California Upstream and Residential Lighting Impact Evaluation

Work Order 28 (WO28) Final Report

California Public Utility Commission, Energy Division
Prepared by KEMA, Inc.

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1. Executive Summary

This report presents the results of California Public Utilities Commission (CPUC) Evaluation Measurement & Verification (EM&V) Work Order (WO 028) – California Upstream and Residential Lighting Impact evaluation, which encompassed all lighting measures associated with upstream delivery mechanisms across sectors and all downstream lighting measures targeted at the residential sector.

1.1 Program Background

Together, upstream and residential downstream lighting measures account for about a third of the investor-owned utility (IOU) reported net energy savings and net peak demand impacts for the 2010–2012 program period. Shown in Table 1 are the reported impacts by IOU and the reported impacts expressed as a percentage of each IOU's total portfolio savings (as well as the statewide savings and percentage of the statewide savings).

Table 1: Summary of IOU Reported Upstream and Residential Downstream Lighting Measure Savings (2010-2012)

IOU	Upstream and Residential Downstream Lighting Measures		Total IOU Portfolio		Percent of IOU Reported Net Annual GWh Savings	Percent of IOU Reported Net Peak MW Reductions
	IOU Reported Net Annual GWh Savings	IOU Reported Net Peak MW Reductions	IOU Reported Net Annual GWh Savings	IOU Reported Net Peak MW Reductions		
Pacific Gas and Electric Company (PG&E)	566	84	2,943	522	19%	16%
Southern California Edison Company (SCE)	1,200	183	3,504	650	34%	28%
San Diego Gas & Electric Company (SDG&E)	185	26	602	100	31%	26%
Statewide	**1,951**	**293**	**10,097**	**1,799**	**28%**	**23%**

The measures included in WO28 fall into 29 measure groups, where measure groups consist of similar individual lighting measures. High-impact measure (HIM) groups represent those measure groups that comprise at least 1 percent of an IOU's reported portfolio impacts in kilowatt hours (kWh) or kilowatts (kW). The evaluation identified four measure groups (CFL [compact fluorescent lamp] A-lamp, CFL basic spiral, CFL reflector, and CFL globe) as HIMs based on IOU-reported accomplishments through Q4 2012. These four measure groups are included within the scope of this evaluation. All other measure groups, including residential downstream lighting measures, were ultimately not included in the evaluation since they do not comprise significant savings, are not evaluable and/or represent measures likely to persist in future cycles.

Table 2 shows the quantity of HIMs for which the IOUs provided incentives through the upstream programs.

Table 2: Quantity of Upstream Measures by IOU Program (Residential Only)

IOU	Program Name	Quantity of Basic Spiral CFLs Rebated	Quantity of A-Lamp CFLs Rebated	Quantity of Reflector CFLs Rebated	Quantity of Globe CFLs Rebated
PG&E	Residential Programs - Advanced Lighting	44,283	3,826,344	3,087,578	
	Residential Programs - Basic CFL Lighting	15,818,451		1,824	
	PG&E Total	**15,862,734**	**3,826,344**	**3,089,402**	
SCE	Residential Energy Efficiency Program	24,663,864	6,775,163	7,073,021	1,218,924
	SCE Total	**24,663,864**	**6,775,163**	**7,073,021**	**1,218,924**
SDG&E	Residential Basic Lighting (SW-ResA)	6,100,808		1,718	
	Advanced Consumer Lighting (SW-ResB)		475,819	658,594	128,131
	SDG&E Total	**6,100,808**	**475,819**	**660,312**	**128,131**

1.2 Evaluation Goals and Approach

The overarching goal of this impact evaluation was to verify and validate the IOU reported energy savings and peak demand reduction estimates. The 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 PG&E, SCE and SDG&E service territories during the 2010-2012 program period;
- Estimate the gross energy and demand impacts from these measures; and

- Determine an appropriate net-to-gross ratio (NTGR) for estimating net energy and demand impacts.

The impact evaluation approach has three main components:

- **Adjustments to Quantity of Measures Rebated**, which includes a verification assessment of a sample of program invoices and applications, an assessment of the percentage of IOU-discounted products purchased by non-IOU customers (for example, leakage), and an assessment of the percentage of IOU-discounted products purchased by residential versus nonresidential customers.
- **Development of Gross Savings Inputs**, which includes an assessment of the percentage of IOU-discounted products installed, estimates of the average daily hours-of-use (HOU), estimates of the average percent of measures operating at peak (coincidence 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).
- **Development of Net Savings Inputs**, which includes estimates of the NTGR.

1.3 Evaluation Results

This section presents the final impact evaluation results for the four HIMs as well as total savings from all measures addressed in WO028. As shown in Table 3 and Table 4, more than 2,804 GWh in gross annual energy savings and 1,861 GWh in net annual energy savings were achieved as a result of the measures rebated through these programs. Gross peak reductions amounted to nearly 346 MW and net peak demand reductions amounted to over 229 MW. Overall, the IOUs realized about 99 percent of their ex-ante claims for gross energy savings and 81 percent of their peak demand reduction claim. The IOUs realized about 95 percent of their ex-ante claims for net energy and 78 percent of their peak demand reduction claim.

The key drivers for these results include:

- The overall invoice verification rate was determined to be 100 percent for all IOUs. This represents a significant improvement over the findings of the 2006-2008 program cycle. The utilities are to be commended in their diligence and attention in addressing the shortcomings found in the last evaluation.
- The number of upstream CFLs being purchased and installed in non-residential settings increased by between one and two percent, resulting in more savings due to higher non-residential unit energy savings.
- The recommendation to move away from a year to year installation rate, as used in previous evaluations, and change to definition of upstream CFL installation rates that gives credit for all CFLs that will ultimately be installed was adopted for this evaluation.

This change resulted in an installation rate 22 percent higher than the ex-ante assumptions.

- Per-unit gross savings estimates were reduced by about a third due to ex-post adjustments to the estimates for annual operating hours, peak coincidence factors and delta watts. Annual operating hours were about three-fourths of ex-ante assumptions and peak coincidence factors came in between and half and two thirds of the ex ante assumptions.
- NTGR for basic spiral CFLs came in at around ex ante assumptions, but were lower than ex-ante assumption for the other HIMs (A-lamp, reflector and globe CFLs).

Table 3: Ex-post Gross Annual Energy and Peak Demand Impacts from the 2010-2012 Upstream Lighting Program

All IOUs	Ex-ante Gross Annual Energy Impacts (kWh/yr)	Ex-ante Gross Annual Energy Impacts (kWh/yr)	Ex-post Gross Annual Energy Impacts (kWh/yr)	Ex-post Gross Peak Demand Impacts (kW)	Gross Realization Rates	
					(kWh/yr)	(kW)
Basic Spiral CFLs	1,698,687,005	260,153	1,629,903,434	208,938	96%	80%
A-Lamp CFLs	346,885,922	53,895	385,190,762	43,329	111%	80%
Reflector CFLs	419,507,437	65,588	431,450,224	50,303	103%	77%
Globe CFLs	45,998,902	7,356	34,263,256	4,734	74%	64%
Non-HIM WO028 Measures	323,436,153	38,676	323,436,153	38,676	100%	100%
All WO028 Measures	**2,834,515,419**	**425,668**	**2,804,243,830**	**345,980**	**99%**	**81%**
PG&E	**Ex-ante Gross Annual Energy Impacts (kWh/yr)**	**Ex-ante Gross Annual Energy Impacts (kWh/yr)**	**Ex-post Gross Annual Energy Impacts (kWh/yr)**	**Ex-post Gross Peak Demand Impacts (kW)**	**Gross Realization Rates**	
					(kWh/yr)	**(kW)**
Basic Spiral CFLs	549,718,293	81,061	530,436,510	67,968	96%	84%
A-Lamp CFLs	90,051,957	13,272	121,637,849	13,567	135%	102%
Reflector CFLs	106,955,546	16,047	122,153,547	14,196	114%	88%
Globe CFLs	n/a	n/a	n/a	n/a	n/a	n/a
Non-HIM WO028 Measures	100,986,655	15,720	100,986,655	15,720	100%	100%
All WO028 Measures	**847,712,452**	**126,100**	**875,214,561**	**111,451**	**103%**	**88%**

SCE	Ex-ante Gross Annual Energy Impacts (kWh/yr)	Ex-ante Gross Annual Energy Impacts (kWh/yr)	Ex-post Gross Annual Energy Impacts (kWh/yr)	Ex-post Gross Peak Demand Impacts (kW)	Gross Realization Rates	
					(kWh/yr)	(kW)
Basic Spiral CFLs	936,934,589	148,545	915,839,654	119,220	98%	80%
A-Lamp CFLs	243,945,886	38,769	250,030,707	28,181	102%	73%
Reflector CFLs	291,734,733	46,377	290,511,264	33,909	100%	73%
Globe CFLs	43,802,143	7,067	32,043,736	4,423	73%	63%
Non-HIM WO028 Measures	189,616,373	19,373	189,616,373	19,373	100%	100%
All WO028 Measures	**1,706,033,723**	**260,131**	**1,678,041,734**	**205,106**	**98%**	**79%**
SDG&E	**Ex-ante Gross Annual Energy Impacts (kWh/yr)**	**Ex-ante Gross Annual Energy Impacts (kWh/yr)**	**Ex-post Gross Annual Energy Impacts (kWh/yr)**	**Ex-post Gross Peak Demand Impacts (kW)**	**Gross Realization Rates**	
					(kWh/yr)	**(kW)**
Basic Spiral CFLs	212,034,123	30,546	183,627,271	21,749	87%	71%
A-Lamp CFLs	12,888,079	1,854	13,522,206	1,581	105%	85%
Reflector CFLs	20,817,157	3,164	18,785,412	2,197	90%	69%
Globe CFLs	2,196,759	289	2,219,520	311	101%	108%
Non-HIM WO028 Measures	32,833,126	3,584	32,833,126	3,584	100%	100%
All WO028 Measures	**280,769,244**	**39,437**	**250,987,535**	**29,422**	**89%**	**75%**

Table 4: Ex-post Net Annual Energy and Peak Demand Impacts from the 2010-2012 Upstream Lighting Program

All IOUs	Ex-ante Net Annual Energy Impacts (kWh/yr)	Ex-ante Net Annual Energy Impacts (kWh/yr)	Ex-post Net Annual Energy Impacts (kWh/yr)	Ex-post Net Peak Demand Impacts (kW)	Net Realization Rates	
					(kWh/yr)	(kW)
Basic Spiral CFLs	1,019,291,196	156,103	1,027,383,622	131,863	101%	84%
A-Lamp CFLs	291,396,421	45,188	303,557,418	34,157	104%	76%
Reflector CFLs	353,118,460	55,122	257,257,703	29,996	73%	54%
Globe CFLs	39,099,066	6,253	25,608,661	3,538	65%	57%
Non-HIM WO028 Measures	247,438,233	29,878	247,438,233	29,878	100%	100%
All WO028 Measures	**1,950,343,376**	**292,544**	**1,861,245,638**	**229,432**	**95%**	**78%**
PG&E	**Ex-ante Net Annual Energy Impacts (kWh/yr)**	**Ex-ante Net Annual Energy Impacts (kWh/yr)**	**Ex-post Net Annual Energy Impacts (kWh/yr)**	**Ex-post Net Peak Demand Impacts (kW)**	**Net Realization Rates**	
					(kWh/yr)	**(kW)**
Basic Spiral CFLs	329,830,976	48,637	318,261,906	40,781	96%	84%
A-Lamp CFLs	73,087,550	10,659	87,579,251	9,768	120%	92%
Reflector CFLs	87,449,353	13,012	67,184,451	7,808	77%	60%
Globe CFLs	n/a	n/a	n/a	n/a	n/a	n/a
Non-HIM WO028 Measures	75,208,936	11,532	75,208,936	11,533	100%	100%
All WO028 Measures	**565,576,815**	**83,840**	**548,234,545**	**69,890**	**97%**	**83%**
SCE	**Ex-ante Net Annual Energy Impacts (kWh/yr)**	**Ex-ante Net Annual Energy Impacts (kWh/yr)**	**Ex-post Net Annual Energy Impacts (kWh/yr)**	**Ex-post Net Peak Demand Impacts (kW)**	**Net Realization Rates**	
					(kWh/yr)	**(kW)**
Basic Spiral CFLs	562,160,753	89,127	604,454,171	78,686	108%	88%
A-Lamp CFLs	207,354,003	32,953	205,025,180	23,108	99%	70%
Reflector CFLs	247,974,523	39,421	180,116,984	21,024	73%	53%
Globe CFLs	37,231,821	6,007	24,032,802	3,317	65%	55%
Non-HIM WO028 Measures	145,250,538	15,424	145,250,538	15,423	100%	100%
All WO028 Measures	**1,199,971,638**	**182,932**	**1,158,879,675**	**141,558**	**97%**	**77%**

SDG&E	Ex-ante Net Annual Energy Impacts (kWh/yr)	Ex-ante Net Annual Energy Impacts (kWh/yr)	Ex-post Net Annual Energy Impacts (kWh/yr)	Ex-post Net Peak Demand Impacts (kW)	Net Realization Rates	
					(kWh/yr)	(kW)
Basic Spiral CFLs	127,299,467	18,339	104,667,544	12,397	82%	68%
A-Lamp CFLs	10,954,868	1,576	10,952,987	1,281	100%	81%
Reflector CFLs	17,694,584	2,689	9,956,268	1,165	56%	43%
Globe CFLs	1,867,245	245	1,575,859	220	84%	90%
Non-HIM WO028 Measures	26,978,759	2,922	26,978,759	2,922	100%	100%
All WO028 Measures	**184,794,923**	**25,771**	**154,131,419**	**17,985**	**95%**	**78%**

1.4 Recommendations

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

- IOUs should continue to rebate CFLs of various styles; however, focus should begin to shift towards LED products and advanced CFLs.
- IOUs should continue to rebate basic spiral CFLs, but only within selected retail stores where NTG ratios have been consistently shown to be high; discount stores, discount grocery chains, small/independent grocery stores, and small/independent stores of any type located in rural or hard to reach areas.
- IOUs should continue to be targeting "Big box" stores within the large home improvement, mass merchandise, and membership club channels, for promoting advanced CFL and moving towards LED lighting products.
- 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: residential v. nonresidential sales, installation rates, HOU, peak CF, and NTG values.

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. Studies planned to be conducted for the 2013 and 2014 programs years should continue to explore important questions like baseline and net impacts and a further metering should be considered beyond 2015.

2. Introduction

2.1 Evaluation Overview

Work Order 28 (WO28) was designed to include all lighting measures associated with upstream delivery mechanisms and all downstream lighting measures targeted at the residential sector. Together, upstream and residential downstream lighting measures account for about a third of the investor-owned-utility (IOU) reported electric net energy savings and net peak demand impacts for the 2010–2012 program period. Shown in Table 5 are the reported impacts by IOU and the reported impacts expressed as a percentage of each IOU's total portfolio savings (as well as the statewide totals, and percentage of the statewide savings).

Table 5: Summary of IOU Reported Upstream and Residential Downstream Lighting Measure Savings (2010-2012)

IOU	Upstream and Residential Downstream Lighting Measures		Total IOU Portfolio		Percent of IOU Reported Net Annual GWh Savings	Percent of IOU Reported Net Peak MW Reductions
	IOU Reported Net Annual GWh* Savings	**IOU Reported Net Peak MW* Reductions**	**IOU Reported Net Annual GWh Savings**	**IOU Reported Net Peak MW Reductions**		
Pacific Gas and Electric Company (PG&E)	566	84	2,943	522	19%	16%
Southern California Edison Company (SCE)	1,200	183	3,504	650	34%	28%
San Diego Gas & Electric Company (SDG&E)	185	26	602	100	31%	26%
Statewide	**1,951**	**293**	**10,097**	**1,799**	**28%**	**23%**

* Gigawatt-hour

** Megawatt

The measures included in WO28 fall into 29 measure groups, where measure groups consist of similar individual lighting measures. High-impact measure (HIM) groups represent those that individually comprise at least 1 percent of an IOU's kilowatt hour (kWh) or kilowatt (kW) reported portfolio impacts. Three measure groups (CFL [compact fluorescent lamp] A-lamp, CFL basic, and CFL reflector) have been identified as HIMs based on IOU reported accomplishments through Q4 2012, as shown in Table 6.

These three measure groups, along with CFL globes, are included within the scope of this evaluation. All other measure groups, including residential downstream lighting measures, were ultimately not included in the evaluation since they do not comprise significant savings, are not evaluable and/or represent measures unlikely to persist in future cycles.

Table 6: Upstream and Residential Downstream Lighting HIM Groups 1

Measure Group	Percent of Reported Portfolio-Level Net Annual Energy Savings				Percent of Reported Portfolio-Level Net Peak Demand Reductions			
	Overall	**PG&E**	**SCE**	**SDG&E**	**Overall**	**PG&E**	**SCE**	**SDG&E**
Lighting Indoor CFL A- lamp	3.0%	1.8%	4.3%	1.3%	3.4%	2.1%	4.9%	1.5%
Lighting Indoor CFL Basic Spiral	16.4%	14.7%	17.0%	22.3%	18.6%	16.2%	19.5%	25.2%
Lighting Indoor CFL Reflector	3.7%	2.2%	5.2%	3.0%	4.2%	2.5%	5.9%	2.9%
Lighting Indoor CFL Globe	0.4%	0.0%	0.8%	0.2%	0.5%	0.0%	0.9%	0.3%
All Upstream and Residential Downstream HIMs	23.2%	18.6%	26.5%	26.67%	26.3%	20.9%	30.4%	29.6%
All Upstream and Residential Downstream Measure Groups	25.2%	20.0%	28.9%	29.0%	29.5%	23.0%	34.5%	32.3%

[1] HIM groups are highlighted in light blue, representing more than 1 percent of portfolio-level impacts. Globe CFLs, highlighted in green, have been included in the evaluation despite not being defined as HIMs.

A wide range of CFL measures are is included within each of the measure groups shown in Table 6. Savings claims included within the IOU tracking data are based on assumptions that are tied to the characteristics of specific measures. The evaluation applies updates to savings at the measure group level. A spreadsheet is provided in Appendix A showing the one-to-one comparison of the evaluation results applied to each unique measure included within the tracking data.

Table 7 shows the quantity of HIMs that were rebated through each of the IOU upstream programs and then expected to be installed within residential applications.

Table 7: Quantity of Upstream HIM Measures by IOU Program

IOU	Program Name	Quantity of Basic Spiral CFLs Rebated	Quantity of A-Lamp CFLs Rebated	Quantity of Reflector CFLs Rebated	Quantity of Globe CFLs Rebated
PG&E	Residential Programs - Advanced Lighting	44,283	3,826,344	3,087,578	
	Residential Programs - Basic CFL Lighting	15,818,451		1,824	
	PG&E Total	**15,862,734**	**3,826,344**	**3,089,402**	
SCE	Residential Energy Efficiency Program	24,663,864	6,775,163	7,073,021	1,218,924
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SDG&E	Residential Basic Lighting (SW-ResA)	6,100,808		1,718	
	Advanced Consumer Lighting (SW-ResB)		475,819	658,594	128,131
	SDG&E Total	**6,100,808**	**475,819**	**660,312**	**128,131**

2.2 Evaluation Goals

The overarching goal of this impact evaluation for upstream and residential downstream lighting measures is to verify and validate the IOU reported energy savings and peak demand reduction estimates.

The impact evaluation approach has three main components:

- **Adjustments to Quantity of Measures Rebated**, which includes a verification assessment of a sample of program invoices and applications, an assessment of the percentage of IOU-discounted products purchased by non-IOU customers (for example, leakage), and an assessment of the percentage of IOU-discounted products purchased by residential versus nonresidential customers.
- **Development of Gross Savings Inputs**, which includes an assessment of the percentage of IOU-discounted products installed, estimates of the average daily hours-of-use (HOU), estimates of the average percent of measures operating at peak (coincidence 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).

- **Development of Net Savings Inputs**, which includes estimates of the NTGR.

3. Quantity Adjustments

Three adjustments are applied to the quantity of rebated measures claimed by the IOUs as having been sold to IOU residential and nonresidential customers during 2010-2012. These three 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 purchased by residential versus nonresidential customers
- Percent of IOU-discounted products purchased by non-IOU customers (for example, leakage)

3.1 Invoice Verification

Table 8, Table 9, and Table 10 present the results from the invoice/application verification assessment by IOU, separately for chain and independent stores. As described in Section 6.1.1, invoices were randomly sampled across IOU, retail channel, and store ownership (chain versus independent), according to our sampling plan. The records were drawn from the IOU tracking data for four quarters in 2010. The data request was sent to the IOUs in the first quarter of 2011. As shown, the overall invoice verification rate was determined to be 100 percent for all IOUs. In a few instances, the number of units verified for an application was not 100 percent; however, this shortfall in verification was not sufficient to alter the average verification rate at the IOU level.

These results represent a significant improvement over the findings of the 2006-2008 evaluation findings in which inadequate documentation of invoices and product shipments had resulted in one to four percent adjustment, depending on IOU, to the quantity of products shipped. A few recommendations for further improving the tracking data would be to ensure that units from applications with multiple retail locations be claimed at each retail location, avoiding the lumping of all units into one location. Quality control efforts should also confirm that units are correctly mapped to measure types in the tracking data. A few instances were found where there were slight mismatches of lamp to measure, such as a 15W reflector CFL being reported in the tracking data as a 15 watt (W) Bare Spiral CFL. As a general principle, sales data is a better form of "proof" than shipping data, so where inventory systems facilitate the use of sales reports, these should be provided as documentation in addition to freight bills or other types of shipment documentation.

Table 8: Invoice Verification Results by IOU – PG&E

Channel	Chain versus Independent	Quantity of Units Claimed	Quantity of Units Verified	Verification Rate
Discount	Independent	4,780	4,780	100%
Drug		5,080	5,080	100%
Grocery		25,780	25,780	100%
Hardware		13,360	13,360	100%
Home Improvement				
Lighting & Electronics		912	912	100%
Mass Merchandise				
Other		2,000	2,000	100%
Discount	Chain	10,272	10,272	100%
Drug		1,344	1,344	100%
Grocery		9,540	9,540	100%
Hardware		4,160	4,160	100%
Home Improvement		3,404	3,391	~100%
Lighting & Electronics		8,640	8,640	100%
Mass Merchandise		3,250	3,250	100%
Membership		86,132	86,136	~100%
	Total	**128,742**	**128,733**	**~100%**

Table 9: Invoice Verification Results by IOU – SCE

Channel	Chain versus Independent	Quantity of Units Claimed	Quantity of Units Verified	Verification Rate
Discount	Independent	3,625	3,625	100%
Drug				
Grocery		12,650	12,650	100%
Hardware		1,500	1,500	100%
Home Improvement				
Lighting & Electronics		1,316	1,316	100%
Mass Merchandise				
Other				
Discount	Chain	2,680	2,680	100%
Drug		444	444	100%
Grocery		10,363	10,363	100%
Hardware		6,510	6,510	100%
Home Improvement		3,510	3,510	100%
Lighting & Electronics		1,614	1,614	100%
Mass Merchandise		3,996	3,975	99%
Membership		25,703	25,703	100%
	Total	**73,911**	**73,890**	**~100%**

Table 10: Invoice Verification Results by IOU – SDG&E

Channel	Chain versus Independent	Quantity of Units Claimed	Quantity of Units Verified	Verification Rate
Discount	Independent	6,640	6,640	100%
Drug				
Grocery		14,000	14,000	100%
Hardware		2,116	2,116	100%
Home Improvement				
Lighting & Electronics		372	372	100%
Mass Merchandise				
Other		2,400	2,400	100%
Discount	Chain	68,448	68,448	100%
Drug				
Grocery		54,048	54,048	100%
Hardware		118,800	118,800	100%
Home Improvement		8,000	8,000	100%
Lighting & Electronics		3,893	3,893	100%
Mass Merchandise		6,228	6,228	100%
Membership		21,019	21,019	100%
	Total	**305,964**	**305,964**	**100%**

3.2 Residential Versus Non-Residential

The second quantity adjustment to the number IOU discounted CFLs is the percentage that are purchased for use by non-residential customers. This is an important split because CFLs that end up in non-residential applications have different gross UES values compared to CFLs that get installed in residential applications. Due to the upstream nature of the programs, there are not readily verifiable participants to accurately know which purchases are for residential applications and which are for non-residential applications. To estimate the portion of upstream CFLs that go to non-residential applications, estimates from two on-site surveys were used: California Lighting and Appliance Saturation Survey[1] (CLASS) (WO021) and Commercial Market Share Tracking Commercial Saturation Study[2] (CSS) (WO024). The methodology for the residential versus non-residential split is in Section 06.1.3. Estimates were developed of the numbers of CFLs that were purchased through retail sales channels and then installed in residential versus non-residential settings. The percentage of total CFL purchases reported as installed in non-residential applications is applied to the number of CFLs shipped through the upstream CFL program to represent the residential versus non-residential split.

Table 11: CFLs Purchaced through Retail Channels

	PG&E	SCE	SDG&E	Overall
CFLs Installed in Residential Applications	57,337,000	54,758,000	16,393,000	128,489,000
CFLs Installed in Non-Residential Applications	4,460,000	3,522,000	1,120,000	9,103,000
Non-Residential Percentage	7%	6%	6%	7%

As shown above in Table 11, the statewide non-residential percentage is at 7 percent, while it is slightly lower at 6 percent for SCE and SDG&E. This represents a 1-2 percent increase in the percentage of upstream CFLs that end up installed in non-residential applications from the ex-ante assumption of 5 percent.

[1] DNV GL, 2014. WO21: Residential On-Site Study: California Lighting and Appliance Saturation Study (CLASS 2012) – Draft Final Report. Prepared for the CPUC ED. Final report expected Q3 2014

[2] Itron, Inc. 2014. California Commercial Saturation Survey Report – DRAFT. Prepared for CPUC ED. May, 2014.

3.3 Leakage

Leakage is an adjustment to the number of lamps shipped through the upstream programs that represents lamps that end up outside of the IOU service territory. Leakage can happen through customers from outside the IOU service territory buying the discounted products and installing them outside of IOU service territory. For the 2010-2012 evaluation cycle, Leakage was a secondary research question that was explored through questions in the consumer intercept surveys (Appendix C-1). Customers where asked if they planned to take any of the bulbs that had purchased and install outside of the IOU service territory. In the 2006-2008 upstream lighting evaluation, leakage was found to be at 2.5 percent statewide. For the 2010-2012 program cycle evaluation, little evidence was found of leakage in the data collection efforts: less than 1 percent of respondents answered that they planned to install CFLs outside of IOU territory. Ultimately, due to the lack of strong data supporting leakage, no adjustment to quantity was applied for this evaluation. More detail on leakage can be found in section 6.1.2.

