercial and residential install sites and highly uncertain sales data is not likely to produce accurate or precise values. Why were other results ignored (e.g., interviews with vendors, manufacturers, etc.)? We commented on these in 2006-07, and there was still ample time and resources to consider enhancing previous efforts with a broader array of research other than one mostly focused on asking residential customers to say how many CFLs they put in their businesses--when the majority don't own businesses. Also, did you in your analyses look into CFL used in home-offices?	were used as the basis for the res/nonres results. The CFL User Survey and intercept results have limitations (as mentioned in the report and in the comments) that the onsite survey results do not. In addition, the onsite survey results are based on actual, observed IOU-discounted CFL installations in homes v. businesses (not "highly uncertain sales data" as indicated in the comments). Onsite survey results were considered more reliable than results from suppliers.
14	PG&E Company	Res/NonRes split	Res/Nres	15	Why did you assume that the R/C split of CFLs would also apply to fixtures and LEDs? Why didn't you ask about those? They are very different products. LEDs likely saw significant use in Exit and other signage in stores. Fixtures, due to their significant cost, are more likely to be placed in businesses applications.	As stated in the report, we assumed that sales of IOU-discounted fixtures and LEDs would sell through similar channels with similar patterns as sales of IOU-discounted CFLs. The one exception is LED open/closed signs which were assumed to have been installed in 100% nonresidential locations. Suppliers were not asked about res/nonres split as part of the impact evaluation.
37	PG&E Company	Res/NonRes split	Res/Nres	39	What is the uncertainty associated with each of the intercept survey-based, CFL user survey-based, and onsite survey-based estimates of the residential/nonresidential CFL purchase splits?	Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results.
46	PG&E	Res/NonRe	Res/Nres	68	R/C split - value used is based on	The approach used to determine the

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	Company	s split			extrapolations and algebraic manipulations of in-situ observations that are uncertain. Other survey-based methods showed much higher values. Please provide discussion of the uncertainty around this value given its high impact on E and peak savings. SCE and SDG&E values do not sum to 100%.	residential/nonresidential split was based on the results from verified IOU-discounted products observed in residential v. nonresidential businesses. Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results. The correct residential/nonresidential splits should be as follows: PG&E 94%/6%; SCE 94%/6%, SDG&E 95%/5%. These corrections have been reflected in the final report.
76	SCE	Res/NonRes split	Res/Nres	4	The breakdown of res and nonres fixtures and LEDs does not match with what SCE has.	The breakdown matches what was reported in SCE's 4Q 2008 E3 database.
83	SCE	Res/NonRes split	Res/Nres	14	The intercepts are unlikely to be able to provide meaningful results. If residential purchasers are being interviewed about bulbs that may ultimately be installed in business locations, the bulbs may be delayed in making the final move into the business from home storage. Thus, interviewing residents at residences may lead to a delay-induced downward bias in percent ultimately non-residentially installed at some point after the intercept. The on-site method is further unlikely to yield meaningful results because the on-sites are by necessity clusters trying to identify a very large number of manufacturer/model number combinations. Because the sampling is clustered and a bulb's type is related to the types of the other bulbs found (due to the limited types of bulbs sold at the stores where individuals and	Neither the CFL User Survey, nor the intercept results, were used in the determination of the res/nonres split. As indicated on page 39, the onsite surveys were used as the basis for the res/nonres results. The CFL User Survey and intercept results have limitations (as mentioned in the report and in the comments) that the onsite survey results do not. In addition, the onsite survey results are based on actual, observed IOU-discounted CFL installations in homes v. businesses. Please see Appendix B, Section 8.2.2 for discussion of statistical as well as professional confidence intervals for all ex-post evaluation results.