4. Gross Impacts

4.1 Overview of Gross Impacts

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 (ULP):

- UES_p (kWh/year) = IR_p x HOU_p x $\Delta W_p/1000$, where:
- IR_p = installation rate for IOU-discounted product *p*
- HOUp = annual average hours-of-use for IOU-discounted product p
- ΔWp = average displaced (delta) wattage for IOU-discounted product p
- Peak kW_p = IR_p x CF_p x $\Delta W_p/1000$, where:
- IRp = installation rate for IOU-discounted product p
- CFp = average percent on at peak for IOU-discounted product p
- ΔWp = average displaced (delta) wattage for IOU-discounted product p

The relative variance of each of each of the estimates is approximated by the first order expansion of the terms. This approximation assumes that the terms are statistically independent from each other.

$$\frac{Var(UES_p)}{(UES_p)^2} \cong \frac{Var(IR_p)}{(IR_p)^2} + \frac{Var(HOU_p)}{(HOU_p)^2} + \frac{Var(\Delta W_p)}{(\Delta W_p)^2}$$

$$\frac{Var(kW_p)}{(kW_p)^2} \cong \frac{Var(IR_p)}{(IR_p)^2} + \frac{Var(CF_p)}{(CF_p)^2} + \frac{Var(\Delta W_p)}{(\Delta W_p)^2}$$

4.1.1 HOU

Estimates of the average daily HOU for residential lighting were derived from the analysis of logger data collected through the 2006-2008 Residential Lighting Metering Study, and applied to the residential lighting inventories collected as part of the 2010-2012 CLASS. Section 6.2.3 contains a more detailed discussion of the methodology for the HOU estimates included in this analysis.

4.1.2 Peak CF

Peak CF represent the average percent of time that a CFL is used during the peak period. The peak periods vary by climate zone. Similar to the HOU estimates, the estimates for CF were derived from the logger data collected for the 2006-2008 evaluation and applied to the lighting inventories collected during CLASS. Section 6.2.3.26.2.3.2 provides a more detailed discussion of the methodology for the peak CF factors developed as part of this analysis.

4.1.3 Delta Watts

Delta watts was calculated as the difference between the average wattage of CFLs rebated during each program year from 2010-2012 and the average wattage of incandescent lamps used in similar applications. As the saturation of CFLs in California has increased, CFLs replacing existing CFLs is becoming more of a concern for the baseline assumptions of upstream CFLs. For this evaluation, the baseline technology is incandescent lamps, with CFL to CFL replacement being captured in the Net-to-Gross analysis. Section 6.2.3 provides additional detail on the delta watts results used in this analysis.

4.1.4 Installation Rate

For this evaluation report, we have moved away from a year-by-year installation rate method used in previous upstream lighting evaluations, and applied an installation rate that gives credit for all CFLs that will ultimately be installed. An installation rate of 97 percent is being applied to all upstream CFLs evaluated in this report. The 97 percent installation rate is based on telephone surveys with consumers and previous installation rate research that suggests CFLs purchased by residential customers all get installed within four year time range of purchase, except for 3 percent that never get installed[3]. In previous evaluations, a year-to-year installation flow was calculated, and the program was credited for the cumulative installations within the program cycle. Program CFLs that were installed after the end of the program cycle were carried over the subsequent years and savings credits were applied in those years. Moving to the new installation rate for this evaluation, CFLs rebated within a program year will be credited to that year, with the understanding that not all will actually be installed in the first year, but that 97 percent of the rebated CFLs will eventually make it into a socket. The 97 percent installation rate eliminates the need for carryover analysis to be applied to future upstream programs. Eliminating carry-over savings between program years will help facilitate the transition to rolling program cycles in coming years, given that the IOUs have previously been managing their portfolios based on the previous definition. The installation rate methodology is described in more detail in Section 6.

In the sections below, DNV GL provided gross savings results for basic spiral CFLs, A-lamp CFLs, reflector CFLs, and globe CFLs.

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[3] KEMA, Inc. and Cadmus Group. *Final Evaluation Report: Upstream Lighting Program, Volume 1.* CALMAC Study ID CPU0015.01: Prepared for the California Public Utilities Commission, 2010

4.2 Basic Spiral CFL Results

Basic spiral CFLs are defined as spiral-shaped, medium screw base (MSB) replacement lamps of less than 30 watts. During the 2010-2012 program cycle, the IOUs provided incentives for over 46 million basic spiral CFLs through the five IOU upstream programs. Table 12 provides a summary of the number of basic spiral CFLs rebated for each IOU.

Table 12: Quantity of Rebated Basic Spiral CFLs from Tracking Data (2010-2012)

	PG&E	SCE	SDG&E	Overall
Quantity of Rebated Basic Spiral CFLs	15,862,734	24,663,864	6,100,808	46,627,406

4.2.1 Basic Spiral CFL Saturation Changes

The driving force in changes to the gross saving parameters for CFL measures has been the increase in saturation, meaning the overall presence of CFLs in applicable MSB sockets. As shown in Figure 1, by 2012, spiral-shaped CFLs and A-lamps of any technology type comprised around 66 percent of all MSB sockets in residential applications throughout the IOU service territories. This compares to 63 percent of all MSB sockets in 2009, representing a slight increase in the overall use of spiral CFLs and A-lamps of any technology type (as compared to reflector, globe, and other lamp shapes) over time.

Figure 1: Residential Saturation Levels: All MSB Sockets

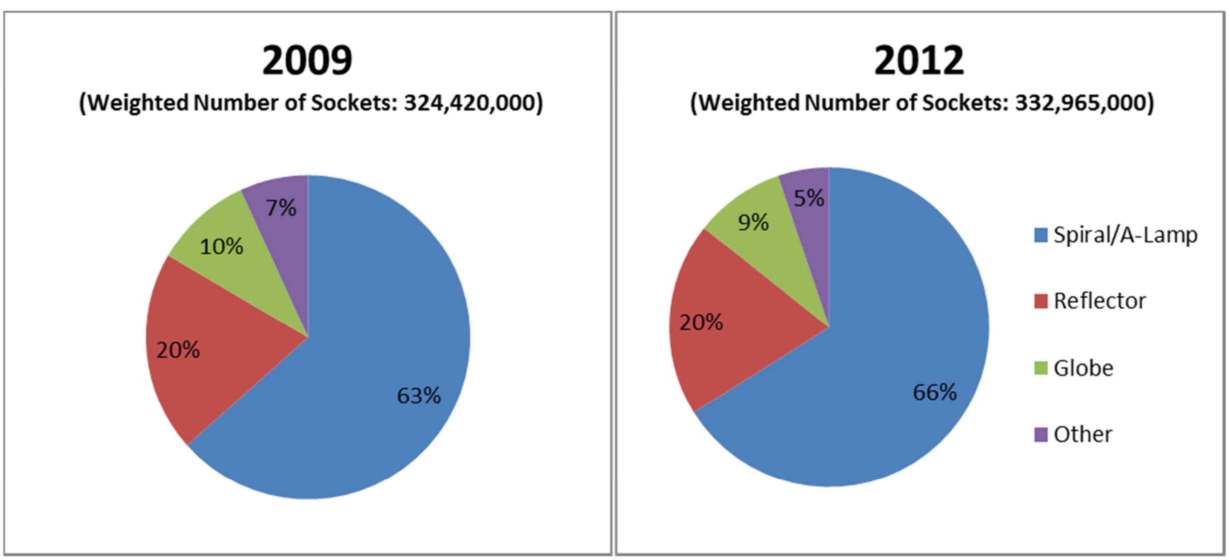


Table 13 shows similar results, but the percentages are based only on applicable MSB sockets (for example, those MSB sockets that contain a spiral-shaped CFL or A-lamp of any technology type). As shown, the saturation of basic spiral CFLs had increased from 36.5 percent in 2009 to 49.1 percent in 2012. For a further explanation of how saturation levels are calculated, see Section 6.2.1.

Table 13: Residential Saturation Levels: Basic Spiral and A-Lamps (Percent of All MSB Spiral and A-Lamps)

	Lamp Type	PG&E	SCE	SDG&E	Overall
2012 Saturation Levels	**CFL Spiral**	50.5%	47.8%	49.0%	49.1%
	CFL A-lamp	1.9%	1.7%	2.7%	1.9%
	Incandescent A-lamp	46.9%	49.6%	47.1%	48.1%
	LED* A-lamp	0.6%	0.5%	0.5%	0.6%
	Other A-lamp	0.1%	0.4%	0.7%	0.3%
2009 Saturation Levels	**CFL Spiral**	37.9%	35.8%	33.8%	36.5%
	CFL A-lamp	1.4%	1.0%	1.0%	1.2%
	Incandescent A-lamp	60.5%	62.8%	64.2%	61.9%
	LED A-lamp	0.0%	0.0%	0.0%	0.0%
	Other A-lamp	0.3%	0.3%	1.1%	0.4%
Difference	CFL Spiral	*12.6%*	*11.9%*	*15.2%*	*12.7%*
	CFL A-lamp	*0.5%*	*0.7%*	*1.7%*	*0.7%*
	Incandescent A-lamp	*-13.6%*	*-13.2%*	*-17.1%*	*-13.9%*
	LED A-lamp	*0.6%*	*0.5%*	*0.5%*	*0.6%*
	Other A-lamp	*-0.2%*	*0.1%*	*-0.4%*	*-0.1%*

* LED = light-emitting diode
Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.2.2 Basic Spiral CFL HOU

As shown in Table 14, overall, the average HOU estimate for residential basic spiral CFLs has decreased by approximately 9 percent as compared to the 2006-2008 evaluation result. That is, at the end of the 2006-2008 program cycle, basic spiral CFLs were estimated to use 1.9 hours per day and, at the end of the 2010-2012 program cycle, basic CFLs were estimated to use 1.7

hours per day. This change is driven largely by the increased saturation levels for basic spiral CFLs, as discussed previously and shown in Table 13. As more basic spiral CFLs are installed, they are being used in sockets that are used fewer hours per day. See Section 6.2.3 for a more detailed discussion of the methodology for estimating HOU for the 2010-2012 program cycle.

Table 14: Comparison of 2006-2008 and 2010-2012 Residential HOU Estimates: Basic Spiral CFLs

	PG&E		SCE		SDG&E		Overall	
	HOU	**90% CI**	**SCE**	**90% CI**	**SDG&E**	**90% CI**	**Overall**	**90% CI**
2010-2012	**1.6**	0.2	**1.9**	0.2	**1.4**	0.2	**1.7**	0.1
2006-2008[4]	1.8	0.3	2.1	0.3	1.5	0.3	1.9	0.3
Difference	**-0.2**		**-0.2**		**-0.1†**		**-0.2**	
Percentage Difference	**-9%**		**-9%**		**-9%†**		**-9%**	

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

According to the IOU work papers, 2.18 hours per day was assumed for all CFLs rebated through the 2010-2012 upstream programs. This represents a significant difference from both the 2006-2008 and 2010-2012 evaluation results. As discussed below in Section 2.3.5, this difference is due to the lag between the relevant Database for Energy Efficient Resources[5] (DEER) updates. IOU work papers (IOU 2012) developed for the 2010-2012 Program cycle are the source for the 2.18 average hours per day assumption using for the 2010-2012 program cycle. These work papers were drawing from the latest available information at the time, which appears to be the DEER 2008 update. The 2006-2008 evaluation result was used to inform the DEER 2011 update. The 2013-2014 program cycle used 1.9 average hours per day, consistent with the 2006-2008 evaluation result and the DEER 2011 update.

4.2.3 Basic Spiral CFL Peak CF

As shown in Table 15, peak CF estimates for residential basic spiral CFLs have declined by about 5 percent across all three IOU service territories as compared to the 2006-2008 evaluation

[4] In the 2006-2008 evaluation (KEMA, Inc. and Cadmus Group 2010), Spiral and A-lamp results were combined.

[5] The Database for Energy Efficient Resources (DEER) is a California Energy Commission and California Public Utilities Commission (CPUC) sponsored database designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life (EUL) all with one data source. http://www.energy.ca.gov/deer/.

result. As shown, PG&E's estimate of peak CF decreased by about 4 percent and the peak CF estimate for SCE decreased by about 7 percent. SDG&E's peak CF estimate remained the same over the two time periods. Average HOU and peak CF estimates are closely related; as CFL saturations increase, overall HOU and peak CF tend to drop as the more efficient lamps are installed in sockets that are used less often. A further explanation of how peak CF is calculated is laid out in Section 6.2.3.26.2.3.2.

IOU assumptions for peak CF parameter values were not provided within the 2010-2012 work papers. As such, DNV GL cannot provide an explanation for the differences between ex ante and ex post peak CF estimates.

Table 15: Comparison of 2006-2008 and 2010-2012 Residential Peak CF Estimates: Basic Spiral CFLs

	PG&E		SCE		SDG&E		Overall	
	Peak CF	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**
2010-2012	**5.4%**	1.3%	**6.7%**	1.4%	**4.4%**	1.8%	**5.8%**	1.0%
2006-2008[6]	5.6%	2.8%	7.2%	2.8%	4.4%	2.9%	6.1%	2.8%
Difference	**-0.2%**†		**-0.5%**†		**0.0%**†		**-0.3%**†	
Percentage Difference	**-4%**†		**-7%**†		**0%**†		**-5%**†	

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.2.4 Basic Spiral CFL Delta Watts

Delta watts results for residential basic spiral CFLs, broken out by program year, are shown Table 16. As shown, overall, the average wattage for basic spiral CFLs rebated through the 2010-2012 programs ranged from 20.3 in 2010 to 16.5 in 2012. When compared to the average wattage of comparable incandescent lamps, this yields average delta watts of 43.3 in 2010, 43.6 in 2011 and 44.2 in 2012 for residential basic spiral CFLs. The methodology for calculating delta watts is explained in more detail in Section 6.2.3.

Over time, the baseline for basic spiral CFLs are declining. For example, the average wattage of comparable incandescent lamps was 65.1 in the 2006-2008 evaluation. This results in lower delta watts for the 2010-2012 programs. The average delta watts determined through the 2006-

[6] In the 2006-2008 evaluation (KEMA, Inc. and Cadmus Group 2010), Spiral and A-lamp results were combined.

2008 evaluation was 47.7, which reflects the difference between average wattage for basic spiral and A-lamp CFLs rebated through the 2006-2008 programs and verified as being installed in residential applications (17.4) and the baseline.

Table 16: 2010-2012 Basic Spiral CFL Delta Watts Calculation

		PG&E	SCE	SDG&E	Overall
Average Wattage of Equivalent Incandescent Lamps	2010	63.5	63.5	64.8	63.7
	2011	62.0	62.2	63.3	62.2
	2012	60.6	60.8	61.8	60.8
Average Wattage of Rebated Basic Spiral CFLs (2010-2012 Program Cycle)	2010	19.5	21.2	19.4	20.3
	2011	20.0	17.8	18.3	18.6
	2012	20.0	14.1	18.7	16.5
Delta Watts	2010	43.9	42.3	45.4	43.3
	2011	42.0	44.4	45.0	43.6
	2012	40.6	46.7	43.1	44.2

4.2.5 Basic Spiral CFL Non-Residential UES

As explained in Section 3.2, between 6 percent and 7 percent of upstream CFLs end up in non-residential applications. This report focuses on the parameters that go into calculating the residential UES. For the CFLs that go to non-residential settings, the approved weighted commercial UES value from DEER is applied to the average wattage of rebated measures for each program year. Below in Table 17, the UES value applied in non-residential applications for Basic Spiral CFLs is calculated for each program year. DEER does not distinguish between the different CFL shapes, so all four HIMs have the same per watt values.

Table 17: Basic Spiral CFL Non-Residential UES values

Non-Residential UES Values	Year	PG&E	SCE	SDG&E
kWh per Watt		8.17	8.71	8.71
kW per Watt		0.002	0.002	0.002
Average rebated wattage	2010	19.5	21.2	19.4
	2011	20.0	17.8	18.3
	2012	20.0	14.1	18.7
UES -kWh	2010	159.50	184.72	168.96
	2011	163.57	155.07	159.67
	2012	163.70	122.74	162.48
UES -kW	2010	0.039	0.042	0.039
	2011	0.040	0.036	0.037
	2012	0.040	0.028	0.037

4.2.6 Basic Spiral CFL Gross Impact Results

As shown in Table 18, the ex post annual gross energy savings are estimated to be about 96 percent of the IOU reported ex ante estimates, overall. Peak demand reductions are estimated at about 80 percent of the overall ex ante estimate.

Table 18: Basic Spiral CFL Ex Ante and Ex Post Gross Impacts Comparison

Measure Group: Lighting Indoor CFL Basic Spiral	Ex Ante Annual Gross Energy Savings (kWh)	Ex Ante Gross Peak Demand Reductions (kW)	Ex Post Annual Gross Energy Savings (kWh)	Ex Post Gross Peak Demand Reductions (kW)	Ex Post Percentage of Ex Ante (kWh)	Ex Post Percentage of Ex Ante (kW)
PG&E	549,718,293	81,061	530,436,510	67,968	96%	84%
SCE	936,934,589	148,545	915,839,654	119,220	98%	80%
SDG&E	212,034,123	30,546	183,627,271	21,749	87%	71%
Overall	**1,698,687,005**	**260,153**	**1,629,903,434**	**208,938**	**96%**	**80%**

The differences between the ex post results and the ex ante results are primarily due to the following factors:

- **HOU:** IOU work papers assumed 2.18 average hours per day, derived from a 795.9 annual operating hours assumption in the DEER 2008 (California Energy Commission 2008) update, versus the overall 2012 modeled lighting inventory result of 1.73 average hours per day (21 percent lower).
- **Installation Rate:** The change in methodology, as a result of a change from the CPUC in definition, for the Installation rate increased the ex-post gross savings. By giving credit for CFL installations during the program year they were rebated in, the savings are no longer carried over into subsequent years.
- **Peak CF:** As explained in section 4.2.3, IOU assumptions for peak CF parameter values were not provided within the 2010-2012 work papers. Ex ante UES values for kW were calculated from the DEER tool, but the evaluators estimate that ex-ante peak CF assumptions ranged between 30-50 percent higher than evaluated ex-post results. This results in ex post peak demand savings (kW) not achieving as high of a percentage of ex ante savings as annual energy savings (kWh)
- **Residential vs Non-Residential split**: The ex post split of 6 to 7 percent was greater than the ex ante assumptions of 5 percent. Due to the non-residential UES being higher than residential UES, a greater portion of non-residential measures results in higher overall savings.

Table 19 presents a breakdown of the ex-post gross savings to the residential and non-residential sectors. Detailed summaries of the updates to savings claims are provided in Appendix A.

Table 19: Basic Spiral CFL Residential and Non-Residential Gross Savings

Measure Group: Lighting Indoor CFL Basic	Residential Ex Post Annual Gross Energy Savings (kWh)	Residential Ex Post Gross Peak Demand Reductions (kW)	Non-Residential Ex Post Annual Gross Energy Savings (kWh)	Non-Residential Ex Post Gross Peak Demand Reductions (kW)	Total Ex Post Annual Gross Energy Savings (kWh)	Total Ex Post Gross Peak Demand Reductions (kW)
PG&E	356,409,959	32,956	174,026,552	35,013	530,436,510	67,968
SCE	690,014,606	76,613	225,825,048	42,607	915,839,654	119,220
SDG&E	125,735,622	10,827	57,891,648	10,922	183,627,271	21,749
Overall	**1,172,160,187**	**120,395**	**457,743,248**	**88,542**	**1,629,903,434**	**208,938**

4.3 A-Lamp CFL Results

A-lamp CFLs are defined as MSB CFLs that are covered to resemble traditional incandescent A-lamp bulbs. During the 2010-2012 program cycles, approximately 11 million A-lamp CFLs were rebated through the IOU upstream programs. Table 20 shows the quantity of rebated A-lamp CFLs rebated by each IOU.

Table 20: Quantity of Rebated A-Lamp CFLs from Tracking Data (2010-2012)

	PG&E	SCE	SDG&E	Overall
Quantity of Rebated A-Lamp CFLs	3,826,344	6,775,163	475,819	11,077,326

4.3.1 A-Lamp CFL Saturation Changes

As shown earlier in Figure 1, by 2012, spiral-shaped CFLs and A-lamps of any technology type comprised around 66 percent of all MSB sockets in residential applications throughout the IOU service territories. This compares to 61 percent of all MSB sockets in 2009, representing a slight increase in the overall use of spiral CFLs and A-lamps of any technology type (as compared to reflector, globe, and other lamp shapes) over time. However, most of that change was driven by increases in spiral-shaped CFLs as opposed to A-lamp shaped CFLs. As shown in Table 21, A-lamp shaped CFLs increased from 1.2 percent of all applicable MSB sockets containing spiral-shaped CFLs and A-lamps of any technology type to 1.9 percent. For a further explanation of how saturation levels are calculated, see Section 6.2.1.

Table 21: Residential Saturation Levels: Basic Spirals and A-Lamps (Percent of All MSB Spiral and A-Lamps)

	Lamp Type	PG&E	SCE	SDG&E	Overall
2012 Saturation Levels	CFL Spiral	50.5%	47.8%	49.0%	49.1%
	CFL A-lamp	**1.9%**	**1.7%**	**2.7%**	**1.9%**
	Incandescent A-lamp	46.9%	49.6%	47.1%	48.1%
	LED A-lamp	0.6%	0.5%	0.5%	0.6%
	Other A-lamp	0.1%	0.4%	0.7%	0.3%
2009 Saturation Levels	CFL Spiral	37.9%	35.8%	33.8%	36.5%
	CFL A-lamp	**1.4%**	**1.0%**	**1.0%**	**1.2%**
	Incandescent A-lamp	60.5%	62.8%	64.2%	61.9%
	LED A-lamp	0.0%	0.0%	0.0%	0.0%
	Other A-lamp	0.3%	0.3%	1.1%	0.4%
Difference	*CFL Spiral*	*12.6%*	*11.9%*	*15.2%*	*12.7%*
	CFL A-lamp	*0.5%*	*0.7%*	*1.7%*	*0.7%*
	Incandescent A-lamp	*-13.6%*	*-13.2%*	*-17.1%*	*-13.9%*
	LED A-lamp	*0.6%*	*0.5%*	*0.5%*	*0.6%*
	Other A-lamp	*-0.2%*	*0.1%*	*-0.4%*	*-0.1%*

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.3.2 A-Lamp CFL HOU

As shown in Table 22, overall, the average HOU estimate for residential A-lamp CFLs has decreased by approximately 15 percent as compared to the 2006-2008 evaluation result. That is, at the end of the 2006-2008 program cycle, A-lamp CFLs were estimated to be used 1.9 hours per day, whereas A-lamp CFLs were estimated at 1.6 hours per day at the end of the 2010-2012 program cycle. Similar to basic spiral CFLs, this change is driven largely by increased saturation levels of CFLs that are being installed in sockets that are used fewer hours per day. See Section 6.2.3 for a more detailed discussion of the methodology for estimating HOU for the 2010-2012 program cycle.

Table 22: Comparison of 2006-2008 and 2010-2012 Residential HOU Estimates: A-Lamp CFLs

	PG&E		SCE		SDG&E		Overall	
	HOU	**90% CI**	**SCE**	**90% CI**	**SDG&E**	**90% CI**	**Overall**	**90% CI**
2010-2012	1.5	0.2	1.9	0.2	1.3	0.3	1.6	0.2
2006-2008[7]	1.8	0.3	2.1	0.3	1.5	0.3	1.9	0.3
Difference	-0.3		-0.2†		-0.2†		-0.3	
Percentage Difference	-18%		-10%†		-13%†		-15%	

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.3.3 A-Lamp CFL Peak CF

As shown in Table 23, peak CF estimates for residential A-lamp CFLs have declined by about 18 percent across all three IOU service territories. As shown, PG&E's estimate of peak CF decreased by about 18 percent, SCE's estimate decreased by 14 percent, and SDG&E's estimate did not decrease. A further explanation of how peak CF is calculated is laid out in Section 6.2.3.2.

As mentioned above, average HOU and peak CF estimates are closely related; as CFL saturations increase, overall, HOU and peak CF tend to drop as the more efficient lamps are installed in sockets that are used less often. However, IOU assumptions for peak CF parameter values were not provided within the 2010-2012 work papers. As such, DNV GL cannot provide a more specific explanation for the differences between ex ante and ex post peak CF estimates.

[7] In the 2006-2008 evaluation (KEMA, Inc. and Cadmus Group 2010), Spiral and A-lamp results were combined.

Table 23: Comparison of 2006-2008 and 2010-2012 Residential Peak CF Estimates: A-Lamp CFLs

	PG&E		SCE		SDG&E		Overall	
	Peak CF	**90% CI***	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**
2010-2012	4.6%	1.6%	6.2%	1.5%	4.4%	2.0%	5.2%	1.2%
2006-2008[8]	5.6%	2.8%	7.2%	2.8%	4.4%	2.9%	6.1%	2.8%
Difference	-1.0%†		-1.0%†		0.0%†		-0.9%†	
Percentage Differences	-18%†		-14%†		0%†		-15%†	

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.3.4 A-Lamp CFL Delta Watts

Delta watts results for residential A-lamp CFLs are shown Table 24. As shown, overall, the average wattage for A-lamp CFLs rebated ranges from 14.1 in 2010 to 17.7 in 2012. When compared to the average wattage of comparable incandescent lamps this yields a delta watts of 49.3 in 2010, 47.3 in 2011, and 43.1 in 2012 for residential A-lamp CFLs. The delta watts decrease year to year as the baseline is decreasing, and the average rebate wattage increases. A separate, A-lamp CFL specific delta watts result was not determined through the 2006-2008 evaluation. Instead, basic spiral and A-lamp CFL results were combined and, as mentioned above, the average delta watts estimate determined through the 2006-2008 evaluation was 47.7. This reflects the difference between the average wattage of comparable incandescent lamps (65.1) and the average wattage for basic spiral and A-lamp CFLs rebated through the 2006-2008 program and verified as being installed in residential applications (17.4).

[8] In the 2006-2008 evaluation (KEMA, Inc. and Cadmus Group 2010), Spiral and A-lamp results were combined.

Table 24: 2010-2012 A-Lamp CFL Delta Watts Calculation

	Year	PG&E	SCE	SDG&E	Overall
Average Wattage of Equivalent Incandescent Lamps	2010	63.5	63.5	64.8	63.7
	2011	62.0	62.2	63.3	62.2
	2012	60.6	60.8	61.8	60.8
Average Wattage of Rebated A-Lamp CFLs (2010-2012 Program Cycle)	2010	13.8	14.5	14.2	14.1
	2011	13.1	15.6	14.2	14.9
	2012	12.7	18.8	14.1	17.7
Delta Watts	2010	49.7	49.0	50.6	49.6
	2011	48.9	46.6	49.1	47.3
	2012	47.9	42.0	47.7	43.1

4.3.5 A-Lamp CFL Non-Residential UES

As explained in Section 3.2, between 6 percent and 7 percent of upstream CFLs end up in non-residential applications. This report focuses on the parameters that go into calculating the residential UES. For the CFLs that go to non-residential settings, the approved weighted commercial UES value from DEER is applied to the average wattage of rebated measures for each program year. Below in Table 25, the UES value applied in non-residential applications for A-Lamp CFLs is calculated for each program year. DEER does not distinguish between the different CFL shapes, so all four HIMs have the same per watt values.