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					businesses shop and the common practice of purchasing multiple bulbs at one time) and the number of models to cover is very large, the result would be highly prone to uncertainty. It is also unclear how sampl	
84	SCE	Res/NonRes split	Res/Nres	14	The CFL User survey results were much different: ranging from 19% non-residential for SCE, to 8% for PG&E and SDG&E, and 13% for all IOUs. This is a larger survey effort without multi-purpose stratification and clustering that occurred in the intercept survey, and robust regarding memory issues, with 491 recent (3 month) CFL purchases obtained at random over five waves. The sampling error is more cleanly estimable, and the 90% precision level for the estimated overall fraction of 13% is about +/- 2.5%. This is an unbiased approach to residential responses and the fact that these residents report 13% of bulbs going into business locations appears to establish a lower limit for percent residential. The split in the larger subsample of total CFL purchasers from the intercept survey should be made available for comparison.	Neither the CFL User Survey, nor the intercept results, were used in the determination of the res/nonres split. As indicated on page 39, the onsite surveys were used as the basis for the res/nonres results. The CFL User Survey and intercept results have limitations (as mentioned in the report and in the comments) that the onsite survey results do not. In addition, the onsite survey results are based on actual, observed IOU-discounted CFL installations in homes v. businesses.
101	SCE	Res/NonRes split	Res/Nres	38-39	The CFL user survey results are described as self-report rather than actual. But "self-report" is only problematic if people don't know the answer or will otherwise be likely to provide an untrue answer. People will likely know whether something is in their home or at work and are unlikely	Neither the CFL User Survey, nor the intercept results, were used in the determination of the res/nonres split. As indicated on page 39, the onsite surveys were used as the basis for the res/nonres results. The CFL User Survey and intercept results have limitations (as mentioned in the report and in the comments) that the

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					to lie about this. On the other hand, the intercept surveys are likely to suffer from significant non-response bias on the part of nonresidential customers.	onsite survey results do not. In addition, the onsite survey results are based on actual, observed IOU-discounted CFL installations in homes v. businesses.
102	SCE	Res/NonRes split	Res/Nres	39	Membership club intercepts are vastly under-represented from a shipment-proportional standpoint, and whether or not these are properly weighted up, there is reason to be concerned about whether these 43 surveys, in a channel significantly contributing to small business purposes. For example, COSTCO has a business-only hour prior to general opening, and it is not clear how the analysis treated this subtle but powerful influence on the achieved sample in membership stores, or whether the CFL user study was investigated to determine the role of membership stores in providing lighting products to small businesses.	Neither the CFL User Survey, nor the intercept results, were used in the determination of the res/nonres split. As indicated on page 39, the onsite surveys were used as the basis for the res/nonres results. The CFL User Survey and intercept results have limitations (as mentioned in the report and in the comments) that the onsite survey results do not. In addition, the onsite survey results are based on actual, observed IOU-discounted CFL installations in homes v. businesses.
103	SCE	Res/NonRes split	Res/Nres	40	The final recommendation for SCE shows 94/5. What about the other percent? With only two values it can’t be a rounding issue.	The corrected res/nonres split for SCE is 94%/6%. This has been corrected in Table 17 in the revised report.
117	SCE	Res/NonRes split	Ex-Post Savings	59	Table 29 shows that the ex-post res/nonres split is 94/6, but the actual unit counts reported ex-post are 95% res and 5% nonres.	The corrected res/nonres split for SCE is 94%/6%. This has been corrected in Table 30 in the revised report.
118	SCE	Res/NonRes split	Ex-Post Savings	63	As in Table 29 above, the split is reported as 94/6, but the unit counts are 95/5.	The res/nonres results for SCE LEDs are correct as shown in Table 34.
145	SDGE	Res/NonRes split	Res/Nres		The adjustment for the use of a product in non-residential applications is limited to screw-in CFLs, with no information offered about other lighting products. The analysis is based on the CFL user	Invoice verification results were applicable to fixtures and LEDs, as these products were included in this assessment. Leakage rates, shipments v. sales adjustments, and most res/nonres adjustments for fixtures

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					survey, in-store consumer intercept surveys, on-site data, and extrapolation techniques. The manner in which the survey results are used in conjunction with the extrapolation techniques is never defined. Products other than CFL are never evaluated and therefore the CFL results should not be applied to non-screw-in CFL products and therefore no adjustment to reported non-screw-in CFLs should be applied.	and LEDs were the same as CFLs since, as stated in the report, we assumed that sales of IOU-discounted fixtures and LEDs would sell through similar channels with similar patterns as sales of IOU-discounted CFLs. The one exception is LED open/close signs which were assumed to be 100% nonres. Ex-ante installation rates (100%) were retained for fixtures and LEDs. Fixture HOU, peak CF and delta watts values were derived from the metering study for comparable wattages/applications. LED HOU, peak CF and delta watts values were derived based on a review of workpapers and updated assumptions. DEER default values were used for ex-post NTGR.
7	PG&E Company	Shipments vs. Sales	Quantity Adjustmen t	12	What is the basis for the assumption that non-sales of CFLs would also apply to fixtures and LEDs? Even though sales were smaller than CFLs, why weren't products discussed directly in the interviews?	As stated in the report, we assumed that sales of IOU-discounted fixtures and LEDs would sell through similar channels with similar patterns as sales of IOU-discounted CFLs. We did not ask about sales of LEDs and fixtures post-2008 since we already had 3-4 hours worth of questions included in the survey. Our priority for the supplier interviews was to focus as much as possible on questions concerning CFLs.
35	PG&E Company	Shipments vs. Sales	Quantity Adjustmen t	37	Please verify that the values derived for 2008 shipments were only applied to 2008 and not to shipments made in 2006 and 2007.	The shipment v. sales adjustment was applied only to 2008 shipments and not to 2006-2007 shipments. We included Table 14 to illustrate how the shipment v. sales adjustments were applied for screw-in CFLs.
78	SCE	Shipments vs. Sales	Quantity Adjustmen t	12	Store managers may have overstated the percent not sold because the initial questions does not specifically define the scope as all 2008 bulbs, and	In terms of estimating the percentage of 2008 Upstream Lighting Program CFLs that were unsold, all three levels of the CFL supply chain -- manufacturers, high-level

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					retailers may have interpreted the question as referring the most recent shipment, which would change the result for retailers that received multiple shipments in 2008. Additionally, there may be a problem in cases in which the manager has not held the position since mid 2006 when the program began.	buyers, and store managers -- have their pros and cons. The manufacturer reps who deal with the Upstream Lighting Program have the least amount of turnover and are most familiar with the shipping volumes. The high-level buyers have the second-highest level of staff continuity in terms of dealing with the Upstream Lighting Program, are familiar with shipping volumes, and are closer to the point of sale than the manufacturers. The store managers are closest to the point of sale, but are less familiar with shipping volumes and have the least continuity. Because of these various tradeoffs in terms of reliability, we chose to use the retail buyer estimate as the "happy medium" between the manufacturer and store manager estimates.
79	SCE	Shipments vs. Sales	Quantity Adjustmen t	12	If these bulbs are to be counted as zero savings in 2008, there must be an allowance for their sale and installation in 2009, otherwise these bulbs are accounted as generating no savings simply because of the calendar changing.	Comment noted. According to policy and protocols developed for the 2006-2008 impact evaluations, the IOUs were only credited for impacts associated with measures installed and operating within IOU service territories by year-end 2008.
80	SCE	Shipments vs. Sales	Quantity Adjustmen t	12	There is no reason to expect that divergent sell-through rates, however compiled, would be similar between these divergent products, so the results should not be applied to fixtures and LEDs.	Since we see no evidence to the contrary, we assumed that sales of IOU-discounted fixtures and LEDs would sell through similar channels with similar patterns as sales of IOU-discounted CFLs.
100	SCE	Shipments vs. Sales	Revealed Preference Elasticity Model	36	The procedure for refereeing between the results over 12 manufacturers, 10 retail buyers, and 223 store managers by averaging them is arbitrary. Manufacturers' and retail buyers'	We did not always average the manufacturer, high-level buyer, and store manager estimates together. For example, as discussed on p. 24 we did not think the store managers in the Discount channel

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					responses represent a significantly larger portion of the program than store managers. Thus, if this method is to be used, it seems reasonable to weight their responses more heavily.	had the broad market knowledge (e.g., knowledge of Energy Star CFL production costs) to determine whether they would be able to sell these CFLs through the $1/99 cent stores in the Discount channel. Therefore our supplier self-report NTGR estimates for the Discount channel are based on the manufacturer and high-level retail buyers estimates only. For the supplier self-report NTGR estimates for the Small Grocery channel we made a similar decision. For other retail channels we did average the manufacturer, high-level buyer, and store manager estimates together. While the store manager estimators did represent a smaller share of Upstream Lighting Program shipments than the manufacturers and high-level buyers, since retail store managers are less likely to be aware of any gaming opportunities, averaging in their NTGR estimates can also help dilute the effect of any potential gaming.