Table 25: A-Lamp CFL Non-Residntail UES values

A-Lamp Non-Residential UES Values	Year	PG&E	SCE	SDG&E
kWh per Watt		8.17	8.71	8.71
kW per Watt		0.002	0.002	0.002
Average rebated wattage	2010	13.8	14.5	14.2
	2011	13.1	15.6	14.2
	2012	12.7	18.8	14.1
UES -kWh	2010	112.29	126.53	123.57
	2011	106.87	135.83	123.81
	2012	103.81	163.84	122.41
UES -kW	2010	0.028	0.029	0.028
	2011	0.026	0.031	0.028
	2012	0.025	0.038	0.028

4.3.6 A-Lamp CFL Gross Impact Results

As shown in Table 26, the ex post annual gross energy savings for A-lamp CFLs are estimated to be about 111 percent of the IOU reported ex ante estimates, overall. Peak demand reductions are estimated at about 80 percent of the overall ex ante estimate.

Table 26: A-Lamp CFL Ex Ante and Ex Post Gross Impacts Comparison

Measure Group: Lighting Indoor A-Lamp CFL	Ex Ante Annual Gross Energy Savings (kWh)	Ex Ante Gross Peak Demand Reductions (kW)	Ex Post Annual Gross Energy Savings (kWh)	Ex Post Gross Peak Demand Reductions (kW)	Ex Post Percentage of Ex Ante (kWh)	Ex Post Percentage of Ex Ante (kW)
PG&E	90,051,957	13,272	121,637,849	13,567	135%	102%
SCE	243,945,886	38,769	250,030,707	28,181	102%	73%
SDG&E	12,888,079	1,854	13,522,206	1,581	105%	85%
Overall	**346,885,922**	**53,895**	**385,190,762**	**43,329**	**111%**	**80%**

The differences between the ex post results and the ex-ante results are primarily due to the following factors:

- **HOU:** IOU work papers assumed 2.18 average hours per day, derived from a 795.9 annual operating hours assumption in the DEER 2008 (California Energy Commission 2008) update, versus the overall 2012 modeled lighting inventory result of 1.61 average hours per day (26 percent lower).

- **Installation Rate:** The change in methodology, as a result of a change from the CPUC in definition, for the Installation rate increased the ex-post gross savings. By giving credit for CFL installations during the program year they were rebated in, the savings are no longer carried over into subsequent years.
- **Peak CF:** As explained in section 4.2.34.3.3, IOU assumptions for peak CF parameter values were not provided within the 2010-2012 work papers. Ex-Ante UES values for kW were calculated from the DEER tool, but the evaluators estimate that ex-ante peak CF assumptions ranged between 30-50 percent higher than evaluated ex-post results. This results in ex post peak demand savings (kW) not achieving as high of a percentage of ex ante savings as annual energy savings (kWh)
- **Residential vs Non-Residential split**: The ex post split of 6 to 7 percent was greater than the ex ante assumptions of 5 percent. Due to the non-residential UES being higher than residential UES, a greater portion of non-residential measures results in higher overall savings.

Table 27 presents breakdown of the residential and non-residential gross savings for the 2010-2012 evaluation results for A-lamp CFL impact parameters. Detailed summaries of the updates to savings claims are provided in Appendix A.

Table 27: A-Lamp CFL Residential and Non-Residential Gross Savings

Measure Group: Lighting Indoor A-Lamp CFL	Residential Ex Post Annual Gross Energy Savings (kWh)	Residential Ex Post Gross Peak Demand Reductions (kW)	Non-Residential Ex Post Annual Gross Energy Savings (kWh)	Non-Residential Ex Post Gross Peak Demand Reductions (kW)	Total Ex Post Annual Gross Energy Savings (kWh)	Total Ex Post Gross Peak Demand Reductions (kW)
PG&E	93,074,740	7,820	28,563,109	5,747	121,637,849	13,567
SCE	191,327,053	17,105	58,703,655	11,076	250,030,707	28,181
SDG&E	10,108,193	937	3,414,014	644	13,522,206	1,581
Overall	**294,509,985**	**25,862**	**90,680,777**	**17,467**	**385,190,762**	**43,329**

4.4 Reflector CFL Results

Reflector CFLs are defined as lamps that are covered and include a directional reflective casing. They are sometimes referred to as spotlights. During the 2010-2012 program cycle, more than 10 million reflector CFLs were rebated through the IOU upstream programs and expected to be installed in residential applications. Table 28 shows the quantity of rebated reflector CFLs rebated by each IOU.

Table 28: Quantity of Rebated Reflector CFLs from Tracking Data (2010-2012)

	PG&E	SCE	SDG&E	Overall
Quantity of Rebated Reflector CFLs	3,089,402	7,073,021	660,312	10,822,735

4.4.1 Reflector CFL Saturation Changes

As shown earlier in Figure 1, saturation levels for reflector lamps of any technology type have remained the same from 2009 to 2012 (for example, around 20 percent of all MSB sockets). However, as shown in Table 29, saturation levels for CFL reflectors as a percent of applicable MSB sockets (for example, MSB sockets that contain a reflector lamp of any technology type) has increased from approximately 12 percent of all MSB reflectors in 2009 to nearly 18 percent in 2012. For a further explanation of how saturation levels are calculated for CFL reflectors, see Section 6.2.1.

Table 29: Residential Saturation Levels: Reflectors (Percent of All MSB Reflectors)

	Lamp Type	PG&E	SCE	SDG&E	Overall
2012 Saturation Levels	**CFL Reflector**	13.4%	21.1%	18.6%	17.6%
	Incandescent Reflector	59.7%	52.9%	67.9%	57.7%
	LED Reflector	2.0%	0.9%	1.5%	1.4%
	Other Reflector	24.9%	25.1%	12.0%	23.3%
2009 Saturation Levels	**CFL Reflector**	9.3%	14.3%	12.9%	12.0%
	Incandescent Reflector	63.2%	64.2%	68.3%	64.3%
	LED Reflector	0.3%	0.0%	0.0%	0.1%
	Other Reflector	27.3%	21.5%	18.8%	23.6%
Difference	***CFL Reflector***	*4.2%*	*6.7%*	*5.7%*	*5.6%*
	Incandescent Reflector	*-3.5%*	*-11.3%*	*-0.4%†*	*-6.6%*
	LED Reflector	*1.7%*	*0.9%*	*1.4%*	*1.3%*
	Other Reflector	*-2.4%*	*3.6%*	*-6.8%*	*-0.3%*

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.4.2 Reflector CFL HOU

As shown in Table 30, overall, the average HOU estimate for residential reflector CFLs has decreased by approximately 9 percent as compared to the 2006-2008 evaluation result. That is, at the end of the 2006-2008 program cycle, reflector CFLs were estimated to use 1.9 hours per day and, at the end of the 2010-2012 program cycle, reflector CFLs were estimated to use 1.7 hours per day. Similar to other types of CFLs, this change is driven largely by increased saturation levels of CFLs that are being installed in sockets that are used fewer hours per day. See Section 6.2.3 for a more detailed discussion of the methodology for estimating HOU for the 2010-2012 program cycle.

Table 30: Comparison of 2006-2008 and 2010-2012 Residential HOU Estimates: Reflector CFLs

	PG&E		SCE		SDG&E		Overall	
	HOU	**90% CI**	**SCE**	**90% CI**	**SDG&E**	**90% CI**	**Overall**	**90% CI**
2010-2012	1.7	0.3	1.9	0.2	1.2	0.4	1.7	0.2
2006-2008	1.7	0.4	2.2	0.3	1.4	0.4	1.9	0.3
Difference	**0.0†**		**-0.3**		**-0.2†**		**-0.2**	
Percentage Difference	**-3%†**		**-12%**		**-14%†**		**-9%**	

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.4.3 Reflector CFL Peak CF

As shown in Table 31, peak CF estimates for residential reflector CFLs have declined by about 12 percent across all three IOU service territories. As shown, PG&E's estimate of peak CF decreased by about 17 percent and SCE's estimate decreased by 14 percent. SDG&E's peak CF estimate increased by about 19 percent. A further explanation of how peak CF is calculated is laid out in Section 6.2.3.2.

As mentioned above, IOU assumptions for peak CF parameter values were not provided within the 2010-2012 work papers. As such, DNV GL cannot provide an explanation for the differences between ex ante and ex post peak CF estimates.

Table 31: Comparison of 2006-2008 and 2010-2012 Residential Peak CF Estimates: Reflector CFLs

	PG&E		SCE		SDG&E		Overall	
	Peak CF	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**
2010-2012	5.4%	2.1%	6.5%	1.9%	3.8%	2.5%	5.7%	1.7%
2006-2008	6.5%	3.2%	7.6%	2.8%	3.2%	3.3%	6.5%	2.9%
Difference	**-1.1%**		**-1.1%**		**0.6%**†		**-0.8%**	
Percentage Differences	**-17%**		**-14%**		**19%**†		**-12%**	

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.4.4 Reflector CFL Delta Watts

Delta watts results for residential reflector CFLs are shown Table 32. As shown, overall, the average wattage for reflector CFLs rebated was 18.9 in 2010, 19.6 in 2011 and 18.6 in 2012. When compared to the average wattage of comparable incandescent, this yields an average delta watt of 50.8 in 2010, 49.8 in 2011, and 50.5 for residential reflector CFLs. The methodology for calculating delta watts is explained in Section 6.2.3.

Overtime, the average delta watts for reflector CFLs are declining. For example, the average delta watts determined through the 2006-2008 evaluation was 52.7, which reflects the difference between the average wattage of comparable incandescent lamps (70.0) and the average wattage for reflector CFLs rebated through the 2006-2008 program and verified as being installed in residential applications (17.3).

Table 32: 2010-2012 Reflector CFL Delta Watts Calculation

		PG&E	SCE	SDG&E	Overall
Average Wattage of Equivalent Incandescent Lamps	2010	70.5	69.4	68.4	69.7
	2011	70.8	68.9	67.4	69.4
	2012	71.0	68.3	66.4	69.1
Average Wattage of Rebated Reflector CFLs (2010-2012 Program Cycle)	2010	17.9	19.3	17.8	18.9
	2011	18.4	20.3	16.4	19.6
	2012	18.2	19.2	16.5	18.6
Delta Watts	**2010**	**52.6**	**50.1**	**50.6**	**50.8**
	2011	**52.4**	**48.6**	**51.0**	**49.8**
	2012	**52.8**	**49.1**	**49.9**	**50.5**

4.4.5 Reflector CFL Non-Residential UES

As explained in Section 3.2, between 6 percent and 7 percent of upstream CFLs end up in non-residential applications. This report focuses on the parameters that go into calculating the residential UES. For the CFLs that go to non-residential settings, the approved weighted commercial UES value from DEER is applied to the average wattage of rebated measures for each program year. Below in Table 33, the UES value applied in non-residential applications for Reflector CFLs is calculated for each program year. DEER does not distinguish between the different CFL shapes, so all four HIMs have the same per watt values.

Table 33: Reflector CFL Non-Residentail UES values

Reflector Non-Residential UES Values	Year	PG&E	SCE	SDG&E
kWh per Watt		8.17	8.71	8.71
kW per Watt		0.002	0.002	0.002
Average rebated wattage	2010	17.9	19.3	17.8
	2011	18.4	20.3	16.4
	2012	18.2	19.2	16.5
UES -kWh	2010	146.38	168.36	155.23
	2011	150.38	176.87	143.16
	2012	148.91	167.15	143.46
UES -kW	2010	0.036	0.039	0.036
	2011	0.037	0.041	0.033
	2012	0.036	0.038	0.033

4.4.6 Reflector CFL Gross Impact Results

As shown in Table 34, the ex post annual gross energy savings for reflector CFLs are estimated to be about 103 percent of the IOU reported ex ante estimates, overall. Peak demand reductions are estimated at about 77 percent of the overall ex ante estimate.

Table 34: Reflector CFL Ex Ante and Ex Post Gross Impacts Comparison

Measure Group: Lighting Indoor Reflector CFL	Ex Ante Annual Gross Energy Savings (kWh)	Ex Ante Gross Peak Demand Reductions (kW)	Ex Post Annual Gross Energy Savings (kWh)	Ex Post Gross Peak Demand Reductions (kW)	Ex Post Percentage of Ex Ante (kWh)	Ex Post Percentage of Ex Ante (kW)
PG&E	106,955,546	16,047	122,153,547	14,196	114%	88%
SCE	291,734,733	46,377	290,511,264	33,909	100%	73%
SDG&E	20,817,157	3,164	18,785,412	2,197	90%	69%
Overall	**419,507,437**	**65,588**	**431,450,224**	**50,303**	**103%**	**77%**

The differences between the ex post results and the ex ante results are primarily due to the following factors:

- **HOU:** IOU work papers assumed 2.18 average hours per day, derived from a 795.9 annual operating hours assumption in the DEER 2008 (California Energy Commission 2008) update, versus the overall 2012 modeled lighting inventory result of 1.72 average hours per day (21 percent lower).

- **Installation Rate:** The change in methodology, as a result of a change from the CPUC in definition, for the Installation rate increased the ex-post gross savings. By giving credit for CFL installations during the program year they were rebated in, the savings are no longer carried over into subsequent years.
- **Peak CF:** As explained in section 4.2.34.4.3, IOU assumptions for peak CF parameter values were not provided within the 2010-2012 work papers. Ex-Ante UES values for kW were calculated from the DEER tool, but the evaluators estimate that ex-ante peak CF assumptions ranged between 30-50 percent higher than evaluated ex-post results. This results in ex post peak demand savings (kW) not achieving as high of a percentage of ex ante savings as annual energy savings (kWh)
- **Residential vs Non-Residential split**: The ex post split of 6 to 7 percent was greater than the ex ante assumptions of 5 percent. Due to the non-residential UES being higher than residential UES, a greater portion of non-residential measures results in higher overall savings.

Table 35 presents a breakdown of the residential and non-residential gross savings for the 2010-2012 evaluation results for reflector CFL impact parameters. Detailed summaries of the updates to savings claims are provided in Appendix A.

Table 35: Reflector CFL Residential and Non-Residential Gross Savings

Measure Group: Lighting Indoor CFL Reflector	Residential Ex Post Annual Gross Energy Savings (kWh)	Residential Ex Post Gross Peak Demand Reductions (kW)	Non-Residential Ex Post Annual Gross Energy Savings (kWh)	Non-Residential Ex Post Gross Peak Demand Reductions (kW)	Total Ex Post Annual Gross Energy Savings (kWh)	Total Ex Post Gross Peak Demand Reductions (kW)
PG&E	90,921,981	7,913	31,231,566	6,284	122,153,547	14,196
SCE	220,152,980	20,634	70,358,284	13,275	290,511,264	33,909
SDG&E	13,215,577	1,147	5,569,835	1,051	18,785,412	2,197
Overall	**324,290,538**	**29,694**	**107,159,685**	**20,609**	**431,450,224**	**50,303**

4.5 Globe CFL Results

Globe CFLs are defined as covered lamps that have a distinctive spherical shape, which differentiates them from the more traditional A-lamp shaped bulbs. During the 2010-2012 programs cycle, SCE rebated 1.2 million globe CFLs and SDG&E rebated just over 125,000, as shown in Table 36. PG&E did not rebate any globe CFLs through upstream programs in 2010-2012.

Table 36: Quantity of Rebated Globe CFLs from Tracking Data (2010-2012)

	PG&E	SCE	SDG&E	Overall
Quantity of Rebated Globe CFLs	0	1,218,924	128,131	1,347,055

4.5.1 Globe CFL Saturation Changes

As shown earlier in Figure 1, saturation levels for globe lamps of any technology type have remained the same from 2009 to 2012 (for example, around 10 percent of all MSB sockets). As shown in Table 37, saturation levels for globe CFLs as a percent of applicable MSB sockets (for example, MSB sockets that contain a globe lamp of any technology type) has increased only slightly from approximately 14 percent of all MSB globe lamps in 2009 to 15 percent in 2012. For a further explanation of how saturation levels are calculated for CFL globes, see Section 6.2.1.

Table 37: Residential Saturation Levels: Globes (Percentage of All MSB Globes)

	Lamp Type	PG&E	SCE	SDG&E	Overall
2012 Saturation Levels	**CFL Globe**	14.9%	15.3%	16.7%	15.3%
	Incandescent Globe	84.4%	84.0%	83.1%	84.1%
	LED Globe	0.6%	0.7%	0.2%	0.6%
	Other Globe	0.0%	0.0%	0.0%	0.0%
2009 Saturation Levels	**CFL Globe**	17.6%	11.9%	10.6%	14.3%
	Incandescent Globe	81.7%	88.1%	88.4%	85.2%
	LED Globe	0.0%	0.0%	0.0%	0.0%
	Other Globe	0.7%	0.0%	1.0%	0.5%
Difference	**CFL Globe**	*-2.6%*	*3.4%*	*6.2%*	*1.0%*
	Incandescent Globe	*2.7%*	*-4.1%*	*-5.3%*	*-1.1%*
	LED Globe	*0.6%*	*0.7%*	*0.2%*	*0.6%*
	Other Globe	-0.7%	0.0%	-1.0%	-0.5%

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.5.2 Globe CFL HOU

As shown in Table 38, SCE's average HOU estimate for residential globe CFLs has decreased by about 5 percent, whereas SDG&E's estimate has decreased by 22 percent. Results for PG&E

reflect changes in globe CFL HOU, but these results were not applied to the gross savings update since PG&E did not rebate any of these products during 2010-2012. See Section 6.2.3 for a more detailed discussion of the methodology for estimating HOU for the 2010-2012 program cycle.

Table 38: Comparison of 2006-2008 and 2010-2012 Residential HOU Estimates: Globe CFLs

	PG&E		SCE		SDG&E		Overall	
	HOU	**90% CI**	**SCE**	**90% CI**	**SDG&E**	**90% CI**	**Overall**	**90% CI**
2010-2012	1.2	0.3	1.6	0.3	1.0	0.4	1.3	0.2
2006-2008	1.4	0.3	1.7	0.3	1.3	0.3	1.5	0.3
Difference	**-0.2†**		**-0.1†**		**-0.3†**		**-0.2**	
Percentage Difference	**-15%†**		**-5%†**		**-22%†**		**-11%**	

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.5.3 Globe CFL Peak CF

As shown in Table 39, peak CF estimates for residential reflector CFLs have declined by about 7 percent in SCE's service territory and 16 percent in SDG&E's service territory. PG&E's results suggest an 8 percent decrease in peak CF estimates for globe CFLs, but these results are not applied, as PG&E did not rebate any globe CFLs in the 2010-2012 program cycle. A further explanation of how peak CF is calculated is laid out in Section 6.2.3.2.

Table 39: Comparison of 2006-2008 and 2010-2012 Residential Peak CF Estimates: Globe CFLs

	PG&E		SCE		SDG&E		Overall	
	Peak CF	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**
2010-2012	5.4%	2.2%	6.9%	1.9%	4.2%	2.4%	5.8%	1.8%
2006-2008	5.9%	2.8%	7.4%	2.8%	5.0%	2.9%	6.3%	2.8%
Difference	**-0.5%†**		**-0.5%†**		**-0.8%†**		**-0.5%†**	
Percentage Difference	**-8%†**		**-7%†**		**-16%†**		**-8%†**	

Note: All differences are statistically significant at 90 percent unless indicated with †. See Appendix for tables with complete statistical tests.

4.5.4 Globe CFL Delta Watts

Delta watts results for residential globe CFLs are shown Table 40. As shown, the average wattage for globe CFLs rebated through SCE's and SDG&E's was 13.7 in 2010, 17.6 in 2011, and 17.8 in 2012. This resulted in average delta watts of 31.2 in 2010, 27.3 in 2011, and 27.2 in 2012. PG&E did not rebate any globe CFLs in the 2010-2012 program cycle. The methodology for calculating delta watts is explained in Section 6.2.3.

Overtime, the average delta watts for globe CFLs is declining somewhat. For example, the average delta watts determined through the 2006-2008 evaluation was 34.2, which reflects the difference between the average wattage of comparable incandescent lamps (44.8) and the average wattage for globe CFLs rebated through the 2006-2008 program and verified as being installed in residential applications (10.7).

Table 40: 2010-2012 Globe CFL Delta Watts Calculation

		PG&E	SCE	SDG&E	Overall
Average Wattage of Equivalent Incandescent Lamps	2010	44.2	45.8	44.3	44.9
	2011	43.9	46.0	45.1	44.9
	2012	43.6	46.1	45.9	45.0
Average Wattage of Rebated Globe CFLs (2010-2012 Program Cycle)	2010	n/a	13.7	15.0	13.7
	2011	n/a	17.6	12.1	17.6
	2012	n/a	16.6	12.4	17.8
Delta Watts	**2010**	**n/a**	**32.2**	**29.3**	**31.2**
	2011	**n/a**	**28.4**	**33.0**	**27.3**
	2012	**n/a**	**29.5**	**33.5**	**27.2**

* n/a = not applicable

4.5.5 Globe CFL Non-Residential UES

As explained in Section 3.2, between 6 percent and 7 percent of upstream CFLs end up in non-residential applications. This report focuses on the parameters that go into calculating the residential UES. For the CFLs that go to non-residential settings, the approved weighted commercial UES value from DEER is applied to the average wattage of rebated measures for each program year. Below in Table 41, the UES value applied in non-residential applications for Globe CFLs is calculated for each program year. DEER does not distinguish between the different CFL shapes, so all four HIMs have the same per watt values.

Table 41: Globe CFL Non-Residntail UES values

CFL Globe Non-Residential UES Values	Year	PG&E	SCE	SDG&E
kWh per Watt		8.17	8.71	8.71
kW per Watt		0.002	0.002	0.002
Average rebated wattage	2010	n/a	13.7	15.0
	2011	n/a	17.6	12.1
	2012	n/a	16.6	12.4
UES -kWh	2010	n/a	118.94	130.59
	2011	n/a	153.37	105.19
	2012	n/a	144.42	108.08
UES -kW	2010	n/a	0.027	0.030
	2011	n/a	0.035	0.024
	2012	n/a	0.033	0.025

* n/a = not applicable

4.5.6 Globe CFL Gross Impact Results

As shown in Table 42, the ex post annual gross energy savings for SCE's globe CFLs are estimated to be about 73 percent of reported ex ante estimates, and 63 percent of the reported ex ante estimate for peak demand reductions. For SDG&E, ex post annual gross energy savings for globe CFLs are estimated to be 101 percent of the reported ex ante estimates, and 108 percent of the reported ex ante estimate for peak demand reductions.

Table 42: Globe CFL Ex Ante and Ex Post Gross Impacts Comparison

Measure Group: Lighting Indoor Globe CFL	Ex Ante Annual Gross Energy Savings (kWh)	Ex Ante Gross Peak Demand Reductions (kW)	Ex Post Annual Gross Energy Savings (kWh)	Ex Post Gross Peak Demand Reductions (kW)	Ex Post Percentage of Ex Ante (kWh)	Ex Post Percentage of Ex Ante (kW)
PG&E	n/a	n/a	n/a	n/a	n/a	n/a
SCE	43,802,143	7,067	32,043,736	4,423	73%	63%
SDG&E	2,196,759	289	2,219,520	311	101%	108%
Overall	**45,998,902**	**7,356**	**34,263,256**	**4,734**	**74%**	**64%**

The differences between the ex post results and the ex ante results are primarily due to the following factors:

- **HOU**: IOU work papers assumed 2.18 average hours per day, derived from a 795.9 annual operating hours assumption in the DEER 2008 (California Energy Commission 2008) update, versus the SCE 2012 modeled lighting inventory result of 1.62 average hours per day (26 percent lower) and the SDG&E 2012 modeled lighting inventory result of 1.01 average hours per day (54 percent lower).
- **Installation Rate:** The change in methodology, as a result of a change from the CPUC in definition, for the Installation rate increased the ex-post gross savings. By giving credit for CFL installations during the program year they were rebated in, the savings are no longer carried over into subsequent years.
- **Peak CF:** As explained in section 4.2.34.5.3, IOU assumptions for peak CF parameter values were not provided within the 2010-2012 work papers. Ex-Ante UES values for kW were calculated from the DEER tool, but the evaluators estimate that ex-ante peak CF assumptions ranged between 30-50 percent higher than evaluated ex-post results. This results in ex post peak demand savings (kW) not achieving as high of a percentage of ex ante savings as annual energy savings (kWh)
- **Residential vs Non-Residential split**: The ex post split of 6 to 7 percent was greater than the ex ante assumptions of 5 percent. Due to the non-residential UES being higher than residential UES, a greater portion of non-residential measures results in higher overall savings.

Table 43 presents a breakdown of the residential and non-residential gross savings for the 2010-2012 evaluation results for globe CFL impact parameters. Detailed summaries of the updates to savings claims are provided in Appendix A.

Table 43: Globe CFL Residential and Non-Residential Gross Savings

Measure Group: Lighting Indoor CFL Globe	Residential Ex Post Annual Gross Energy Savings (kWh)	Residential Ex Post Gross Peak Demand Reductions (kW)	Non-Residential Ex Post Annual Gross Energy Savings (kWh)	Non-Residential Ex Post Gross Peak Demand Reductions (kW)	Total Ex Post Annual Gross Energy Savings (kWh)	Total Ex Post Gross Peak Demand Reductions (kW)
PG&E	n/a	n/a	n/a	n/a	n/a	n/a
SCE	20,632,051	2,438	11,411,685	1,985	32,043,736	4,423
SDG&E	1,417,528	159	801,992	151	2,219,520	311
Overall	**22,049,579**	**2,597**	**12,213,677**	**2,137**	**34,263,256**	**4,734**

5. Net Impacts

This section describes the results of the net impacts assessment for the 2010-2012 ULPs. We determined net impacts by applying net-to-gross (NTG) ratios (which reflect the portion of IOU-discounted lighting products that would not have been sold, purchased or installed had it not been for the program) to estimates of gross savings for the program.

Net impacts are difficult to calculate for a program like the ULPs because of the program's upstream nature and focus. It was thus difficult to identify and distinguish downstream participants, making it challenging (if not impossible) to apply consumer self-report methods of assessing net impacts.

The approach we used to estimate net impacts examined the program's influence from three angles:

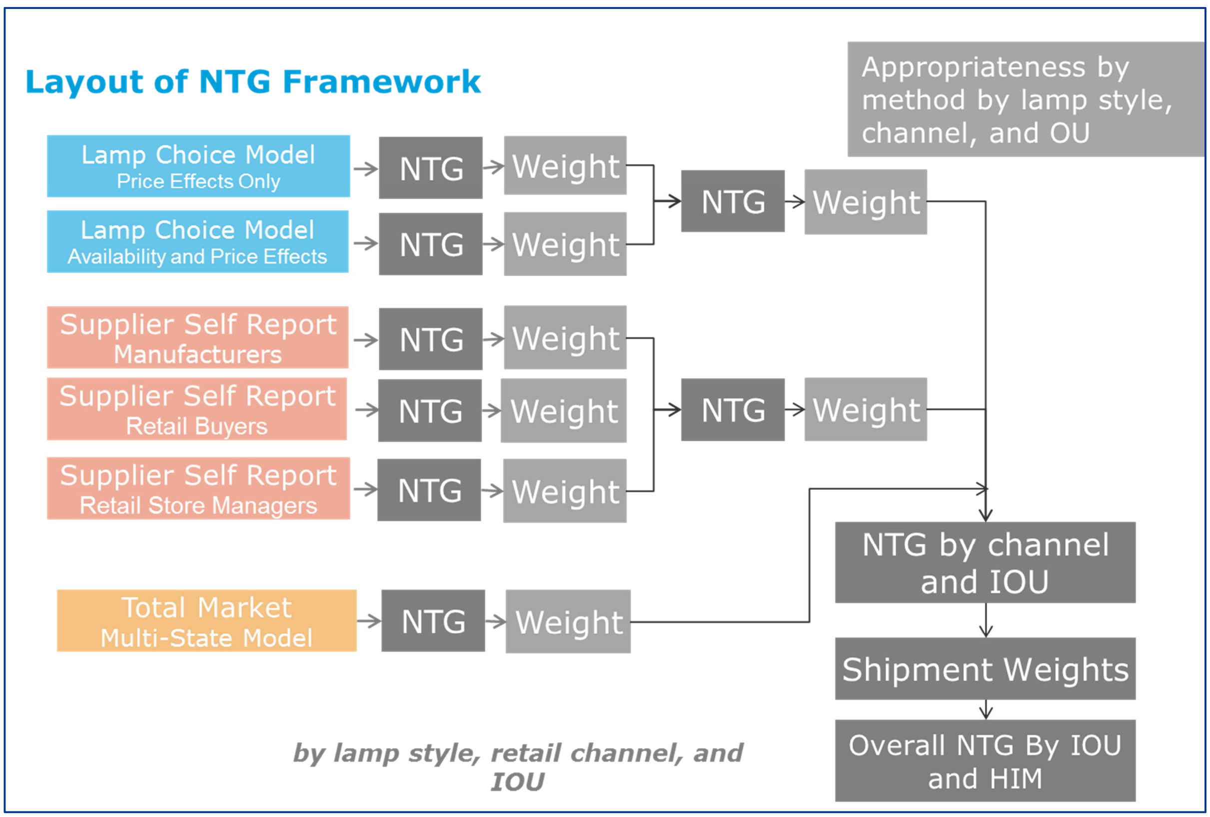
- Changes in consumer demand
- Supply chain changes
- Total market changes

We executed these three approaches and combined their results in a systematic way to generate a final NTG estimate. We applied this estimate to the final program tracking data to yield net program impacts.

5.1 Overview of Net-To-Gross Estimate Framework

Figure 2 lays out the framework of how the different methods were weighted and combined to produce the final NTG ratios that were applied for this report. DNV GL assigned a weight to the sub-methods within a method group (grouped by color) for each HIM, channel and IOU combination. The weighted result produced a single NTG ratio for each method groups within each HIM, channel and IOU combination. Next a weight was assigned to each method group to produce a single NTG ratio for each channel, by IOU and HIM. Finally, the channel NTG ratios were weighted by the number of rebated shipments to each channel and combined into the NTG ratios by IOU and HIM that are shown below in Figure 2. The rationale that was used for the weighting at each stage is explained throughout section5 .

Figure 2: Net-To-Gross Framework



As shown, there were three primary sources of input to the final NTG estimates:

- **Lamp Choice Model (LCM)** – provided estimates of changes in consumer demand (for example, market share) attributable to the program
- **Supplier Self-Report** – provided estimates of changes in product availability and supply as a result of the program

- **Multi-State Model** – provided a statewide estimate of product purchase rates (in California versus other states) as an indicator of program influence

The sections below describe the NTG estimates derived from each of these three sources of input. The final section describes the results from the final step of combining and weighting to arrive at the recommended NTG estimates for each IOU and HIM. Section 6, Appendix C, Appendix E, and Appendix F, provide additional detail on various methods and analyses.

5.2 Lamp Choice Model NTG Results

The LCM is essentially a discrete choice model that was used to calculate a NTG estimate from the consumer perspective. The LCM is a discrete choice logit model that predicts the probability that a consumer would choose, for example, a traditional incandescent A-lamp, a halogen A-lamp that complies with the efficacy standards in the Energy Independence and Security Act of 2007 (EISA), a spiral-shaped CFL, a covered A-lamp CFL, or an A-lamp LED.

As discussed in more detail in Section6.3.1, DNV GL estimated the model using customer characteristic and preference data gathered during two waves of in-store customer intercept surveys. Concurrently with the intercept surveys, DNV GL staff also collected information on the lamps stocked by the retail stores in which we conducted intercept surveys

DNV GL ran the model against three scenarios:

- **Observed Conditions (Program).** This scenario reflects the lamp prices and availability that DNV GL observed in retail stores in 2012 and 2013. This scenario results in an estimate of observed market shares.
- Price Effects Only (No Program Scenario 1). This scenario reflects the lamp prices that consumers would have seen without IOU discounts. DNV GL estimated price differences based on clearly labeled IOU discounts in the stores or by matching lamps to program tracking data. This scenario results in a counter-factual estimate of market shares that would have occurred if only prices on CFLs changed due no program activity.
- Availability and Price Effects (No Program Scenario 2). In addition to price effects, this scenario reflects stocking changes that would have occurred in the absence of the ULP. When a manufacturer stated that they would not have shipped any CFLs to the California market without the program incentives, DNV GL flagged that manufacturer's lighting products as "program-reliant." This scenario results in a counter-factual estimate of market shares if program-reliant lamps were not in stores and if CFL prices were not discounted by the IOUs.

The LCM estimates “program” and “no Program” market shares that feed directly into the NTG rate calculation:

$$NTG = \frac{Program - No\ Program}{Program}$$

The NTG is the percentage change in market share due to the influence of program activity—that is, the difference between the observed and counter-factual market shares divided by the program market share. For each combination of IOU, channel and product type, we evaluated the differences between the “Price Effects Only” and the “Availability and Price Effects” counter-factual scenarios.

To illustrate, we present an example of the market share and resulting NTG calculations for spiral-style CFL in two channels in SCE’s service territory – home improvement and discount. As shown in Table 44, in the home improvement channel, the difference between the “Price Effects Only” and the “Availability and Price Effects” scenarios was slight. However, in the discount channel, where “program-reliant” products make up a much larger portion of the spiral CFL available to consumers for purchase, the differences between the two scenarios was much more significant.

Table 44: Illustration of LCM NTG Results by Counter-Factual “Scenario” for SCE Home Improvement and Discount Channels (Spiral-Style CFLs)

SCE Home Improvement Channel, Spiral CFLs:	Market Share – Observed	Market Share – Counter-Factual	NTG
Price Effects Only	70%	39%	0.44
Availability & Price Effects	70%	36%	0.49
SCE Discount Channel, Spiral CFL:			
Price Effects Only	30%	14%	0.53
Availability & Price Effects	30%	3%	0.90

In reviewing the differences across all IOUs, we found that in channels where we expected the “program reliance” effect to be less significant (e.g., Home Improvement) the results between the two scenarios were very similar. This was also the case when reviewing the results for CFL A-lamps. As a result, the “Availability and Price Effects” scenario results were assigned a weight of 1.00 and the “Price Effects Only” scenario results were assigned a weight of 0.00.

Once we made the decision to weight the “Availability and Price Effects” scenario results for both spiral CFLs and CFL A-lamps at 1.00, we then assessed the reasonableness of LCM NTG results by channel and IOU. Criteria for assessing reasonableness of results included:

- Do the underlying data support IOU-specific results?
    - If so, recommend IOU-specific result
    - If not, recommend statewide result
- Did the model adequately address energy efficient technology substitution between CFL Twisters versus CFL A-lamps?
    - If so, recommend technology-specific result
    - If not, recommend combined technology (both Spiral and A-lamp) result

In the cases where we used statewide results over IOU-specific results, the rationale usually tied back to small sample sizes. For example, as shown in Table 45, we observed extremely small sample sizes for spiral CFLs in the independent grocery channel for all three IOUs. In this example, we recommended the statewide NTG result (0.46) for all three IOUs, which incidentally was very similar to the IOU-specific result for SCE (0.42).

Table 45: LCM NTG Results for Independent Grocery Channel Spiral CFLs - *Availability and Price Effects*

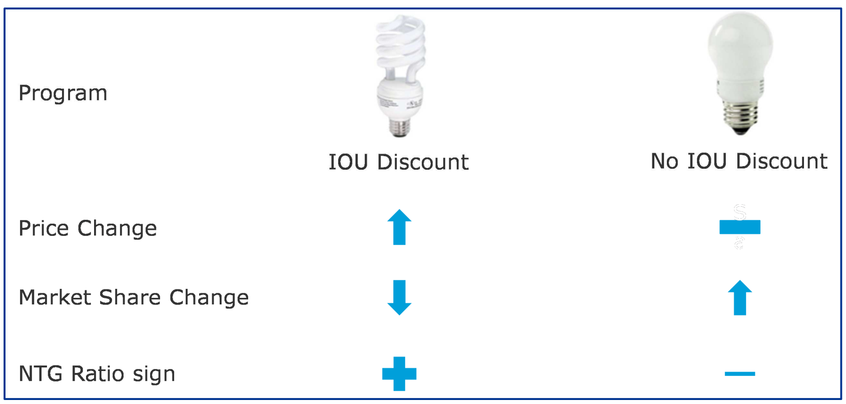
Independent Grocery, Spiral CFLs	Number of Observations	Market Share – Observed	Market Share – Counter Factual *(Availability and Price Effects)*	Calculated NTG	Recommended NTG
All IOUs	31	84%	45%	0.46	**0.46**
PG&E	1	99%	0%	1.00	**0.46**
SCE	26	84%	49%	0.42	**0.46**
SDG&E	4	79%	35%	0.56	**0.46**
Target values in the green cells were used in the NTG framework					

The LCM can produce seemingly paradoxical results in certain circumstances where the calculation implies a negative NTG ratio for a technology. This is due a substitution effect. Figure 3 illustrates a store that stocks discounted basic Spiral CFLs as part of the upstream program. The store does not offer discounted CFL A-Lamps as part of the program.

Under the no program scenario, the price of the basic spiral CFLs rises, while the price of the CFL A-Lamps remains the same. This leads to a decrease in market share for basic spirals and a positive NTG ratio. However, the market share for CFL A-Lamps increases under the no program scenario as buyers of basic spiral CFLs substitute to all other technologies. In other words, offering discounts to basic spiral CFLs takes market share from all other competing technologies. As a result, the NTG ratio for CFL A-lamps is negative.

The issue of negative NTG ratios from the lamp choice is tied to how IOUs ran their program and what retail stores stocked. In channels where IOUs discounted both basic spiral CFLs and CFL A-Lamps, the LCM provides technology-specific NTG ratios. Where that is not the case, we recommend using the overall CFL NTG ratio.

Figure 3: Example of Substitution Effect



Take the example of the home improvement channel. As shown in Table 46, the technology-specific results for SCE were reasonable in that we would have expected a higher NTG ratio for CFL A-lamps versus spiral CFLs, which is what was calculated (0.48 versus 0.96). However, the home improvement channel results for PG&E and SDG&E did not reflect what we would expect (for example, negative NTG in the case of PG&E, and CFL A-lamp NTG lower than spiral CFL NTG in the case of SDG&E). This suggested that the technology-specific results in this channel for these two IOUs were not adequately capturing the substitution effect. As such, as shown in Table 46, we recommended using the statewide, combined technology result of 0.39 for both PG&E and SDG&E.

Table 46: LCM NTG Results for Home Improvement Channel Spiral CFLs and CFL - Lamps – *Availability and Price Effects*

Home Improvement Channel	Calculated Spiral CFL NTG	Calculated CFL A-Lamp NTG	Calculated Combined Technology NTG	Recommended CFL Twister NTG	Recommended CFL A-Lamp NTG
All IOUs	0.39	0.33	0.39	0.39	0.33
PG&E	0.32	-1.54	0.30	0.39	0.39
SCE	0.48	0.96	0.43	0.48	0.96
SDG&E	0.41	0.29	0.39	0.39	0.39
Target values in the green cells were used in the NTG framework					

Another exception involves the LCM results for the membership club channel. In this channel, we did not observe any inefficient technology options available to consumers – only spiral CFLs and LED lamps – and, as a result, the LCM results were not applicable. See Section 5-37 for a discussion of how the Supplier Self-Report results were used for the membership club channel.

Table 47 and Table 48 reflect the final recommended LCM NTG results for spiral CFLs and CFL A-lamps, respectively, taking into account the "Availability and Price Effects" scenario weight of 1.00, and the exceptions taken for IOU-specific results and technology-specific results. In all cases, exceptions were taken because of small sample sizes and/or the LCM's inability to adequately address between spiral CFL and CFL A-lamps.

Table 47: LCM NTG Results for Basic Spiral CFLs by Channel and IOU

Channel	IOU	LCM NTG Results				
		Price Effects Only Scenario		Availability and Price Effects Scenario		NTG Used in Framework
		Recommended modeled NTG	Weight	Recommended modeled NTG	Weight	
Discount	PG&E	0.31	0.00	0.84	1.00	**0.84**
	SCE	0.52	0.00	0.91	1.00	**0.91**
	SDG&E	0.52	0.00	0.86	1.00	**0.86**
Drug Store	PG&E	0.40	0.00	0.57	1.00	**0.57**
	SCE	0.52	0.00	0.54	1.00	**0.54**
	SDG&E	0.66	0.00	0.62	1.00	**0.62**

Channel	IOU	LCM NTG Results				
		Price Effects Only Scenario		Availability and Price Effects Scenario		NTG Used in Framework
		Recommended modeled NTG	Weight	Recommended modeled NTG	Weight	
Grocery – Chain	PG&E	0.44	0.00	0.65	1.00	**0.65**
	SCE	0.44	0.00	0.65	1.00	**0.65**
	SDG&E	0.44	0.00	0.65	1.00	**0.65**
Grocery – Independent	PG&E	0.04	0.00	0.46	1.00	**0.46**
	SCE	0.04	0.00	0.46	1.00	**0.46**
	SDG&E	0.04	0.00	0.46	1.00	**0.46**
Hardware	PG&E	0.36	0.00	0.36	1.00	**0.36**
	SCE	0.46	0.00	0.75	1.00	**0.75**
	SDG&E	0.56	0.00	0.53	1.00	**0.53**
Home Improvement	PG&E	0.36	0.00	0.39	1.00	**0.39**
	SCE	0.43	0.00	0.48	1.00	**0.48**
	SDG&E	0.36	0.00	0.39	1.00	**0.39**
Mass Merchandise	PG&E	0.31	0.00	0.36	1.00	**0.36**
	SCE	0.52	0.00	0.48	1.00	**0.48**
	SDG&E	0.25	0.00	0.32	1.00	**0.32**
Membership Club	PG&E	n/a				
	SCE					
	SDG&E					

Table 48: LCM NTG Results for CFL A-Lamps by Channel and IOU

Channel	Utility	LCM NTG Results				
		Price Effects Only Scenario		Availability and Price Effects Scenario		NTG Used in Framework
		Recommended modeled NTG	Weight	Recommended modeled NTG	Weight	
Discount	PG&E	0.78	0.00	0.87	1.00	**0.87**
	SCE	0.89	0.00	1.00	1.00	**1.00**
	SDG&E	0.83	0.00	0.93	1.00	**0.93**
Drug Store	PG&E	0.51	0.00	0.53	1.00	**0.53**
	SCE	0.51	0.00	0.53	1.00	**0.53**
	SDG&E	0.51	0.00	0.53	1.00	**0.53**

Channel	Utility	LCM NTG Results				
		Price Effects Only Scenario		Availability and Price Effects Scenario		NTG Used in Framework
		Recommended modeled NTG	Weight	Recommended modeled NTG	Weight	
Grocery - Chain	PG&E	0.53	0.00	1.00	1.00	**1.00**
	SCE	0.53	0.00	1.00	1.00	**1.00**
	SDG&E	0.53	0.00	1.00	1.00	**1.00**
Grocery - Independent	PG&E	0.19	0.00	0.44	1.00	**0.44**
	SCE	0.19	0.00	0.44	1.00	**0.44**
	SDG&E	0.19	0.00	0.44	1.00	**0.44**
Hardware	PG&E	0.49	0.00	0.48	1.00	**0.48**
	SCE	0.38	0.00	0.48	1.00	**0.48**
	SDG&E	0.47	0.00	0.48	1.00	**0.48**
Home Improvement	PG&E	0.36	0.00	0.39	1.00	**0.39**
	SCE	0.96	0.00	0.96	1.00	**0.96**
	SDG&E	0.36	0.00	0.39	1.00	**0.39**
Mass Merchandise	PG&E	0.55	0.00	0.60	1.00	**0.60**
	SCE	0.57	0.00	0.53	1.00	**0.53**
	SDG&E	0.55	0.00	0.62	1.00	**0.62**
Membership Club	PG&E	n/a				
	SCE					
	SDG&E					

For CFL reflectors and CFL globes, we recommended the “Price Effects Only” scenario results (weight equal to 1.00) because generally, the LCM did not perform as well due to small sample sizes. For CFL reflectors and CFL globes, the “program reliance” effect is best captured in the supplier self-report NTG results.

In addition, for CFL reflectors and CFL globes, the LCM results were generally not as robust at the IOU and channel level as the LCM results for Spiral and A-lamp CLFs. As a result, we recommend the statewide, aggregated NTG results of 0.09 for CFL reflectors and 0.17 for CFL globes across all channels and IOUs. Table 49 and Table 50 shows these results.

Table 49: LCM NTG Results for CFL Reflectors

Channel	Utility	LCM				
		Price Effects Only Scenario		Availability and Price Effects Scenario		NTG Used in Framework
		Recommended modeled NTG	Weight	Recommended modeled NTG	Weight	
All Channels	All IOUs	0.09	1.00	0.33	0.00	0.09

Table 50: LCM NTG Results for CFL Globes

Channel	Utility	LCM				
		Price Effects Only Scenario		Availability and Price Effects Scenario		NTG Used in Framework
		Recommended modeled NTG	Weight	Recommended modeled NTG	Weight	
All Channels	All IOUs	0.17	1.00	0.93	0.00	0.17

5.3 Supplier Self-Report NTG Results

As a point of comparison to the demand side perspective, DNV GL also explored how the IOU ULPs affected the California retail lighting market from the manufacturer and retailer perspectives. We asked NTG questions of market actors at three different levels of the supply chain: lighting manufacturers, lighting buyers for large retail chains, and individual store managers. We based the self-reported NTG ratios from each level on questions that asked the respondents to estimate how CFL sales would have differed absent the IOU ULPs. There were two waves of data collection for each of these efforts (one during the third and fourth quarters of 2012 and a second wave during the third and fourth quarters of 2013).

5.3.1 Manufacturer In-Depth Interviews

DNV GL interviewed manufacturers responsible for over 97 percent of IOU-discounted CFL shipments during the 2010-2012 program cycle. We interviewed 21 manufacturers regarding basic (spiral shaped) CFL shipments and 23 manufacturers about specialty (A-lamp, reflector, and globe) CFL shipments. These manufacturers represented 97.3 percent of total program-discounted basic spiral CFL shipments and 99.7 percent of program-discounted specialty CFL shipments, respectively.

The top-down perspective of manufacturers provides a look at how the supply of CFLs being shipped to California retail stores would have changed absent the program. For each major energy-efficient lamp type (Basic CFL, specialty CFL, LED), DNV GL asked manufacturers to first indicate whether they would have sold any lamps through their major retail channels absent the IOU ULP buy-down discounts and promotional assistance. If manufacturers said that they would not have sold any of that lamp type through that channel without the program, DNV GL marked these shipments as having a NTG ratio of one. If manufacturers said they would have sold some of that lamp type through that channel without the program, then we asked them to provide the percentage by which their sales of that lamp type would have changed (decreased) in absence of the program. This percentage then became the NTG ratio for that lamp type and that channel. We then weighted results according to the number of shipments distributed by channel to produce a NTG ratio for each retail channel by lamp type.

5.3.2 Retail Buyer In-Depth Interviews

DNV GL used a similar NTG question battery during the interviews with lighting buyers for major retail chains. However, retail buyers were only estimating the program's impact on their own company's retail lighting sales. (whereas manufacturers were providing estimates for all of the retail channels they supply).

In total, DNV GL completed seven interviews with retail buyers. However, only four provided enough information to use in the estimation of NTG ratios. One of these four buyers actually distributed CFLs through community events and, as a result, their responses could not be associated with any retail channel in the NTG analysis. With the help of IOU contacts, we were able to reach several retail buyers who represented large distributions of rebated lamps. However, in all of these cases, we were talking with national buyers who could only talk about broader national lighting channel trends and were unwilling to provide California-specific information. In the end, the retail buyer NTG estimates came from California based chains. This was accounted for in the weights applied to retail buyer supplied NTG estimates.

5.3.3 Retail Store Manager Telephone Survey

Using a computer-aided telephone interview (CATI) approach, DNV GL asked managers at retail stores selling lighting products whether they would have sold any of the major energy-efficient lamp types (basic spiral CFL, specialty CFL, LED) without the program. We asked retail store managers to first indicate whether they would have sold any lamps of that type at their store without the program. If they said that they would have sold some lamps without the program, we then asked to indicate the percentage by which their sales of that lamp type would have changed (decreased) in absence of the program. This percentage then became the NTG ratio for that lamp type and that retail store. We then weighted the results according to the number of shipments sent to each store to produce a NTG ratio for each retail channel by lamp type.

5.3.4 Supplier Self-Report NTG Results for Basic Spiral CFLs

Table 51 shows the NTG results for each of the three market actor sources. As shown, NTG results were only available at the channel level; we did not ask suppliers to provide responses by IOU.

Overall, for Basic Spiral CFLs, we assigned results from manufacturers a weight of zero percent as we already accounted for their input in the results from the "Availability and Price Effects" scenario of the LCM. The one exception was in the membership club channel, where the LCM results were not applicable because any inefficient technology options were not available for sale (for example, only spiral CFLs and LED lamps) when we conducted the data collection. As a result, in the membership club channel, we included the manufacturer self-report results and assigned them a weight of 60 percent. We assigned a weight of 40 percent to the retail store manager self-report results.

In the chain grocery and home improvement channels, we assigned equal weight to the retail buyer self-report results and the retail store manager self-report results (50 percent each). The one exception to this was the discount channel, where we assigned the retail buyer self-report results a weight of 66 percent (and retail store manager self-report results a 34 percent weight) because the one retail buyer we interviewed accounted for four times as many shipments as all of the retail store managers together.

In channels where we did not have any results from retail buyers (for example, drug, independent grocery, hardware and mass merchandise), we assigned the retail store manager self-report results a weight of 100 percent.

Table 51: Supplier Self-Report NTG Results for Spiral CFLs

Channel	Retail Store Managers		Retail Buyers		Manufacturers		Recommended Supply side NTG
	NTG Result	Weight	NTG Result	Weight	NTG Result	Weight	
Discount	0.74	0.34	1.00	0.66	0.83	0.00	0.91
Drug Store	0.52	1.00	n/a		0.72	0.00	0.52
Grocery - Chain	0.80	0.50	1.00	0.50	0.95	0.00	0.90
Grocery - Independent	0.71	1.00	n/a		0.88	0.00	0.71
Hardware	0.52	1.00	n/a		0.73	0.00	0.52
Home Improvement	0.60	0.50	0.90	0.50	0.51	0.00	0.75
Mass Merchandise	0.25	1.00	n/a		0.69	0.00	0.25
Membership Club	0.44	0.40	n/a		0.50	0.60	0.48

5.3.5 Supplier Self-Report NTG Results for CFL A-lamps, CFL Reflectors and CFL Globes

Table 52 shows the NTG results for each of the three market actor sources. As shown, NTG results were only available at the channel level; we did not ask suppliers to provide responses by IOU.

In general, we assigned a weight of 20 percent to retail store manager self-report results, a weight of 10 percent to retail buyer self-report results, and a weight of 70 percent to manufacturer results. There were some exceptions, however: for example, in channels where we did not obtain results from retail buyers (for example, drug, independent grocery, hardware, mass merchandise and membership club), we assigned retail store manager self-report results a weight of 30 percent. In addition, in the discount channel, we assigned the retail store manager self-report results a weight of zero percent, as these results were not well aligned with the other two sources.

As mentioned above, we asked suppliers to provide results representing all specialty CFLs (for example, A-lamps, reflectors and globes). As such, we applied the same weights across all three specialty HIMs.

Table 52: Supplier Self-Report NTG Results for CFL A-Lamps, CFL Reflectors and CFL Globes

Channel	Retail Store Managers		Retail Buyers		Manufacturers		Recommended NTG
	NTG Result	Weight	NTG Result	Weight	NTG Result	Weight	
Discount	0.55	0.00	1.00	0.30	0.83	0.70	0.88
Drug Store	0.80	0.30	n/a		0.65	0.70	0.70
Grocery - Chain	0.62	0.20	1.00	0.10	0.95	0.70	0.89
Grocery - Independent	0.75	0.20	n/a		0.88	0.80	0.85
Hardware	0.56	0.30	n/a		0.57	0.70	0.57
Home Improvement	0.53	0.20	1.00	0.10	0.70	0.70	0.70
Mass Merchandise	0.43	0.30	n/a		0.20	0.70	0.27
Membership Club	0.64	0.30	n/a		0.71	0.70	0.69

5.4 Multi-State Model

This discussion refers to the effort of applying California data to a Multi-State Model (MSM) effort implemented by NMR Group Inc. in 2009, 2010 and 2012.

NMR implemented the 2009 MSM effort in California and comparison states to generate a set of NTG results for California's 2006-2008 Upstream Lighting Program Impact Evaluation Report.[9]

NMR completed the 2010 MSM effort in June 2010. This effort did not include information from California. It did, however, include information collected in representative portions of several comparison states – Illinois, Missouri, Michigan, Ohio, Maryland, Massachusetts, New York, Rhode Island, Arizona, Texas, Kansas, Kansas and South Dakota. In 2012, new data was collected in California through 70 onsite visits and telephone surveys. This 2012 California data was applied to the previous MSM parameters. A full methodology of the MSM can be found in Appendix F of this report.

The results from the MSM were assigned a weight of zero in the NTG framework. The decision to not give any weight in the NTG framework was reached after considering the strengths and weaknesses of the MSM when applying it to the California market. The weakness in the MSM included multiple factors; the time lapse between the original data collection and modeling effort to the current evaluations, the model only producing statewide results, as well as the differences between the more mature California market and the comparison markets used in the model estimation. Ultimately, it was decided that these weaknesses outweighed the strengths of a market wide approach for this evaluation, and the MSM was not factored into the final NTG framework.

5.5 Rationale for NTG Methods Weights

The preceding sections described how we determined the recommended NTG results for each of the three methods – for example, LCM, supplier self-report and MSM. This section discusses the rationale for determining the weights we applied to each method to estimate the final NTG results for each IOU, channel and HIM.

For spiral CFLs and CFL A-lamps, we generally favored the LCM results over the supplier self-report results, as shown in Table 53. That is, we assigned a weight of 90 percent to the LCM results and 10 percent to the supplier self-report results. There were several exceptions, however. For example, in the chain grocery channel, the supplier self-report results were more robust than the LCM results due to the very small sample sizes for each IOU in the LCM results.

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[9] KEMA, Inc. and Cadmus Group. *Final Evaluation Report: Upstream Lighting Program, Volume 1*. CALMAC Study ID CPU0015.01: Prepared for the California Public Utilities Commission, 2010

In this case, we assigned a weight of 50 percent to the LCM results and 50 percent to the supplier self-report results. Another exception was the independent grocery channel, where the LCM results were more robust than the Chain grocery, but not as strong as other channels; we assigned a weight of 70 percent to the LCM results (and 30 percent to the supplier self-report results). Moreover, as discussed above in section 5.3.4 and section 5.3.5, in the membership club channel, we assigned a weight of 100 percent to the Supplier self-report results because the LCM results were not applicable. Finally, we always assigned a weight of zero percent to the MSM results as discussed above in Section 5.4.

Table 53: Methods Weights for LCM and Supplier Self-Report NTG Results – Spiral CFLs and CFL A-lamps

Channel	Spiral CFLs		CFL A-Lamps	
	LCM	Supplier Self-Report	LCM	Supplier Self-Report
Discount	0.90	0.10	0.90	0.10
Drug Store	0.90	0.10	0.90	0.10
Grocery – Chain	0.50	0.50	0.50	0.50
Grocery – Independent	0.70	0.30	0.70	0.30
Hardware	0.90	0.10	0.90	0.10
Home Improvement	0.90	0.10	0.90	0.10
Mass Merchandise	0.90	0.10	0.90	0.10
Membership Club	0.00	1.00	0.00	1.00

For CFL reflectors and CFL globes, we generally favored the supplier self-report results over the LCM results (as shown in Table 54). While we accept that the supplier self-report results may be somewhat biased, the LCM results were based on extremely small sample sizes in comparison to the LCM results for spiral CFLs and CFL A-lamps. For CFL reflectors, we assigned a weight of 70 percent to the supplier self-report results and 30 percent to the LCM results. For CFL globes, we assigned a weight of 90 percent to the supplier self-report results and 10 percent to the LCM results. The one exception was in the discount channel, where we assigned a weight of 0 percent to the LCM results for both CFL reflectors and CFL globes. This was because of the price cap on CFLs sold in the discount channel (for example, at prices higher than $1, CFL reflectors and CFL globes would not be available for sale within the discount channel).

Table 54: Methods Weights for LCM and Supplier Self-Report NTG Results – CFL Reflectors and CFL Globes

Channel	CFL Reflectors		CFL Globes	
	LCM	Supplier Self-Report	LCM	Supplier Self-Report
Discount	0.00	1.00	0.00	1.00
Drug Store	0.30	0.70	0.10	0.90
Grocery - Chain	0.30	0.70	0.10	0.90
Grocery - Independent	0.30	0.70	0.10	0.90
Hardware	0.30	0.70	0.10	0.90
Home Improvement	0.30	0.70	0.10	0.90
Mass Merchandise	0.30	0.70	0.10	0.90
Membership Club	0.30	0.70	0.10	0.90

5.6 Final Net-To-Gross Ratios

Table 55 shows the final ex-post NTG ratios that we applied by IOU and by HIM to determine the final net savings, alongside the Ex-ante NTG ratios used in the work papers. Basic Spiral CFLs had an ex-ante NTG of 60 percent, and the other three "specialty" HIMs all used an 85 percent NTG in the ex-ante work paper assumptions. The ex-post NTG results for Basic Spiral CFLs ranged from 57 percent for SDG&E, 60 percent for PGE, and 66 percent for SCE. For the three "specialty" HIMs the ex-post results ranged from a low of 55 percent for PGE Reflectors, and up to 82 percent for SCE A-lamps.

Table 55: Final NTG Results

HIM	PG&E		SCE		SDG&E	
	Ex-Ante	Ex-Post	Ex-Ante	Ex-Post	Ex-Ante	Ex-Post
Basic Spiral CFL	60%	60%	60%	66%	60%	57%
A-Lamp CFL	85%	72%	85%	82%	85%	81%
Reflector CFL	85%	55%	85%	62%	85%	53%
Globe CFL	n/a	n/a	85%	75%	85%	71%

5.7 Final Net Savings results

Table 56 to Table 59 show a comparison between the ex-ante and the ex-post net savings for the four HIMS in this evaluation.

Table 56: Basic Spiral CFL Net Savings

Measure Group: Lighting Indoor CFL Basic	Ex Ante Annual Net Energy Savings (kWh)	Ex Ante Net Peak Demand Reductions (kW)	Ex Post Annual Net Energy Savings (kWh)	Ex Post Net Peak Demand Reductions (kW)	Ex Post Percentage of Ex Ante (kWh)	Ex Post Percentage of Ex Ante (kW)
PG&E	329,830,976	48,637	318,261,906	40,781	96%	84%
SCE	562,160,753	89,127	604,454,171	78,686	108%	88%
SDG&E	127,299,467	18,339	104,667,544	12,397	82%	68%
Overall	**1,019,291,196**	**156,103**	**1,027,383,622**	**131,863**	**101%**	**84%**

Table 57: A-Lamp CFL Net Savings

Measure Group: Lighting Indoor CFL A-Lamp	Ex Ante Annual Net Energy Savings (kWh)	Ex Ante Net Peak Demand Reductions (kW)	Ex Post Annual Net Energy Savings (kWh)	Ex Post Net Peak Demand Reductions (kW)	Ex Post Percentage of Ex Ante (kWh)	Ex Post Percentage of Ex Ante (kW)
PG&E	73,087,550	10,659	87,579,251	9,768	120%	92%
SCE	207,354,003	32,953	205,025,180	23,108	99%	70%
SDG&E	10,954,868	1,576	10,952,987	1,281	100%	81%
Overall	**291,396,421**	**45,188**	**303,557,418**	**34,157**	**104%**	**76%**

Table 58: Reflector CFL Net Savings

Measure Group: Lighting Indoor CFL Reflector	Ex Ante Annual Net Energy Savings (kWh)	Ex Ante Net Peak Demand Reductions (kW)	Ex Post Annual Net Energy Savings (kWh)	Ex Post Net Peak Demand Reductions (kW)	Ex Post Percentage of Ex Ante (kWh)	Ex Post Percentage of Ex Ante (kW)
PG&E	87,449,353	13,012	67,184,451	7,808	77%	60%
SCE	247,974,523	39,421	180,116,984	21,024	73%	53%
SDG&E	17,694,584	2,689	9,956,268	1,165	56%	43%
Overall	**353,118,460**	**55,122**	**257,257,703**	**29,996**	**73%**	**54%**

Table 59: Globe CFL Net Savings

Measure Group: Lighting Indoor CFL Globe	Ex Ante Annual Net Energy Savings (kWh)	Ex Ante Net Peak Demand Reductions (kW)	Ex Post Annual Net Energy Savings (kWh)	Ex Post Net Peak Demand Reductions (kW)	Ex Post Percentage of Ex Ante (kWh)	Ex Post Percentage of Ex Ante (kW)
PG&E	n/a	n/a	n/a	n/a	n/a	n/a
SCE	37,231,821	6,007	24,032,802	3,317	65%	55%
SDG&E	1,867,245	245	1,575,859	220	84%	90%
Overall	**39,099,066**	**6,253**	**25,608,661**	**3,538**	**65%**	**57%**

6. Methodology

As described earlier in the previous sections, this report provides current impact evaluation information regarding lamp quantity adjustments and gross impacts and net adjustments. This section provides an overview of the methods associated with each of these topics.

6.1 Quantity Adjustments

As mentioned, evaluators applied adjustments to the IOU's reported lamp quantities for the impact evaluation based on three factors: invoice verification, residential/nonresidential split, and leakage. This report provides an overview of the methods associated with the invoice verification task, the split between residential and nonresidential sales of IOU-discounted lamps and leakage of IOU-discounted lamps to non-IOU areas.

6.1.1 Invoice Verification

The objective of this task was to verify the quantity of IOU-discounted products shipped by participating manufacturers to retailers. Researchers determined quantities by verifying a sample of program invoices/applications against information contained in program tracking databases. These tracking databases include the CPUC's approved ex ante savings claims for all IOU programs, which were provided and uploaded by each of the four IOUs to a centralized server. Evaluators cleaned, re-categorized, reformatted, and merged these separate data sets into one program-tracking database and analyzed them as part of the invoice verification task.

Evaluators analyzed product shipment trends by IOU to select an appropriate sample of invoices/applications. DNV GL analyzed the total and the average shipments by distribution channel (for example, discount, drug store, and so on) and by store type (for example, chain versus independent). DNV GL allocated to each IOU 50 sample points, which was split across distribution channel, based on the proportion of shipments by channel, and store type. Then, evaluators adjusted these allocations to ensure there were at least two invoices/applications per channel and store type, as shown in Table 60. All invoices were received as requested, so the final verified sample matches the planned sample.

Table 60: Invoice/Application Verification Sample Design and Final Sample Size

Channel	Chain versus Independent	PG&E	SCE	SDG&E	Total
Discount	Independent	4	4	2	10
Drug		2	0		2
Grocery		12	7	8	27
Hardware		3	2	3	8
Home Improvement			0		0
LTG & Electronics		2	2	3	7
Mass Merchandise			0		0
Other		2	0	3	5
Discount	Chain	3	4	10	17
Drug		3	4	0	7
Grocery		3	7	3	13
Hardware		3	3	3	9
Home Improvement		5	5	2	12
LTG & Electronics		2	2	4	8
Mass Merchandise		2	5	6	13
Membership		3	5	3	11
	Total	**49**	**50**	**50**	**149**
Target value in blue cells was increased by 1 due to large kWh savings in this strata					
Target value in Red cells has no significant energy savings for this strata					
Grey cells have no shipments for this utility/channel/chain combination					
Yellow cell indicates that the verified applications failed to meet the sample target					

For each invoice/application, DNV GL compared program-tracking data to the information contained in either paper or electronic form. In addition to the number of IOU-discounted products shipped, DNV GL 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

DNV GL also documented the information sources used to verify each metric. Documentation quality for this analysis was very good, so the quantity metric (units verified compared to units shipped or sold) drove the verification results.

DNV GL recorded discrepancies found between program tracking data and information supplied on the documentation. DNV GL also recorded whether sales data were provided and whether shipments were sent to a regional distribution center, whose locations were gathered.

Evaluators calculated a verification score for the following metrics: product type, quantity rebated, and retailer name/location. When both the product type and retailer name/location were verified as complete/accurate, an invoice/application received an initial score of 1.0; otherwise, it received a score of 0.0. This initial score was multiplied by the percentage of verified claimed units (quantity adjustment) to produce an aggregate verification score for the invoice/applications. With a few applications, the quantity of claimed units matched an application's total units, even when the number of claimed units for specific retailer locations was incorrect. For example, an application could show 10 units shipped/sold at 10 retail locations (for example, 10 units per location to equal 100 units for the application). In the tracking data, all 100 units could be claimed by the first retail location with no claims being made for the other nine retail locations —a data entry shortcut that shifts units from 10 locations to one. DNV GL ignored this type of error and qualified an application as 100 percent verified in our analysis when all retail locations were qualified and when the total application claim matched the total shipments/sold units for an application.

6.1.2 Leakage

Leakage is defined as the percentage of IOU rebated upstream CFLs that are purchased and then taken and installed outside of California. To address leakage, questions were included in the customer intercept surveys described in Appendix C.1. Consumers purchasing replacement lamps were first asked if they were purchasing CFLs for a residential application, and then what zip code that residence was located within. Zip codes that fell outside of California were flagged as a leaked purchase. During two waves of customers intercepts, 810 replacement lamp purchasers were intercepted in stores all over California. As shown in Table 61, only one customer responded that they planned to install the replacement lamp they were purchasing outside of California.

Table 61: Customer Intercept Leakage Responses

Total Leakage				
	PG&E	SCE	SDG&E	Overall
Replacement Lamp Purchasers	350	289	171	810
Residential Purchasers	343	273	170	786
Plan to Install outside of California	0	0	1	1
Leakage (%)	**0.0%**	**0.0%**	**0.6%**	**0.1%**

Due to the lack of respondents who were planning to install lamps outside of California, this evaluation report is not applying an adjustment to quantity for leakage. However, this does not mean that the evaluators do not believe that leakage exists, simply that we do not have enough data to apply an adjustment to savings for this report. There is anecdotal evidence of IOU discounted lamps being found outside of California. DNV GL field staff found two packages of SCE discounted CFLs in Arizona while doing comparison area shelf surveys for WO013, but were unable to identify under which program year the CFLs was discounted. While the evaluators acknowledge that leakage exists, more in-depth research focused on the issue would be needed to produce a reasonably sound adjustment.

6.1.3 Residential and Non-Residential Split

The split of upstream CFLS that are bought and installed by residential customers versus non-residential customers was estimated by comparing results from two onsite surveys: CSS and CLASS. The comparison used for the split is between the number CFLs installed in residential applications and the number of CFLs installed in non-residential applications that were purchased from retail channels. This split is used as an approximation for the rate at which upstream CFLs are purchased in the market by residential and non-residential customers. Residential estimates are based on a weighted total of CFLs found installed in the CLASS lighting inventory. The estimate is calculated under the assumption that residential CFLs were purchased through a retail channel. Table 62 shows the results from both estimates and the residential versus non-residential split used in the evaluation.

Table 62: CFLs Purchaced through Retail Channels

	PG&E	SCE	SDG&E	Overall
CFLs Installed in Residential Applications	57,337,000	54,758,000	16,393,000	128,489,000
CFLs Installed in Non-Residential Applications	4,460,000	3,522,000	1,120,000	9,103,000
Non-Residential Percentage	**7%**	**6%**	**6%**	**7%**

The Non-Residential estimates were calculated using data from the CSS survey. As part of the CSS phone survey, individuals were asked, not only if they had purchased CFLs for installation within their business, but by what means that had purchased them (retail store, utility giveaway, etc.) and the quantities that had been bought and installed. When phone survey participants were recruited for an on-site visit, surveyors also collected information on the number of bulbs that were installed and operable, in storage and burned out. A realization rate was applied to these individuals who represented the total CFLs found on site to the total CFLs claimed during the phone survey. Each site was also assigned a weight based on their building type relative to the population. The weighted number of CFL bulbs purchased from retail locations was multiplied by the realization rate to create a population level estimate of CFL purchases through retail channels and these estimates were aggregated to the IOU level.

6.2 Gross Impacts

This section describes the methodology employed to conduct the gross impacts analysis, which had five primary analysis elements:

1. Saturation changes
2. Installation rate
3. Average daily HOU
4. Average percent operating at peak (CF)
5. Wattage displaced by IOU-discounted products (delta watts)
6. UES estimates (kWh/year and peak kW)

Evaluators produced UES estimates by analyzing data collected for the 2006-2008 ULP Metering Study (KEMA, Inc. and Cadmus Group 2010) sample, and the inventory data collected for the 2012 CLASS (DNV KEMA Energy & Sustainability Summer 2013) study:

- **2006-2008 ULP Metering Study.** As part of the 2006-2008 impact evaluation, DNV GL surveyed a random sample of 1,232 households during 2008-2009 to collect complete lighting inventories. In addition, DNV GL collected and analyzed metered data to estimate the average daily HOU and peak CF. This dataset from 2008 and 2009 provides valuable baseline information to assess effects from lighting measures installed in 2010 and 2011. DNV GL compared and leveraged the ULP's data and statistical models with CLASS lighting inventories to produce updated saturations and to estimate UES parameters.
- **CLASS Lighting Inventory.** In 2012, DNV GL began implementing the residential CLASS (WO21) under the direction of the CPUC. The 2012 study is a follow-up to the 2005 and 2000 studies that DNV GL and ASW Engineering (subcontractor) completed. The 2012 statewide study consisted of more than 1,900 onsite residential surveys conducted in the service territories of SCE, PG&E, and SDG&E. Surveys collected

information on residential building configurations and specific construction components and inventoried energy-consuming equipment and lighting installed in homes. Data were collected using iPads, were uploaded to a central database at DNV GL, and were organized and merged with appliance efficiencies, drawn from secondary sources, in the database. The project's final phase will consisted of creating a web-based tool[10] that allows the public to view the appliance and lighting characteristics' analysis as observed in California homes.

DNV GL followed the methodology established for the 2006-2008 ULP Metering Study closely, and the following sections provide methodology updates as used in this study.

6.2.1 Saturation Changes

For the purpose of this report, CFL saturation levels are calculated as household-level averages for each MSB lamp shape. More specifically, DNV GL calculated CFL saturation levels using the following steps:

1. DNV GL restricted the analysis to medium screw-base (MSB) lamps in the lighting inventory.
2. DNV GL categorized all MSB lamps into these measure groups. Note that the basic and A-lamps were combined for this calculation, due to the interchangeability of the two lamp shapes.
   a. Basic and A-Lamp
   b. Reflector
   c. Globes
3. For each household h in the sample:
   a. DNV GL calculated the total number of MSB lamps of each measure group m.
   b. DNV GL calculated the CFL saturation as:

$$CFL\ Satur_{hm} = \frac{\#CFLs_{hm}}{\#CFLs_{hm} + \#Incands_{hm} + \#LEDs_{hm} + \#Other_{hm}}$$

4. Finally, DNV GL calculated the weighted average of CFL Saturation across all households in the sample.

$$CFL\ Satur_{m} = \sum_{h} \frac{CFL\ Sat_{hm}\ w_h}{w_h}$$

[10] CLASS web tool: https://websafe.kemainc.com/projects62/Default.aspx?tabid=190

Note that this calculation of CFL saturation is a weighted average of household-level saturations, which is different from a top-down population level ratio estimator of saturation. The ratio estimator of CFL saturation would be given by (omitting weights):

$$CFL\ Ratio_m = \frac{\sum_h \#CFLs_{hm}}{\sum_h \#CFLs_{hm} + \#Incands_{hm} + \#LEDs_{hm} + \#Other_{hm}}$$

That is, the ratio estimator of CFL saturation is the ratio of the total of all CFLs of a given measure group, divided by the total of all lamps of that measure group, across all households in the sample. The ratio estimation of CFL saturation is not used in this report, instead the household level averages are reported, because the household saturation is applied as a parameter in the HOU and peak CF models.

6.2.2 Installation Rate

For the evaluation of the 2010-2012 ULPs, the installation rate is defined as the proportion of CFLs rebated through the program that are purchased and then eventually get installed. This is a change from how installation rate has been defined for upstream CFLs in previous program cycles; the previous definition would have been the portion of CFLs rebated through the program that were installed by December 31, 2012. The decision to change to the current definition is based on three main points:

- Upstream program theory is aimed at targeting consumer behavior at the time of purchase, rather than at the time of installation.
- The current definition removes the need to carry over savings from one program year or cycle into subsequent programs, and each program year and cycle can be evaluated independently.
- The analysis for the calculating an installation rate under the previous definition relied on assumptions about program market share and burnout/early replacement rates that was not grounded in reliable data.

The 97 percent installation rate is the result of telephone surveys from customers that show that all CFLs purchased are eventually installed, minus 3 percent that remain in permanent storage due to consumer preference or incompatibility with certain applications. The following is an explanation of the analysis used to estimate an installation rate under the previous definition. The results of the trajectory analysis were not used for the final impact evaluation savings estimates.

DNV GL constructed a trajectory from the observed CFL use and storage rates in the pre-2009 period to those observed in 2009 and 2012 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. Table

63 shows a statewide trajectory analysis for Spiral and A-lamp CFLs which results in a cumulative installation rate for the 2010-2012 program cycle of 68 percent. The analysis starts based of observed CFLs installed and in storage from the 2006-2008 ULP Metering inventory, and then follows a year by year trajectory based on the adjustments in Table 64. This trajectory analysis uses a “first in, first out” assumption of storage patterns that assumes CFLs in storage the longest will be installed first. The trajectory analysis results in low first year installation rates, with high second and third year installations, with a 100 percent installation rate by the fourth year.

Table 63: Installation Trajectory Analysis – Statewide Sprial and A-Lamp

Spiral and A-Lamp	2009	2010	2011	2012	2013	2014
Program discounted bulbs	23	23.7	17.2	18.3	15	15
Bulbs going to non-res	1.2	1.7	1.2	1.3	1.1	1.1
Sold in Following year	2.8	2.8	2.1	2.2	1.8	1.8
Total program CFLs	21.9	24.8	18.9	19.1	16.1	15.8
Total Market CFLs bought	31.2	35.4	31.4	31.8	32.3	31.5
CFLs Installed at start of year	77.0	87.8	99.9	105.7	110.5	114.7
CFLs in storage at start of year	27.9	29.4	31.2	31.8	32.3	32.8
CFLs burning out / breakage	11.6	13.2	15.0	15.9	16.6	17.2
CFLs early-replacement	7.7	8.8	10.0	10.6	11.1	11.5
CFLs out of storage	19.3	21.9	25.0	26.4	27.6	28.7
CFLs left in storage	8.6	7.5	6.2	5.4	4.7	4.1
Net increase in stock	12.0	13.5	6.4	5.3	4.7	2.8
CFLs to permanent storage	0.4	0.4	0.2	0.2	0.1	0.1
Net Storage	1.2	1.3	0.6	0.5	0.5	0.3
Net installs	10.8	12.1	5.8	4.8	4.2	2.5
Number installed at end of year	87.8	99.9	105.7	110.5	114.7	117.2
Number in Permanent storage at end of year	1.2	1.6	1.8	2.0	2.1	2.2

Spiral and A-Lamp	2009	2010	2011	2012	2013	2014
Number in Active storage at end of year	28.2	29.6	30.2	30.7	31.2	31.5
Number in storage at end of year	29.4	31.2	31.8	32.3	32.8	33.1
Percent in storage	0.25	0.24	0.23	0.23		
Pre 2010 bulbs installed	87.8	89.9	71.7	45.0	20.4	19.4
Pre 2010 Bulbs in storage	28.2	6.3	0.0	0.0	0.0	
2010 CFLs in houses		33.3	35.0	35.0	35.0	35.0
2010 Bulbs in Active storage		23.3	5.2	0.0	0.0	0.0
2010 Bulbs installed		10.1	29.8	35.0	35.0	35.0
2010 install rate		30%	85%	100%	100%	100%
2011 CFLs in houses			29.2	31.2	31.2	31.2
2011 Bulbs in storage			25.0	4.3	0.0	0.0
2011 Bulbs installed			4.3	26.9	31.2	31.2
2011 Install rate			15%	86%	100%	100%
2012 CFLs in houses				30.0	31.6	31.6
2012 Bulbs in storage				26.4	3.6	0.0
2012 Bulbs Installed				3.5	28.0	31.6
2012 Install rate				12%	89%	100%
Cumulative in house		33.3	64.2	96.2	97.8	97.8
Cumulative installed		10.1	34.0	65.5	94.3	97.8
Cumulative install rate		**30%**	**53%**	**68%**	**96%**	**100%**

Table 64 shows the adjustment factors used in the trajectory analysis shown above in Table 63. Each adjustment factor is applied at different steps in the trajectory analysis. These adjustment factors are the “knobs” that are used to make the trajectory analysis line up with what is observed in on-site data collection. The uncertainty in some of these adjustment factors (e.g. program market share, burn-out rate, and early replacement rate) was the main factor in the decision to change the definition of the installation rate for the 2010-2012 program cycle. In the example below a burnout rate of 15% and an early replacement rate of 10% combine to suggest that a quarter of all installed CFLs are removed or replaced each year. This would point to a higher turnover rate for installed CFLs and a lower Effective Useful Life (EUL) than is currently used in ex-ante assumptions. While updating EUL is outside the scope of this evaluation, this analysis points to higher turnover rate than previously assumed, which has implications for the EUL of CFLs. Additional research into the uncertainty surrounding turnover rate and program market share is recommended.

Table 64: Installation Trajectory Analysis Adjustment Factors

Adjustment factors	2009	2010	2011	2012	2013	2014
Res/Non Res	5%	7%	7%	7%	7%	7%
Sold in Following year	12%	12%	12%	12%	12%	12%
Program Market Share	70%	70%	60%	60%	50%	50%
Burn-out rate	15%	15%	15%	15%	15%	15%
Early Replacement rate	10%	10%	10%	10%	10%	10%
Permanent storage Factor	3%	3%	3%	3%	3%	3%
Net storage Increase factor	10%	10%	10%	10%	10%	10%

6.2.3 Average Daily HOU and Peak CF

This section discusses the methodology used to estimate the average daily HOU and the Peak CF reported in this study. The analysis consisted of the following steps:

1. Meter Data Analysis Conducted for the 2006-2008 Evaluation
   - Annualization
   - HOU ANCOVA Model
   - Peak CF Calculation
2. Weighting of 2012 CLASS Inventory Data
3. Application of 2006-2008 ANCOVA HOU Model to 2012 CLASS Inventory Data

Each step is discussed in its own subsection.

6.2.3.1 Meter Data Analysis Conducted for the 2006-2008 Evaluation

6.2.3.1.1 Annualization

The Annualization methodology and metering data are the same as were used for the 2006-2008 Metering Study (KEMA, Inc. and Cadmus Group 2010), but is repeated here for clarity. Because each logger collected data for only a portion of the year, evaluators needed a procedure to annualize the 2006-2008 logger data. Annualization allows seasonality and level of use indicated by each logger to be applied to a full year, rather than having different logger samples represent different time 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 = HOU on day d

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

α and β are coefficients determined by the regression,

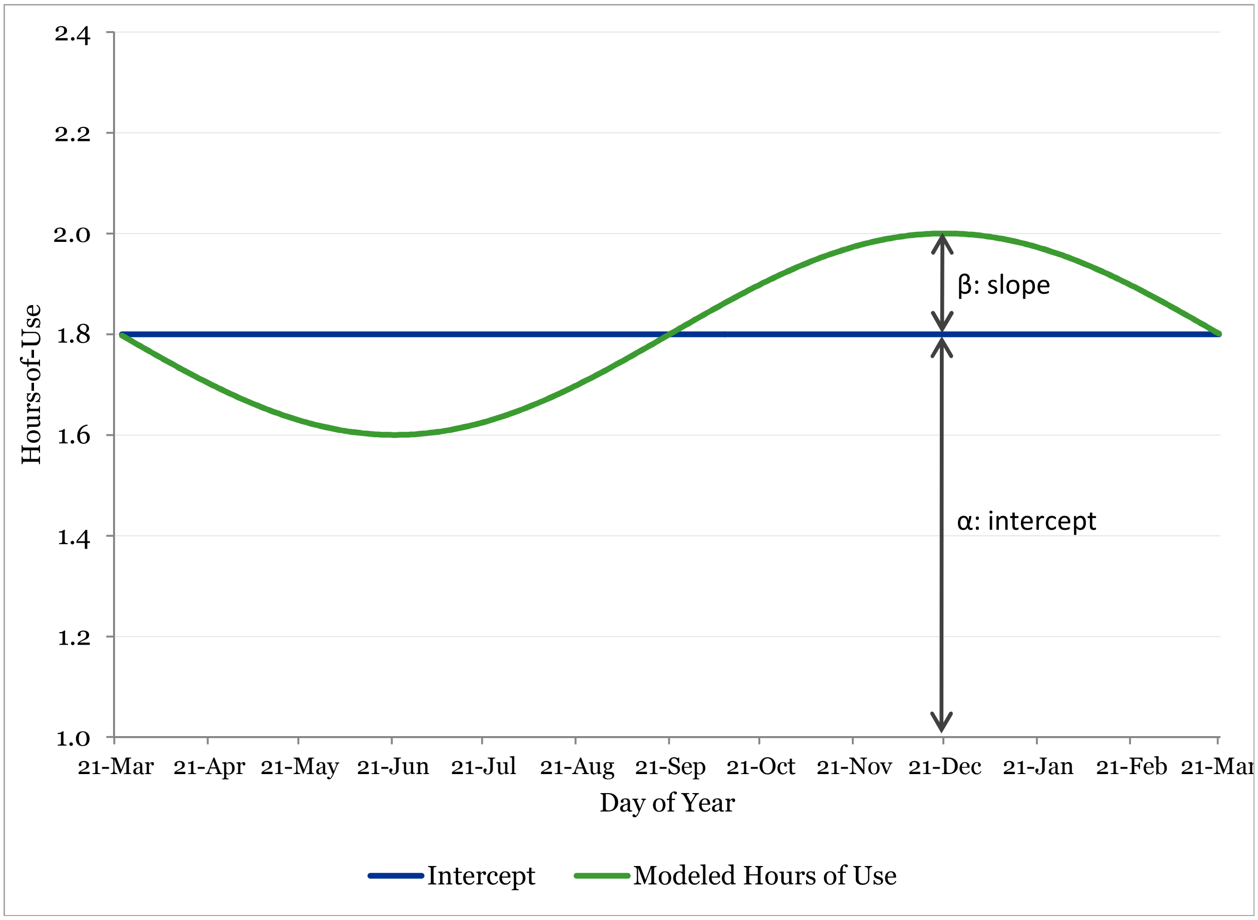
ε_d = residual error.

The sinusoid shape is very close to the shape of hours of darkness and gives very similar estimates. Before settling on the sine wave specification, DNV GL also tested using hours of darkness, calculated as the number of hours between sunset and sunrise along the year, and found them to be nearly indistinguishable to the sinusoid model. DNV GL worked with the sinusoid because it has some convenient features, in particular:

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

DNV GL calculated the average annual daily HOU by averaging the weekday and weekend/holiday intercepts in proportion to the number of each day type in a year.

Figure 4: Illustration of Sinusoidal Model



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, a model without the sine coefficient was estimated. This approach ensured that the "level" information from a logger was included in the analysis sample but treated the "slope" information as uninformative. Classifying fits as good or poor was performed separately for weekdays and weekends.

Figure 5: 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

6.2.3.1.2 HOU ANCOVA Model

The ANCOVA model provides the incremental effect of each dimension on HOU. DNV GL estimated the model across all loggers in the sample and included IOUs as a variable. This approach allows evaluators to use the loggers to inform each IOU's estimate of HOU while still retaining the differences between the IOUs. The ANCOVA model is estimated as follows:

$$H_{hrid} = \alpha_d + \beta_d IOU + \gamma_d Compo_h + \delta_d\, Satur_h + \zeta_d Room_{hr} + \eta_d Fixture_{hri} + \cdots + \varepsilon_d$$

Where

H_{hrid}	=	Estimated lamp HOU
h	=	Housing unit
r	=	Room/space configuration. Example: kitchen.
i	=	Inventory configuration. Example: first fixture in a room.
d	=	Day type: weekday or weekend/holiday
$\alpha_d, \beta_d, \ldots$	=	ANCOVA model coefficients for day type d
ε_{hrid}	=	Model residuals

Compo, Satur, Room, Fixture, and so forth are the model covariates. See Table 67. The ANCOVA model provides several benefits:

- It describes factors that affect lighting use.
- It provides more robust estimates for each small subgroup, in comparison to using direct weighted averages from loggers within each particular subgroup.
- It provides a basis to leverage the full inventory sample, rather than calculating averages from only the metered loggers.
- It provides a basis to transfer estimates from this sample to other populations.

However, ANCOVA-based leveraged estimates tend to have greater variance than direct expansion estimates that use metered loggers only for estimates that do not require small data subsets.

6.2.3.1.2.1 HOU ANCOVA Model Variables

DNV GL tested the HOU ANCOVA model with variables that were likely to affect lighting usage estimates, or might be correlated with lighting-use drivers. The final variables included in the model are listed and described in Table 65; Table 66 corresponds to sequential tests (Type I Sum of Squares tests) for model coefficients, that is, the F-test for the model as each new variable is added to the model without removing the previous ones. HOU ANCOVA results are shown in Table 67. For categorical variables, one of the categories must serve as a base case for the others. The base cases were arbitrarily chosen, and are shown with “n/a”.

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

- Dwelling unit type
- Fixture type
- Heating system type
- Cooling system type
- Lamp type (for example, twister/spiral, A-line, globe, and reflector)
- IOU-discounted versus non-IOU discounted CFL

There are differences in average HOU across these dimensions; however, the other variables included in the model account for these differences.

As anticipated, HOU declines with increasing CFL saturation; however, the general decline had a different pattern when very small numbers of CFLs were in use. Homes with three or four CFLs in use had greater average use than homes with one, two, or five. These differences are captured by the categorical CFL count variable.

There were statistically significant differences by IOU even after accounting for all other factors in the list shown in Table 65. As a consequence, these terms were retained in the model.

Table 65: Variables Used in HOU and CF 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

Variable	Description	Levels
Number of CFLs	Total number of CFLs in the household	1-2
		3-4
		5+
IOU	Utility that serves the household	PG&E
		SCE
		SDG&E
Own/Rent	Household is owned or rented	Own
		Rent
Dwelling Type	Dwelling unit type	Single Family
		Multi-Family
		Mobile Home
Household Composition	Household has children or no children	Children
		No Children
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 High School
		High School Graduate
		College
		Post Graduate

Variable	Description	Levels
Room Type	Type of room or location in which the lamp was found	Bedroom
		Bathroom
		Dining Room
		Garage
		Hall/Entrance
		Kitchen
		Living Room
		Other
		Office
		Exterior
Fixture Type	Type of fixture in which the lamp was found	Ceiling
		Other

Table 66: HOU ANCOVA Model: p-values for Model Variables

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 67: 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+	n/a	n/a	n/a	n/a
IOU	PG&E	0.212	0.139	1.520	0.128
IOU	SCE	0.494	0.139	3.560	0.000
IOU	SDG&E	n/a	n/a	n/a	n/a
Household Composition	Children	0.325	0.107	3.040	0.002
Household Composition	No Children	n/a	n/a	n/a	n/a
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	n/a	n/a	n/a	n/a
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+	n/a	n/a	n/a	n/a
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+	n/a	n/a	n/a	n/a
Education Level	Less than High School	-0.115	0.207	-0.550	0.579
Education Level	High School Graduate	0.429	0.183	2.340	0.019

Variable Name	Level	Coefficient	Std Error	t-stat	*p*-value
Education Level	College	0.213	0.122	1.750	0.081
Education Level	Post Graduate	n/a	n/a	n/a	n/a
Fixture Type	Ceiling	-0.297	0.114	-2.610	0.009
Fixture Type	Other	n/a	n/a	n/a	n/a

6.2.3.2 Peak CF Calculation

For each logger, DNV GL calculated the average percentage-on during designated climate-zone peak hours. First, DNV GL calculated the peak-period fraction, which is the proportion of daily use that occurs during the three-hour period between 2:00 and 5:00 pm for each metered day. A plot of the average proportion by time across the summer period showed no seasonality in the proportion for those hours; therefore, the peak-period fraction was calculated 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.

Then, the HOU analysis' weekday model was used to calculate the average daily usage for each logger's three climate-zone-defined peak days. The CF was calculated as:

> CF = (Average daily usage, hours per day) x (proportion between 2:00 and 5:00 pm) / (3 hours)

That is, DNV GL determined the average number of runtime hours from 2:00 to 5:00 pm on peak days. Then, this average runtime was divided by three to calculate the average fraction of time a lamp runs during the peak period.

For each lamp in the metering sample, DNV GL calculated the CF for each climate zone's peak-day definition. That is, 16 CF's was calculated for each logger (one for each climate zone's peak days).

6.2.3.2.1 CF ANCOVA Model

DNV GL fit the CF ANCOVA model with the same variables used for the HOU model. The variable definitions are shown in Table 65; CF ANCOVA results are shown in Table 68 and Table 69.

DNV GL included the same terms in the peak ANCOVA model as used in the HOU model, though some of the terms were not statistically significant in the peak model. Although CFL saturation was not statistically significant in the CF ANCOVA model, the sign was in the direction expected (negative), and the final estimate of peak CF using the CLASS inventory was lower than the estimate in the 2006-2008 Metering study. This is in line with our expectations, since peak CF is the average a fraction of HOU during the peak period. Unless the load shapes change, both of them are expected to move in the same direction.

Table 68: CF ANCOVA Model: p-values for Model Variables

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 69: 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+	n/a	n/a	n/a	n/a
IOU	PG&E	0.011	0.003	3.560	0.000
IOU	SCE	0.027	0.003	8.410	<.0001
IOU	SDG&E	n/a	n/a	n/a	n/a
Household Composition	Children	-0.014	0.002	-5.850	<.0001
Household Composition	No Children	n/a	n/a	n/a	n/a
Room Type	Bedroom	-0.099	0.004	- 22.460	<.0001
Room Type	Bathroom	-0.070	0.005	-15.040	<.0001

Variable Name	Level	Coefficient	Std Error	t-stat	*p*-value
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	n/a	n/a	n/a	n/a
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+	n/a	n/a	n/a	n/a
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+	n/a	n/a	n/a	n/a
Education Level	Less than High School	0.006	0.005	1.280	0.202
Education Level	High School Graduate	0.013	0.004	3.000	0.003
Education Level	College	-0.001	0.003	-0.400	0.688
Education Level	Post Graduate	n/a	n/a	n/a	n/a
Fixture Type	Ceiling	-0.003	0.003	-1.020	0.308
Fixture Type	Other	n/a	n/a	n/a	n/a

6.2.3.3 Weighting of 2012 CLASS Inventory Data

Sampling weights were used to ensure that results properly reflect the population of interest. Although DNV GL followed most of the same methodology as the 2006-2008 Metering Study, the lighting inventory data in this study comes from 2012 CLASS. The 2012 CLASS Study followed its own sampling design, and the development of premise-level weights is discussed in this section. Premise weights are used in estimating weighted results at the household level, as well as characteristics and quantities for all lamps in the inventory.

6.2.3.3.1 Premise Weights

Stratification for the 2012 CLASS study consisted of 42 strata defined by the following levels:

1. **Utility:** PG&E, SCE, SDG&E
2. **Climate Zone Group:** Mild, Inland, Desert
3. **California Alternate Rates for Energy/Family Electric Rate Assistance (CARE/FERA)**[11] **Statu**s: Yes or No
4. **Daily kWh:** Average Daily kWh for 2010

DNV GL calculated basic premise-level sampling weights as the inverse probability of selection, that is, the ratio of the number of premises in the sample frame over the number of premises in the sample (N/n). Table 70 summarizes the CLASS sample design by stratum. There were 9.9 million premises represented in the sample frame and 1,987 onsite visits completed during the course of the study.

Table 70: CLASS Sampling Strata and Premise Weights

Stratum	IOU	Climate	CARE/FERA	Daily kWh	Number of Premises	CLASS Number of Premises	Premise Weight
1	PG&E	Inland	No	<= 20.9	666,010	82	8,122
2	PG&E	Inland	No	<= 33	345,101	84	4,108
3	PG&E	Inland	No	> 33	204,604	83	2,465
4	PG&E	Inland	Yes	<= 20.6	365,425	49	7,458
5	PG&E	Inland	Yes	<= 32.7	196,932	49	4,019
6	PG&E	Inland	Yes	> 32.7	106,794	50	2,136
7	PG&E	Mild	No	<= 14.9	1,144,436	96	11,921
8	PG&E	Mild	No	<= 25.4	556,869	100	5,569
9	PG&E	Mild	No	> 25.4	277,278	100	2,773
10	PG&E	Mild	Yes	<= 15.2	387,769	34	11,405
11	PG&E	Mild	Yes	<= 28	183,498	35	5,243
12	PG&E	Mild	Yes	> 28	65,969	35	1,885

[11] CARE, the California Alternate Rates for Energy program, provides a monthly discount on energy bills for income-qualified households and housing facilities. Qualifications are based on the number of persons living in the home and the total annual household income. FERA, the Family Electric Rate Assistance program, provides a monthly discount on electric bills for income-qualified households of three or more persons.

Stratum	IOU	Climate	CARE/FERA	Daily kWh	Number of Premises	CLASS Number of Premises	Premise Weight
PGE Subtotal					**4,500,685**	**797**	
13	SCE	Desert	No	<= 27.1	59,879	8	7,485
14	SCE	Desert	No	<= 48.1	23,300	9	2,589
15	SCE	Desert	No	> 48.1	11,356	9	1,262
16	SCE	Desert	Yes	<= 24.2	19,495	3	6,498
17	SCE	Desert	Yes	<= 36.9	10,006	3	3,335
18	SCE	Desert	Yes	> 36.9	5,898	4	1,475
19	SCE	Inland	No	<= 18.2	1,121,730	131	8,563
20	SCE	Inland	No	<= 29.7	578,337	133	4,348
21	SCE	Inland	No	> 29.7	326,220	134	2,434
22	SCE	Inland	Yes	<= 15.6	654,789	71	9,222
23	SCE	Inland	Yes	<= 24.8	344,371	71	4,850
24	SCE	Inland	Yes	> 24.8	201,313	72	2,796
25	SCE	Mild	No	<= 14.8	407,073	39	10,438
26	SCE	Mild	No	<= 25.5	205,117	39	5,259
27	SCE	Mild	No	> 25.5	104,432	40	2,611
28	SCE	Mild	Yes	<= 12.5	103,743	9	11,527
29	SCE	Mild	Yes	<= 20.5	53,880	9	5,987
30	SCE	Mild	Yes	> 20.5	30,598	9	3,400
SCE Subtotal					**4,261,537**	**793**	
31	SDG&E	Inland	No	<= 18.4	154,757	36	4,299
32	SDG&E	Inland	No	<= 31.1	79,136	39	2,029
33	SDG&E	Inland	No	> 31.1	43,514	35	1,243
34	SDG&E	Inland	Yes	<= 14.8	49,484	10	4,948
35	SDG&E	Inland	Yes	<= 25.2	26,895	10	2,690
36	SDG&E	Inland	Yes	> 25.2	14,553	11	1,323
37	SDG&E	Mild	No	<= 13.5	363,967	66	5,515
38	SDG&E	Mild	No	<= 23.5	186,358	66	2,824
39	SDG&E	Mild	No	> 23.5	99,212	69	1,438
40	SDG&E	Mild	Yes	<= 11.5	112,206	18	6,234

Stratum	IOU	Climate	CARE/FERA	Daily kWh	Number of Premises	CLASS Number of Premises	Premise Weight
41	SDG&E	Mild	Yes	<= 18.9	60,038	18	3,335
42	SDG&E	Mild	Yes	> 18.9	34,274	19	1,804
SDG&E Subtotal					**1,224,394**	**397**	
Total					**9,986,616**	**1,987**	

6.2.3.3.2 Premise Weights Raking

The basic premise weights were adjusted by iterative proportional fitting (IPF) or "raking" (Deming and Stephan 1940). Raking is commonly used to make estimates comparable across studies, and it is performed at the primary sampling unit, that is, at a granular level. In this study, raking was applied to the premise weights so that the weighted proportions for each IOU aligned with the 2009 RASS. The raking adjusted the proportions by education, own/rent status, and dwelling unit type, and as a strong proxy for dwelling unit size and income.

In general, this type of raking adjustment to the sample weights can reduce both bias and variance in estimates by correcting the distribution of the weighted sample so that it equals the original frame distribution across the variables used in the raking process. The extent of the bias and variance reduction depends on both the sample size and the amount of correlation between the raking variables and the survey outcome measures of interest. Since HOU is likely correlated with education, own/rent status, dwelling unit type and income we expect the raking weight adjustment will have a beneficial effect on the estimates.

Raking is a useful statistical technique regardless of the methodology used to select the sample as long as the base weight that is being adjusted reflects the true probability of selection. In this study, the original base weight used in the raking process reflected the accurate probability of selection.

In a few cases, demographic variables required for raking had missing values, which were imputed by logistic regressions prior to raking. Table 71 presents the variables that were imputed. Of the three variables, only income had a relatively large number of missing values. The logistic regression imputed the missing cases using known demographic variables, such as dwelling type, number of bedrooms, number of bathrooms, own/rent, and education.

Table 71: 2012 CLASS Variables Imputed for Raking

Variable Name	Number of Observations	Number of Missing Values	Percent of Values Imputed
Dwelling Type	1,970	17	1%
Education	1,970	38	2%
Income	1,970	309	16%

The weighted distributions for each of these variables before and after the raking adjustment are shown in Table 72. The "pre-raking" distributions use basic premise weights where as the "post-raking" distributions use the adjusted weights. For comparison, the distributions for both the 2012 CLASS and the 2006-2008 Metering Study are included. In most cases, adjustments were small and do not have a significant effect on the results.

Table 72: 2009 RASS Weighted Distributions Before and After Raking

Demographic Segments		RASS 2009	2012 CLASS		2006-2008 Metering Study	
			Pre-Raking	Post-Raking	Pre-Raking	Post-Raking
Household Income	<$20,000	15%	12%	15%	16%	15%
	$20,000-$49,999	30%	27%	30%	26%	30%
	$50,000-$74,999	17%	19%	17%	17%	17%
	$75,000-$99,999	12%	15%	12%	16%	12%
	$100,000+	26%	28%	27%	25%	26%
Household Education	Less than High School	7%	7%	7%	9%	7%
	High School Graduate	12%	14%	12%	12%	12%
	Some College	29%	26%	29%	27%	29%
	College / Some Graduate	31%	30%	31%	31%	31%
	Post Graduate Degree	21%	24%	21%	22%	21%
Own versus Rent	Own	70%	67%	70%	70%	70%
	Rent	30%	33%	30%	30%	30%
Dwelling Unit Type	Single Family	64%	70%	64%	74%	64%
	Mobile Home	4%	2%	4%	2%	5%
	Multi-Family	32%	29%	32%	24%	32%

Demographic Segments		RASS 2009	2012 CLASS		2006-2008 Metering Study	
			Pre-Raking	Post-Raking	Pre-Raking	Post-Raking
Household Composition	Have Children, Seniors	4%	3%	4%	3%	4%
	Have Children, No Seniors	35%	31%	35%	31%	35%
	No Children, Seniors	24%	23%	24%	23%	24%
	No Children, No Seniors	38%	43%	38%	43%	38%

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

6.2.3.4 Application of 2006-2008 ANCOVA Models to 2012 CLASS Inventory Data

Evaluators applied the 2006-2008 ANCOVA models to all lamps in both the 2006-2008 and CLASS inventories to produce projected annual HOU and CF for each lamp. By leveraging the full lighting inventories, DNV GL was able to produce results for a sample that was larger than the original metering sample. This enabled us to expand to the population at finer cuts than the metering sample alone would have permitted.

For the leveraged expansion, DNV GL calculated subgroup averages using the adjusted premise weights from the projected annual HOU. Fixture group or lamp weights were not applied because all lamps at each premise were included in these averages.

6.2.3.5 Differences in HOU and CF by IOU

The 2006-2008 study found statistically significant differences in average hours of use across the IOUs. Part of this difference was related to identifiable differences in demographics and characteristics of lamps and applications. Part of the difference could not be explained by these factors. Because the present study relies on the metering data collected in the 2006-2008 study, similar IOU differences are found here. It is useful to review the basis for these estimates and how the differences can be understood.

When the ANCOVA model was estimated in the 2006-2008 evaluation, several variables that might influence lighting use patterns were tested in the model. These covariates included dwelling unit type, household composition, household size, household tenure (own versus rent), highest level of education, house vintage, and other demographic and lamp characteristics that were available in the study. The conjecture was that after controlling for these factors, there would be no statistically significant IOU term. That is, differences by IOU would be explained by the other variables so that no further IOU-specific adder would be needed in the model. However, the IOU term continued to be statistically significant in the model, suggesting that the included covariates alone did not fully account for the IOU differences. The IOU term was therefore retained in the model.

For the 2010-2012 evaluation, as described in 6.2.3, the HOU model from the 2006-2008 Study was used together with new demographic and inventory data from the 2012 CLASS Study. No new metering data were collected for the 2010-2012 study or CLASS, so that no new information is available to revise the HOU model or to reassess the validity of the IOU terms in the model. The model developed in 2006-2008 is retained with all its terms.

The 2006-2008 finding of statistically significant IOU differences not explained by the demographic and lamp type/use factors remains a bit of a puzzle. Possible explanations include the following.

- One hypothesis is that the original sample of households was biased and tended to have certain patterns by IOU. There is no operational reason to expect a bias in one IOU's sample compared to another. The sample in each IOU territory was drawn by the same methods and data were collected by the same protocol over the same time periods. To this day we have seen no indication that there is any systematic problem with the original sample. Random differences of course are present. The finding that the IOU terms are statistically different means that the differences are greater than would be expected simply from random variation, at 99.9% confidence. Thus, if the IOU-specific terms represent a random fluke rather than an underlying characteristic of the populations, this is a 1 in 1000 random event.
- Another hypothesis is that these IOU differences could be explained by housing or population density. Higher housing density could mean lower sunlight penetration and higher lighting use. Although the 2006-2008 Study attempted to obtain data on square footage, the information was only sparsely populated. At the time there was not enough information to construct a good measure of density.
- Yet another hypothesis is that there are differences in lifestyle or habits across the IOU territories that could affect lighting use patterns, and are not captured in the demographic variables.

Further work is possible, short of repeating the metering study, to explore these possible explanations and potentially support or refute them. Such additional work was not included in the scope of this study. The conjectures therefore remain unverified speculations.

6.2.4 Delta Watts

DNV GL derived residential sector bulb/fixture wattage estimates, for those items replaced by rebated products, by analyzing lighting inventory data collected as part of the CLASS sample.

The methodology is still based on the assumptions in the savings claims (work paper and DEER derived) that CFLs are replacing incandescent equivalent bulbs. However, it is clear that as saturation levels of CFLs continue to rise, more careful consideration of methodologies, which account for CFL to CFL replacement, or in the future LED to CFL replacement, is needed to properly reflect the gross savings achieved.

Given the upstream nature of the lighting programs, there is no reliable method to collect wattage data for lighting products replaced by rebated measures. Instead, DNV GL relied on the residential lighting inventory data as bases to estimate delta watts:

- Installed base case wattage:
  - For residential CFLs, the average wattage of non-CFL equivalents was calculated by lamp shape and room type. Then, the non-CFL wattages were averaged, weighting by the room-type distribution of CFLs of that shape.[12]
  - Base case fixture wattage was estimated for each of the applicable fixture categories that were rebated through the program (accounting for room and fixture types). DNV GL assumed that the base case for fixtures was the same for residential applications since the fixture types rebated implied a similar relationship between base case and installed wattage/application.
- Program-rebated wattage:
  - The program-rebated wattage is the average wattage of rebate bulbs across a given measure group. The difference between the program-rebated wattage and the installed base case wattage was used to calculate the delta wattage.

6.3 Net Impacts Methodology

6.3.1 Lamp Choice Model Methodology

This Methodology section presents the LCM and describes how to use the model for net-to-gross (NTG) calculations. The LCM predicts how consumers choose between competing lamp products. The scope of the model covers lamps that are sold through major retail channels, use common lighting technologies (for example, incandescent, CFL, and LED), and are in common shapes (for example, A-Lamp, twister, reflector/flood, and globe).

Key model features include:

[12] 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-lamp shaped lamps were weighted by the room type distribution of observed MSB twister/A-lamp shaped CFLs, and MSB incandescent globes were weighted by the room type distribution of observed MSB CFL globes.

- **Market share predictions for impact evaluation:** The model predicts changes in market shares as a response to price changes such as those that incentive programs introduce. This gives the model the ability to estimate a counter-factual baseline for impact evaluation.
- **Heterogeneous price sensitivities:** Not all consumers have the same price sensitivity. The model design reflects that price sensitivities vary by consumer household income and whether the consumer is making an impulse or planned purchase.
- **Retail channel differences:** The model design recognizes that consumers have price sensitivities and choice sets that vary by retail channel.
- **Nested logit model structure:** The model design utilizes a standard methodology for predicting consumer choice over a set of discrete alternatives.

The LCM is designed to tell a clear and consistent story of market shares change due to program incentives. This memorandum presents the fundamentals of logit modeling and describes the LCM specification in detail.

6.3.1.1 Introduction

ULPs use incentives to influence consumer choice. The underlying theory is discounting a CFL makes a CFL a more attractive choice. The question behind an impact evaluation is: what choice would the consumer have made in the absence of the discounts? Discrete choice models are the analytical framework designed for this class of problem. Discrete choice models combine the relevant information about each possible choice— for example, the price, the application use, attributes about the consumer—and assign a probability to each of the choices. To answer the impact evaluation question, apply the model scenarios with and without the price incentives and calculate the difference in market shares.

This section outlines using a discrete choice model for residential lamp choice. The following subsection gives an overview of logit models. Logit models are a particular discrete choice model formulation that has properties that make them easy to estimate and apply. The subsequent subsections describe the model estimation and the show the estimation results.

6.3.1.2 Logit Model Fundamentals

Logit models operate on the premise that observing everything about a consumer making a choice is not possible. Were that case, the model would be deterministic in that it would say what choice would make for a given situation. Instead, logit models are stochastic. The models yield a probability of making a choice based on observable attributes about all possible alternatives.

The balance of this section is a primer on the important aspects of logit modeling that are relevant for the problem of residential lamp choice. The following subsection describes how to assign values to each possible choice and how to combine utilities into probabilities using the multinomial logit formulation. The second subsection extends multinomial logit to including nesting structures that reflect substitution patterns.

6.3.1.2.1 Multinomial Logit Model

In logit modeling parlance, *alternatives* refer to the *exhaustive* set of *mutually exclusive* choices that a consumer could make. To illustrate with an example, a consumer could replace a burned out lamp with an incandescent, a twister CFL, an A-Lamp CFL, or a LED lamp. This choice is exhaustive in that it contains all of the possible replacement technologies. This choice set is mutually exclusive in that a consumer can only choose one of the alternatives to replace the burned out lamp.

A logit model assigns a utility[13] value to each of the alternatives. Equation 1 defines the utility for alternative *j* in the set of *J* alternatives. There are two parts to the utility equation: the observable utility (*V*) and the unobservable utility (ε).

$$U_j = V_j + \varepsilon_j \quad (1)$$

The observable utility value embodies how a consumer perceives an alternative according to his or her tastes. Environmentally conscious consumers, for example, may place a high value on the low energy use of an LED lamp. The consumer also values the price and that the LED lamp has a long useful life. Equation 2 translates these preferences into a mathematical representation of utility:

$$U_j = \beta_0 + \beta_1 P_j + \beta_2 F_j + \beta_3 H_j + \varepsilon_j \quad (2)$$

where *P* represents the price of the LED lamp, *A* the fixture type, and *H* the household income.

Equation 3 shows the multinomial logit model formulation. The model is multinomial in that it describes the probabilities for each of the *J* alternatives. In words, the equation says that the probability of choosing alternative *i* is the exponentiated utility of alternative *i* over the sum of all the exponentiated alternatives.

$$\Pr(i) = \frac{\exp(U_i)}{\sum_{j \in J} \exp(U_j)} \quad (3)$$

[13] Note: in this section "Utility" refers to the attractiveness of a choice, not an Investor-Owned-Utility (IOU)

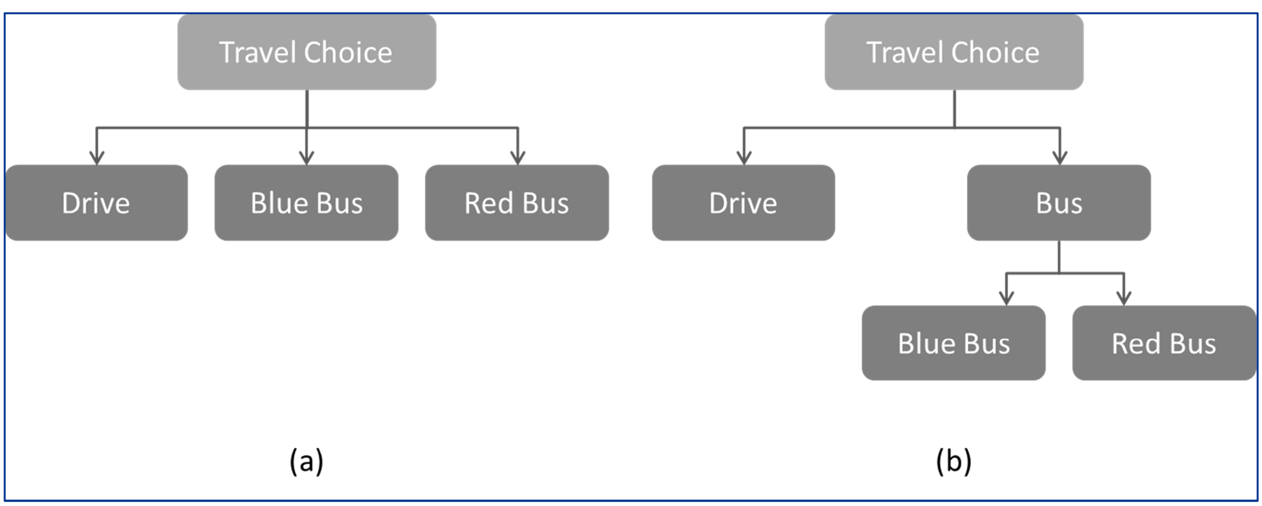
This formulation compares the utility value of one alternative to the utility values of all other alternatives. Only the relative difference in utility between alternatives is important. Further, logit models can only relate differences in taste to observable characteristics of the decision maker. The model does not account for random variation between decision makers that appear identical.

Researchers derived the logit model formulation from assumptions on the unobserved portion of the utility equation, ε. The logit model requires that each ε_j is an independently and identically distributed extreme value. That is, the unobserved utility in each of the alternatives has the same distribution as all other alternatives and is not influenced by other alternatives. The extreme value distribution, also called the Gumbel distribution, has a shape similar to the bell shape of the normal distribution. The extreme value distribution has thicker tails.

6.3.1.3 Nested Logit Model

The structure of logit models results in proportional substitution. This property is sometimes referred to as the red bus/blue effect. Say that travelers can chose between driving a car or a blue bus in one scenario. A second scenario adds a red bus that is identical to the blue bus in every way, except for the color. The multinomial logit model, shown in Figure 6, (a) shifts travelers from the car and the blue bus in equal proportions. That is, half of the new riders on the red bus will be former car drivers and half will be former blue bus riders. Clearly, this substitution pattern does not reflect that the busses are perfect substitutes for each other while the car is not as close a substitute.

Figure 6: Nested Logit Structure



In Figure 6, (b) shows an alternate logit model structure that treats the choice between the red and blue busses as a lower level choice than the choice between drive and bus. The term *nested* *logit* refers to a logit model where the probability of one group of alternatives is conditional on the probability of another alternative. The choice between red and blue busses is a logit model conditioned on the choice between drive and bus.

The nesting structure defines substitution patterns. Within the bus nest, decision makers see the red and blue busses as good substitutes. Increasing the utility of the red bus will primarily have the effect of shifting riders from the blue bus to the red bus. The secondary effect will shift drivers to both busses.

6.3.1.4 LCM Data

The LCM makes use of information known about lamp purchases to predict the probability that a consumer will choose a particular lamp. DNV GL designed a purchaser intercept survey to collect the information the LCM requires. The survey captures information about the lamp, the lamp application, the retail channel and the buyer. This section describes how the LCM will transform information from the intercept survey into a framework that predicts lamp choice.

The section is organized as follows. The first subsection describes the information that the intercept survey collects. The second subsection describes the model structure. The last subsection presents an example model specification.

6.3.1.4.1 Intercept Survey

The intercept survey is the primary data source for estimating the residential LCM. The intercept survey asks respondents a series of questions to understand (1) the application use, (2) the market segment, and (3) housing and household characteristics. Additionally, the survey has respondents perform a stated preference ranking of lamps. The balance of this subsection describes the variables available to the LCM. All of the variables are relative to a specific lamp in the respondent's basket.

6.3.1.4.2 Application Use

The intended application of where a customer planned to use a lamp should help explain lamp choice. Consumers may accept a CFL twister, for example, in a basement but strongly prefers an incandescent for use in a desk lamp. For consumers that intend to install their purchase within the next week, the intercept survey captures the following variables for the LCM:

- **Installation room:** For example, living room, kitchen
- **Fixture type**: For example, ceiling, table lamp
- **Dimmable required**: Whether the lamp will be in a fixture with controls for dimming
- **Replaced technology:** The technology of the burnt out lamp

6.3.1.4.3 Buying Strategy

The intercept asks a series to understand whether the respondent is making a *planned* or *impulse* purchase. Consumers that target their shopping to a particular store to buy a particular lamp will react differently to prices than an opportunistic shopper. The targeted shopper will be relative price inelastic compared to the consumer that decides to buy a lamp only after seeing the lamp is on sale. The LCM reflects the different price elasticities through *market segmentation*. The intercept survey captures the following variables that describe the market segmentation of the consumer:

- **Targeted store:** Whether the respondent intend to buy lamps at this store
- **Targeted style:** Whether the respondent intended to buy the lamp style
- **Targeted technology:** Whether the respondent intended to buy the lamp technology

6.3.1.4.4 Promotional Activity

Retailers try to influence consumer choice through in-store advertising and promotions. Consumers that see signs or displays promoting the benefits of LED lamps may be more likely to buy LED lamps than consumers that do not. Field researchers captured the following variables related to promotional:

- **End cap:** Whether the lamp was located an end cap display
- **In-store display, lighting aisle**: Whether there was an in-store display promoting CFLs in the lighting aisle
- **In-store display, non-lighting aisle**: Whether there was an in-store display promoting CFLs in a location other than the lighting aisle

6.3.1.4.5 Housing and Household Characteristics

The choices consumers make vary with the structure and size of the consumer's housing and household structure. Highly educated consumers may be, for example, more likely to buy LED or CFL lamps. The intercept survey captures the following variables to understand housing size and household structure:

- **Bedrooms:** Number of bedrooms in the house
- **Bathrooms**: Number of bathrooms, with half baths as ½, in the house
- **Occupants:** Number of people who live in the household year round
- **Education:** Highest level of education completed
- **Household income**: Household income in categories consistent with the US Census
- **ZIP code:** ZIP postal code of the respondent's residence
- **Utility:** Electric utility provider for the respondent

6.3.1.4.6 Preference Ranking

The last component of the intercept survey asks respondents to rank a collection of lamps in order of preference. Figure 7 shows the ranking exercise in survey instrument. One of the choices replicates the lamp in the consumer's basket. The other choices are synthetic. The survey instrument populates shows respondents lamps that are were found in the retail channel during previous shelf surveys. The survey instrument randomly chooses prices based on price ranges observed in the channel. The ranking data are a mix between revealed and stated preference data.

Figure 7: Example of Lamp Preference Ranking in the Survey Instrument

6.3.1.5 Lamp Choice Model Design and Estimation

6.3.1.5.1 Alternative Definitions and Choice Sets

The LCM design imposes some structure onto lamp choices to make this problem tractable. For example, we have ignored branding in the design of the LCM. Trying to predict consumer choice around branding adds complexity to the model with minimal benefit for program implementers[14]. This subsection describes the generalizations of lamps into choice sets.

[14] The 2012-2013 programs provided incentives for national and store brands. The IOU programs did not include steering consumers to national or store brands as a program objective.

The LCM design consists of three separate logit models, one for each of the predominant lamp styles (A-Lamp/Twister, Reflector and Globe). Choice sets must represent groups of alternatives that are reasonable substitutes. There are separate models by lamp style as lamps from one style are poor substitutes for lamps in another style. Within each choice set, the choice the consumer makes is which technology to buy.

Manufacturers produce lamps in a myriad of wattages and brightness levels. To simplify these options into a discrete set of comparable alternatives, we grouped into lumen brightness bins, as shown in Table 73. These lumen brightness bins provide a useful framework for creating comparable choice sets for the experiment, even if consumers are not necessarily aware of lumens as a measure of brightness and manufacturers typically market lamps in terms of incandescent wattage equivalents.

Table 73: Lamp Brightness by Lamp Style

Lamp Brightness Category	A-Lamp and Twisters	Reflectors /Floods	Globes	Three Ways
Very High Brightness (>2099 lm)		✔		
High Brightness (1200 – 2099 lm)	✔	✔	✔	
Medium Brightness (700 – 1099 lm)	✔	✔	✔	
Low Brightness (65 – 699 lm)	✔	✔	✔	
Any Brightness				✔
Dimmable	✔	✔	✔	

The model design does not, however, allow for substitution across brightness bins. While consumers can and sometimes do replace a lamp in one brightness level with a lamp in another, the model design implicitly assumes that this is not the norm. In addition, trying to incorporate substitution across brightness levels would impose additional difficulties in the intercept survey and would result in a more complex model design. The choice set would need account for lamp technology and lumen bin, expanding the number of alternatives by a factor of three.

The model explicitly does not allow for a "none of these" option of not making a purchase. The model is a conditional logit model in that the data collection and the model forms forces consumers to choose one of lamp for their lighting application. There are two reasons we followed this approach. First, the lamp that the consumer placed in his or her basket at the price the consumer would have to pay is one of the options in the ranking exercise. Including a "none of these" option would give the survey respondent a choice that is logically inconsistent with his or her actions. Second, we are not aware of evidence that there is a significant portion of the market that chooses not to replace lamps. Our assumption is that there is a negligible change in demand over the range of prices in the scenarios that we tested. Further, the approach that we are following is consistent with the travel demand modeling community. That community uses logit models to describe the propensity to choose travel modes. Transportation mode choice models are also conditional logit models in that conditional on a trip taking place.

The final aspect of the model choice sets relates to the retail channel. Not all lamps are available in each retail channel. Consumers in a discount store generally will not have the opportunity to purchase an LED A-Lamp for example. The model design reflects the difference in choice set by retail channel through availability restrictions that we developed from analysis of retail shelf surveys in 2012. The intercept survey presents only the choices a consumer is likely to see in the retail channel where the survey takes place. Likewise, the model estimation prohibits choices that are not available by retail channel.

Choice sets were constructed under two scenarios:

- **Price only:** This scenario assumes that only difference between the program and the baseline are the IOU discounts. We were able to estimate IOU discounts using two methods:
    - Store displays sometimes showed the IOU discount amount. When our field staff visited stores, they recorded IOU discount amounts whenever this information was unambiguously displayed.
    - Program tracking contains discount amounts. We used program tracking data by matching lamps in the program tracking with lamps on the shelf in each store. Where we had exact matches (by lamp manufacturer, model number, and store), we used the amount in the tracking data as the IOU program discount.
- **Price and availability**: Many suppliers told us that they would not offer any lamps to certain retail in the absence of the program. For example, The Dollar Store only offers products with a retail price of $1 or less. Without program discounts, these channels would not be able to offer CFL. We constructed this scenario by excluding lamps that from manufactures that claimed that they would not ship to a retail channel without the program and removing the IOU discount amount.

The balance of this section describes the estimation results for the A-Lamp/Twister, Reflector, and Globe models.

6.3.1.6 Model Building Approach

- This section explains our approach to building models. The final regression results are the product of exploring many combinations of variables to explain consumer choice. The final model forms are not the result of a applying a single criteria to each of the regression results. Rather, the final model form reflects the regression result that showed the greatest overall strength. The strength of a model follows from its ability to tell a concise, consistent, and compelling story:

- *Concise* models are able to explain the appropriate amount variation.
- *Consistent* models have coefficient values with logical relationships.
- *Compelling* models have a strong statistical fit.

Our general approach is to building the LCM was as follows:

- We started with simple models with alternative specific constants and a generic price coefficient. That is the price coefficient was common to each technology. This resulted in models with negative prices coefficients.
- We then let the price coefficient s vary by technology. Incandescent, CFL, and LED lamps are not perfect substitutes for each other. LED, for example, have a much longer expected life. Our expectation is that consumers would be most price-sensitive toward incandescent lamps and the least price sensitive toward LED lamps because of differences in the technologies. The result was consistent with our *a priori* expectations for the A-Lamp/Twister and reflector models.
- Our next area of concern was including household income and education to explain how some households prefer efficient technologies. We tried incorporating household income and education as an explanatory variables using a couple of specifications. For the A-Lamp Twister model, we settled on interacting high income (household income of $100,000 or more) with price and interacting education with technologies.
- In our experience, consumer behavior varies by retail channel. We accounted for differences by interacting technologies with channels.
- Finally, we looked at the role that household structure, house size, and tenure (rent or own) play in how consumers prefer lamp technologies. The estimation results showed logical relationships for some of these variables in the A-Lamp/Twister, reflector, and globe model results.

We built the model specification by adding the terms in the order described above. We accepted coefficients when they contributed to consistent relationships and when that had high statistical fit. Our tendency is to include terms that less statistical fit than common when the terms contribute to consistent and logical relationships among the variables. Conversely, we did not include statistically significant variables that formed illogical relationships[15].

[15] For example, estimation runs on the reflector model yielded a positive and significant coefficient for watts. This result, when combined with the price coefficient, implies that consumers prefer lamps that use more energy and, thus, cost more to operate. This is contrary to our expectation that consumers are cost minimizers and is more likely the result of co-linearity in the estimation data.

The subsections that follow give details on the final model specification and estimation results for each model.

6.3.1.7 A-Lamp/Twister Model

The estimation data for the A-Lamp and Twister model consists of 1020 observations, from 510 purchaser survey respondents. Figure 8 shows the distribution of observations across retail channels and by the first choice the respondent. Each observation is from a purchaser. The observations reflect the preferences and cost elasticities of consumers buying lamps rather than reflecting what respondents in a hypothetical situation say.

Figure 8: A-Lamp and Twister Observations by First Choice

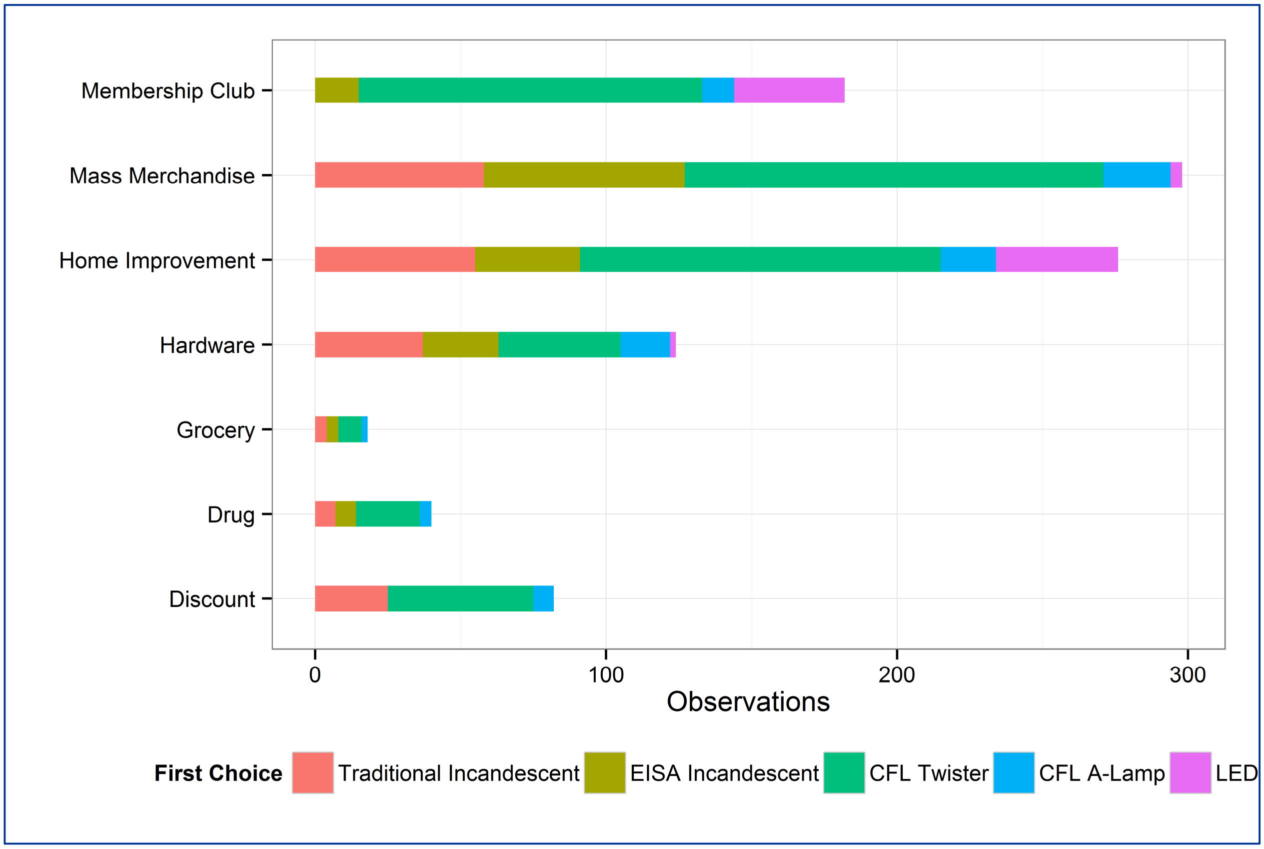


Table 74 shows the coefficient values and statistical significance for each of the parameters in the A-Lamp/Twister model. The pseudo R^2, which measures the overall fit, is 0.32. The table groups related parameters and lists each estimated coefficient and t-statistic. Each parameter is associated with an alternative, an individual, or the choice situation. Parameters associated with an alternative apply to all individuals in all choice situations. Examples include alternative specific constants and alternative specific price coefficients. The parameters on price by annual household income (either unknown or $100,000 and greater) are the two parameters that are only associated with individuals. The remaining parameters describe a choice situation such as buying a LED A-Lamp in a mass merchandise store. Choice situation parameters are interactions. They are the interaction of the alternative and the choice situation.

Table 74: Estimated Parameter Values for the A-Lamp/Twister Model

Group	Parameter	Type	Value	T-Stat
Alternative Specific Constant	CFL Twister	Alternative	0	-
	CFL A-Lamp	Alternative	-1.14	-1.94
	Incandescent A-Lamp	Alternative	-1.44	-2.84
	EISA Incandescent A-Lamp	Alternative	-2.91	-4.65
	LED A-Lamp	Alternative	1.64	1.69
Price Sensitivity	Generic	Choice	-0.38	-9.22
	Income over $100k	Individual	0.08	3.69
	Unknown income	Individual	0.02	0.71
	Planned purchase	Individual	0.02	0.78
	CFL A-Lamp	Alternative	0.06	0.95
	Incandescent A-Lamp	Alternative	-0.20	-2.86
	EISA Incandescent A-Lamp	Alternative	0.01	0.14
	LED A-Lamp	Alternative	0.21	5.64
Discount Channel	Incandescent A-Lamp	Choice	0.86	1.50
	CFL Twister	Choice	0.31	0.64
Drug Store Channel	Incandescent A-Lamp	Choice	-1.10	-1.35
	EISA Incandescent A-Lamp	Choice	0.31	0.34
	CFL Twister	Choice	-1.02	-1.30
Grocery Channel	Incandescent A-Lamp	Choice	1.01	1.06
	EISA Incandescent A-Lamp	Choice	2.11	2.21
	CFL Twister	Choice	0.48	0.51

Group	Parameter	Type	Value	T-Stat
Hardware Channel	CFL A-Lamp	Choice	0.00	0.01
	Incandescent A-Lamp	Choice	0.55	1.68
	EISA Incandescent A-Lamp	Choice	1.08	3.25
	LED A-Lamp	Choice	-1.28	-1.78
Mass Merchandise Channel	CFL A-Lamp	Choice	0.52	1.63
	Incandescent A-Lamp	Choice	-0.10	-0.40
	EISA Incandescent A-Lamp	Choice	0.93	4.03
	LED A-Lamp	Choice	-1.58	-2.45
Replacement	Incandescent to incandescent	Choice	0.62	3.76
	CFL to CFL	Choice	0.38	1.42
Housing size 3 or more	CFL A-Lamp	Choice	-0.21	-0.64
	Incandescent A-Lamp	Choice	-0.83	-2.64
	EISA Incandescent A-Lamp	Choice	-0.73	-3.10
	LED A-Lamp	Choice	-0.20	-0.47
Housing size 4 or more	CFL A-Lamp	Choice	-0.66	-1.84
	Incandescent A-Lamp	Choice	0.25	0.82
	EISA Incandescent A-Lamp	Choice	-0.21	-0.85
	LED A-Lamp	Choice	-0.48	-1.10
Bedrooms, 2 or more	CFL A-Lamp	Choice	0.09	0.17
	Incandescent A-Lamp	Choice	0.16	0.34
	EISA Incandescent A-Lamp	Choice	1.33	2.16
	LED A-Lamp	Choice	-0.88	-1.00
Bedrooms, 3 or more	CFL A-Lamp	Choice	0.72	1.89
	Incandescent A-Lamp	Choice	0.37	1.44
	EISA Incandescent A-Lamp	Choice	0.24	0.89
	LED A-Lamp	Choice	-0.08	-0.15

Group	Parameter	Type	Value	T-Stat
Renting	CFL A-Lamp	Choice	-0.42	-1.40
	Incandescent A-Lamp	Choice	0.17	0.72
	EISA Incandescent A-Lamp	Choice	-0.20	-0.80
	LED A-Lamp	Choice	-1.34	-2.15
Application room	Unknown room—CFL Twist	Choice	-0.15	-0.77
	Bedroom—CFL Twist	Choice	1.16	3.54
Nesting	Incandescent		0.84	5.21
	CFL-LED		0.84	6.85

All of the model coefficients are additive. To illustrate, consider an individual in a four bedroom house, with an annual income over $100,000 and three people in the household, shopping in a discount store to replace a burned out incandescent lamp in the living room. The consumer can buy a CFL Twister for $0.99 or a traditional incandescent for $0.50. The utility equation for the Incandescent A-Lamp would be as follows:

Figure 9: Example Calculation of A-Lamp Utility

U Incandescent A-Lamp =	-1.44	Alternative specific constant
	+ (-0.38 x 0.5)	Price coefficient—generic
	+ (0.08 x 0.5)	Price coefficient--high Income
	+ (0.02 x 0.5)	Price coefficient--planned purchase
	+ (-0.2 x 0.5)	Price coefficient--Incandescent A-Lamp
	+ (0.86 x 1)	Discount channel--Incandescent A-Lamp
	+ (0.62 x 1)	Replacement--incandescent to incandescent
	+ (-0.83 x 1)	Housing size 3 or more--Incandescent A-Lamp
	+ (0.16 x 1)	Bedrooms, 2 or more--Incandescent A-Lamps
	+ (0.37 x 1)	Bedrooms, 3 or more--Incandescent A-Lamps
	= -0.50	
U CFL Twister =	+ (-0.38 x 0.99)	Price coefficient--generic
	+ (0.08 x 0.99)	Price coefficient--high Income
	+ (0.02 x 0.99)	Price coefficient--planned purchase
	+ (0.31 x 1)	Discount channel--CFL Twister
	= 0.033	

Since the Discount Store only offer Incandescent A-Lamps and CFL Twisters, the probability of selecting a CFL Twister is

$$\frac{\exp(\log(0.84 \times \exp(0.033)))}{\exp(\log(0.84 \times \exp(-0.5))) + \exp(\log(0.84 \times \exp(0.033)))} \cong 0.61$$

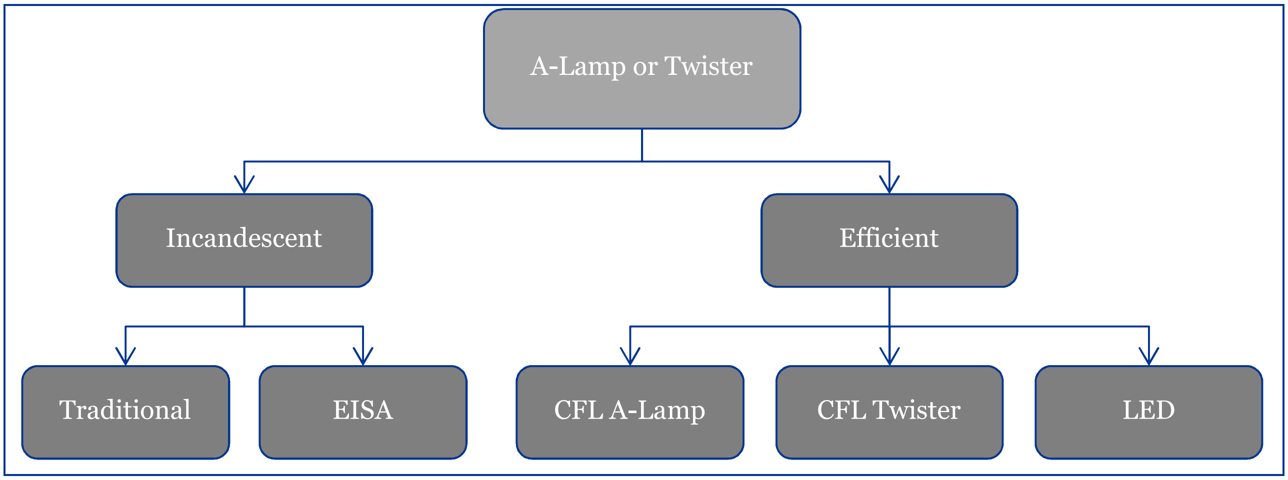
where 0.84 is the value of the nesting coefficients. The estimation process produced nearly identical nesting coefficient values for both the incandescent and CFL/LED nests. There is nothing about the model design or estimation that constrains the values of the nesting coefficients to be identical.

The estimation results capture several of the key relationships that we expect to see:

- **Alternative specific constants:** The signs and relative magnitudes on the alternative specific constants are plausible. The constant for LED A-Lamps is positive. This is consistent with our expectations that consumers would favor LED A-Lamps over CFL Twisters if both were offered at the same price.

- **Price sensitivity:** The model results show that consumers are price sensitivity in that they prefer less costly alternatives being equal. The coefficient value (-0.38) has the correct sign and is very statistically significant with a t-stat of -9.22.
- **Higher income groups have lesser price sensitivity:** Consumers with annual household incomes of $100,000 or more place a less value on the upfront cost of a lamp. This is consistent with our expectation that consumers with higher incomes are in a better position to invest in energy efficiency when the upfront cost is higher.
- **Different price sensitivities by technology:** LEDs last longer and use less power. Our expectation is that consumers recognize that there are differences between incandescent lamps, CFLs, and LEDs. Consumers are less sensitive to LED prices since last longer and operate at less cost.
- **Differences by renting or owning:** Consumers that are renting their homes place less value on LED lamps than consumers who own their homes. This is very plausible outcome as we expect that renters are not as willing to make long investments in energy efficiency products.
- **Nesting coefficients:** Figure 10 depicts the nesting structure. The nesting coefficients for the incandescent lamp and the CFL/LED lamp are both within the expected range (0 to 1) and statistically significant with t-statistics of 5.21 and 6.85, respectively. The interpretation of nesting coefficients is different than that of other parameters in the model. The nesting coefficients measure the substitutability of alternatives within a nest. When alternatives within a nest are closer substitutes than alternatives outside the nest, the nesting coefficient is within range of 0 to 1. Thus, the nesting structure says that consumers view incandescent lamps differently than CFL and LED lamps. Consumers find that both incandescent lamp alternatives are good substitutes compared to CFL and LED lamps. A sale on CFL twisters will pull more market share from CFL A-Lamps and LED lamp than from incandescent lamps.

Figure 10: Nesting Structure



As part of the estimation process, we tested several other relationships that we were not able to include in the final specification. These relationships include:

- **Watts:** Less energy efficient lamps are more costly to operate. As such, we would expect a coefficient on watts to have a negative sign as watts is a proxy for operating costs. However, we were not able to estimate a satisfactory equation that included watts, price, and alternative specific constants due to co-linearity. Within a lumen bin, the watts for incandescent lamps, CFLs, and LEDs do not overlap. The watts variable does not provide additional information beyond the alternative specific constant. As a result, the estimation produced a positive coefficient on watts. Moreover, the significance of watts parameter dropped and the magnitude of watts parameter value changed. Incandescent lamps tend to have both lower prices and higher watts than CFLs and LEDs.
  Instead of using watts to measure different operating costs, we let the coefficient on price vary by alternative. The theory behind this approach is that consumers recognize that lighting technologies are not exactly equivalent and some of the differences vary with price. Although LEDs cost more, they are less expensive to operate. This approach allowed us to indirectly capture differences in the operating costs that should influence consumer choice.
- **Expected useful life:** Similar to the proceeding discussion on watts, we expect that consumers are willing to pay more for lamps that last longer. However, the expected useful life of an incandescent lamp tends to be less than the expected useful life of a CFL and LEDs are expected to last longer than CFLs. Thus, the expected useful life is co-linear with the alternative specific constant. Thus, the alternative specific constant includes expected useful life in addition to other excluded attributes.
- **Promotional activity:** The placement of products within the store and signage draw attention to products and will often increase the sales. We were not able to draw

statistically significant conclusions on the role promotional activity plays in consumer choice. This was likely due to the limited amount of promotional activity that we observed during our site visits.

6.3.1.8 Reflector Model

The estimation data for the Reflector model consists of 700 observations from purchasers. Figure 11 shows the distribution of observations across retail channels and by the first choice the respondent. Each observation is from a purchaser. The observations reflect the preferences and cost elasticities of consumers buying lamps rather than reflecting what respondents in a hypothetical situation say.

Figure 11: Reflectors Observations by First Choice

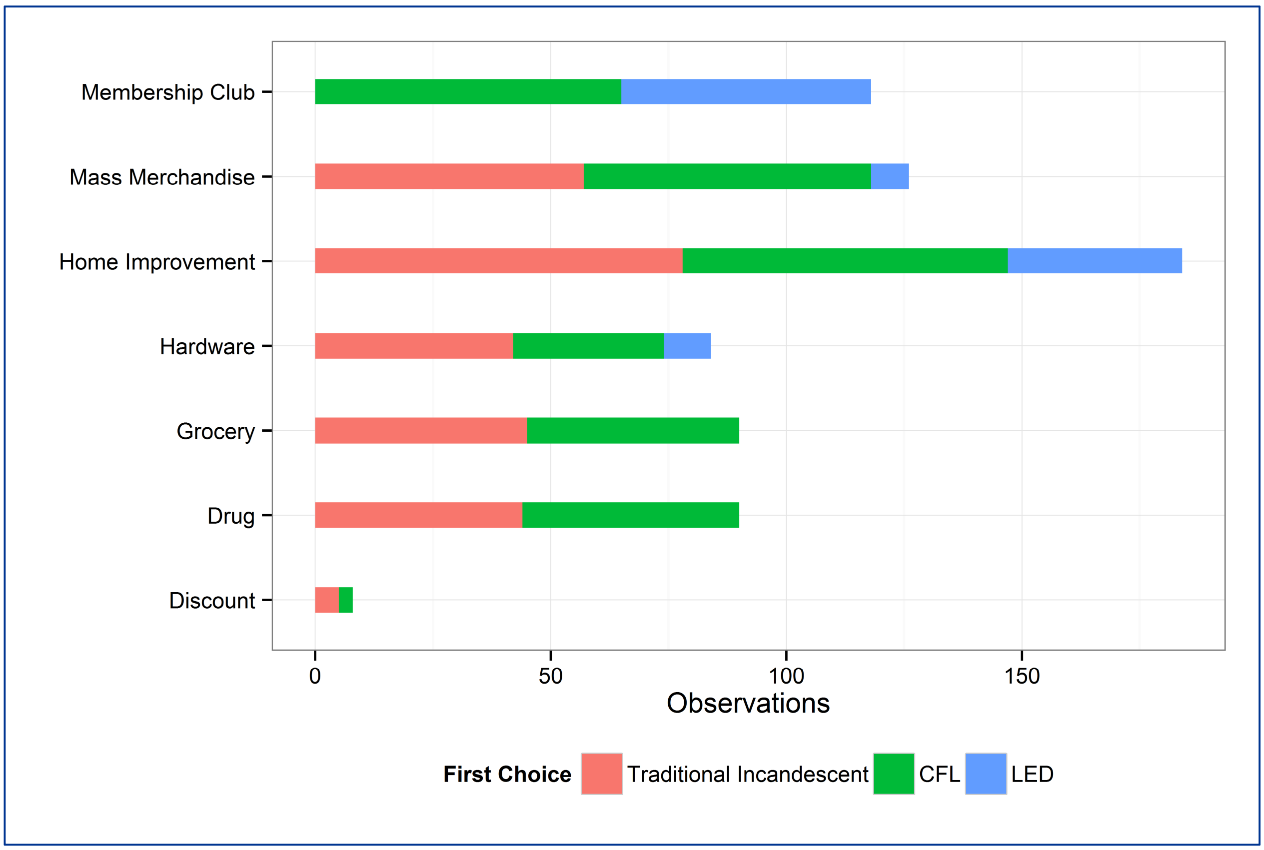


Figure 11 shows the coefficient values and statistical significance for each of the parameters in the Reflector model. The pseudo R^2 is 0.54. The Reflector model has a similar structure to the A-Lamp/Twister model show in Section 6.3.1.7. The primary differences are:

- **Less price sensitivity:** The parameter on generic price (-0.11) has smaller magnitude than the A-Lamp/Twister model (-0.38). Consumers buying reflectors place relatively less emphasis on price when buying a reflector compared to an A-Lamp or Twister.
- **No differences in price sensitivities by technology:** The A-Lamp/Twister model contains price coefficient specific to technology. A-Lamps and Twisters have product characteristics that are correlated with price and technology. However, A-Lamps and Twisters are somewhat homogenous within a style/technology. Reflectors, in contrast, have features that are not correlated with technology. Incandescent, CFL, and LED lamps all can all have different beam angles and light diffusion characteristics.
- **No nesting structure:** The A-Lamp/Twister model benefited from a nesting structure since traditional and EISA incandescent lamps are close substitutes. That is not the case for reflectors. We attempted to estimate a nesting structure with incandescent reflectors in one branch and CFL and LED reflectors in another branch. The estimated nesting coefficient was over 1.0 and not within the theoretical range.
- **Fewer channels:** Reflectors are primarily available in the hardware, home improvement, and mass merchandise retail channels. We were not able to estimate a model that included channel coefficients for drug, grocery, and membership stores.

Table 75: Estimated Parameter Values for the Reflector Model

Group	Parameter	Type	Value	T-Stat
Alternative Specific Constant	Incandescent Reflector	Alternative	0.20	0.40
	CFL Reflector	Alternative	0	-
	LED Reflector	Alternative	1.57	2.40
Price Sensitivity	Generic	Choice	-0.11	-7.22
	Income over $100k	Individual	0.02	1.03
	Unknown income	Individual	-0.03	-0.67
Hardware	Incandescent Reflector	Choice	0.40	0.97
	LED Reflect	Choice	-1.03	-1.82
Home Improvement	Incandescent Reflector	Choice	-0.40	-1.34
	LED Reflector	Choice	-0.27	-0.67

Group	Parameter	Type	Value	T-Stat
Mass Merchandise	Incandescent Reflector	Choice	-2.13	-0.60
	LED Reflector	Choice	-1.44	-2.45
Housing size 2 or more	Incandescent Reflector	Choice	-0.55	-1.14
	LED Reflector	Choice	-0.24	-0.39
Housing size 3 or more	Incandescent Reflector	Choice	0.59	1.71
	LED Reflector	Choice	0.56	1.21
Housing size 4 or more	Incandescent Reflector	Choice	-0.17	-0.47
	LED Reflector	Choice	-0.39	-0.83
Housing size 5 or more	Incandescent Reflector	Choice	-0.83	-2.25
	LED Reflector	Choice	-1.02	-1.89
Bedrooms, 3 or more	Incandescent Reflector	Choice	0.72	2.27
	LED Reflector	Choice	-0.30	-0.69
Renting	Incandescent Reflector	Choice	-0.31	-1.09
	LED Reflector	Choice	-0.15	-0.35

6.3.1.9 Globe Model

The estimation data for the Globe model consists of 410 observations from purchasers. Figure 12 shows the distribution of observations across retail channels and by the first choice the respondent.

Figure 12: Globe Observations by First Choice

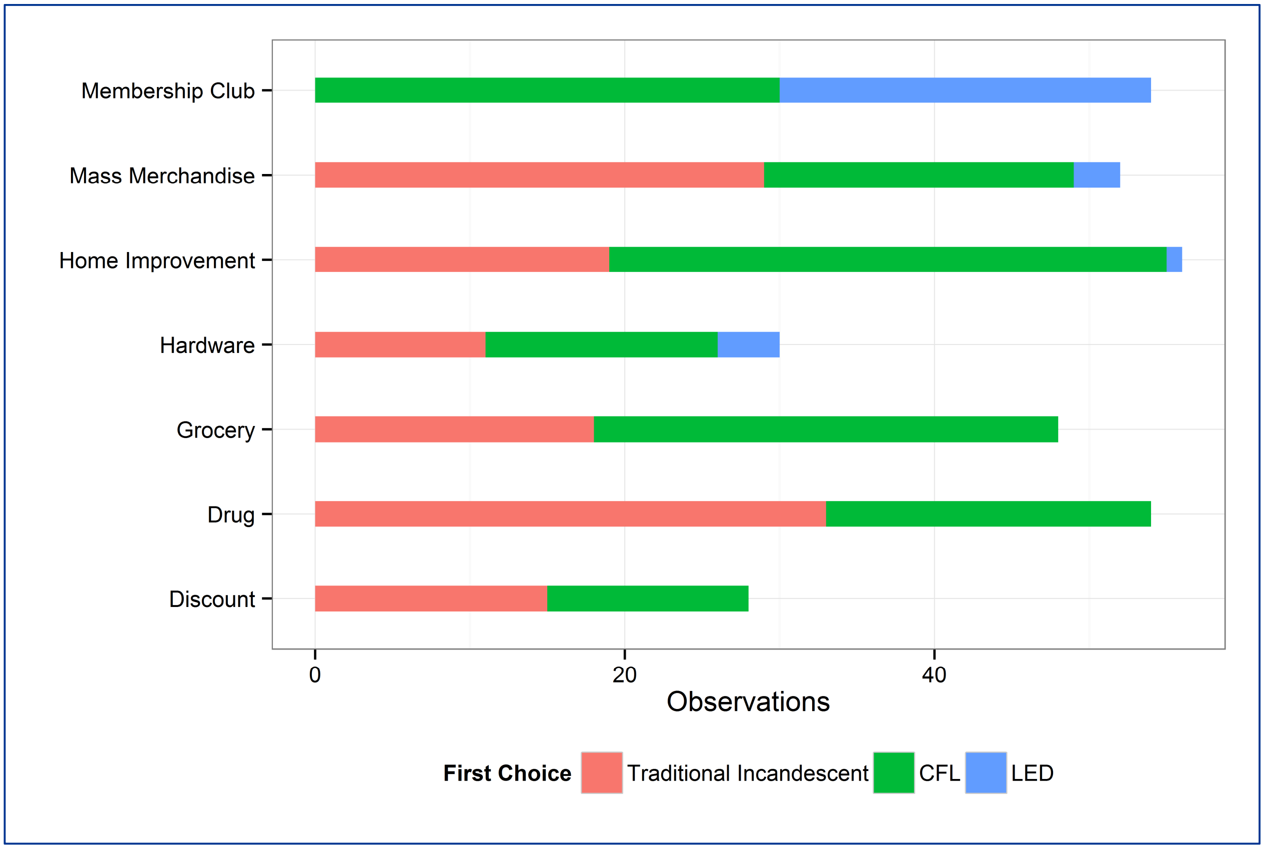


Table 75 shows the coefficient values and statistical significance for each of the parameters in the Reflector model. The pseudo R^2 is 0.54. The Reflector model has a similar structure to the A-Lamp/Twister model show in Section 6.3.1.7. The primary differences are:

- **Less price sensitivity:** The parameter on generic price (-0.27) has smaller magnitude than the A-Lamp/Twister model (-0.38) and a larger magnitude than the Reflector (-0.38). Consumers buying globes place relatively less emphasis on price when buying a globe compared to an A-lamp or twister, but more emphasis on price compared to a reflector.
- **No differences in price sensitivities by technology:** The A-Lamp/Twister model contains price coefficient specific to technology. The estimation results did not show the expected statistically relationships.
- **No income price sensitivity:** The estimation results showed that high-income consumers are *more* price sensitive than lower income consumers. Since this result runs counter to our experience and the data for this model is not as strong as the A-Lamp/Twister model, we did not stratify the price sensitivity by income.

- **No nesting structure:** We attempted to estimate a nesting structure with incandescent reflectors in one branch and CFL and LED reflectors in another branch. The estimated nesting coefficient was over 1.0 and not within the theoretical range.
- **No household or home size:** The globe data did not support parameters that controlled for the size of the house (for example, number of bathrooms and bedrooms) or the number of occupants.
- **No channels:** Globes are primarily available in the hardware, home improvement, and mass merchandise retail channels. We were not able to estimate a model that included channel specific constants for the Globe model.

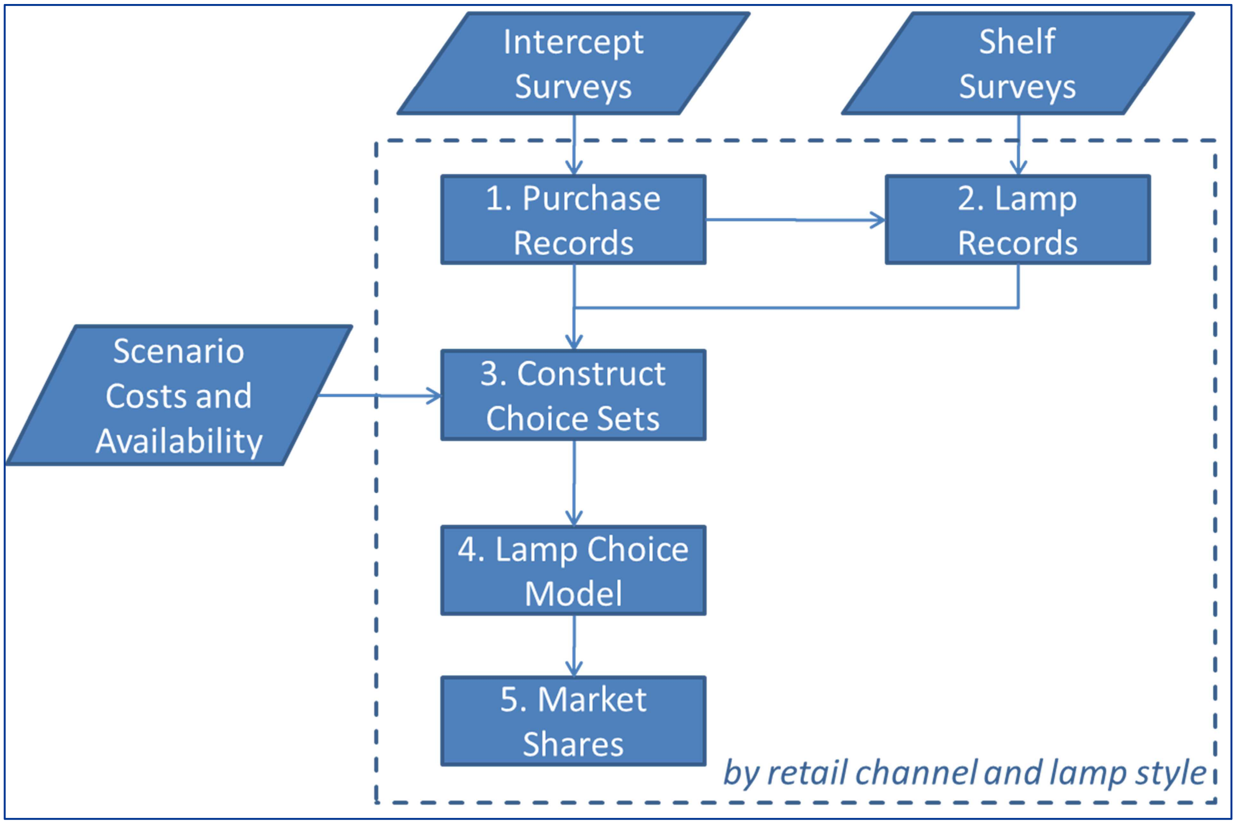
Table 76: Estimated Parameter Values for the Globe Model

Group	Parameter	Type	Value	T-Stat
Alternative Specific Constant	Incandescent Globe	Alternative	-1.01	-2.85
	CFL Globe	Alternative	0	-
	LED Globe	Alternative	0.94	1.99
Price Sensitivity	Generic	Choice	-0.27	-4.57
Renting	Incandescent Globe	Choice	2.08	2.66
	LED Globe	Choice	-1.56	-2.10

6.3.1.10 Model Application

The LCM estimates the probability that an individual will choose a particular alternative from a set of all alternatives. The market share is the sum of applying the model across all individuals in the market by lamp style. Figure 13 shows the process for estimating market shares.

Figure 13: Overview of the Market Shares Calculation



The process combines intercept data on choice with shelf survey records to form choice sets. The choice sets are the input to the LCM. The details of the algorithm are as follows:

Select purchase records from the intercept survey: The intercept survey contains data on lamp purchasers. The survey records the retail channel and applications use of purchases and demographics of the purchaser. The intercept survey is the most complete source of information on customers making lighting purchasers by retail channel.

This step selects records by retail channel and lamp style. These purchase records reflect the distribution of application uses and demographics of purchasers. Each record contains the following attributes:

- Store Id
- IOU territory
- Brand group (national brand or not)
- Intended room
- Intended fixture
- Dimmable requirement

- Three-way requirement
- Geographic region
- Retail Channel
- Storage or installation
- Tenure (own or rent the home)
- Number of bathrooms in the home
- Income level
- Education level
- Number of household members
- Number of bedrooms in the home

Draw lamp records from the shelf survey: The shelf survey data contains data on the lamp prices by lamp technology, shape, brand category, store, and IOU territory. The shelf survey records contain a complete listing of the product attributes (for example, brightness and expected life) for each lamp.

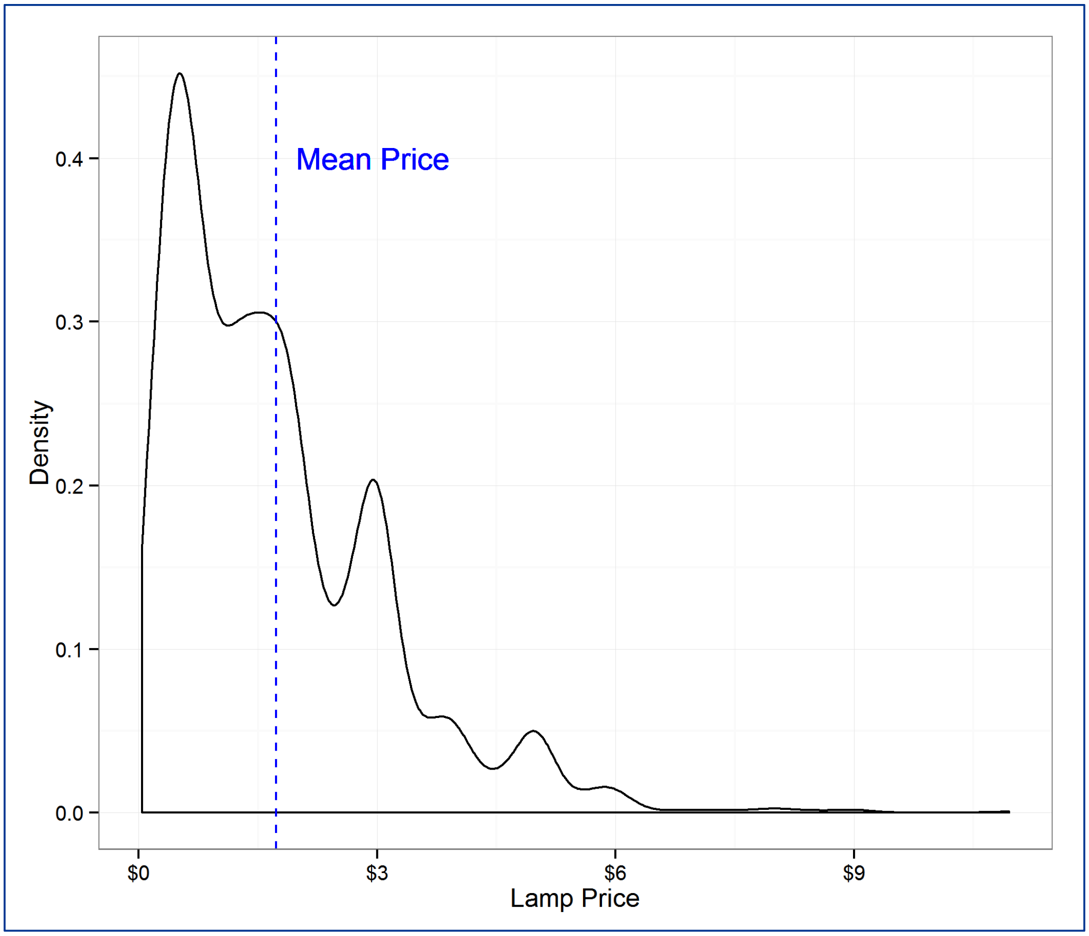
This step draws records from shelf survey records that match the store, brightness group, and lamp style of the purchase record. The shelf survey potentially contains a large number of lamps that fit the purchase criteria. The selection process randomly draws (with replacement) a set of records that meet the criteria.

One important aspect of this step is that we match intercept records with shelf survey by store location. This ensures that the process is able to capture program differences by IOU. The ULPs did not rebate the same products at the same levels over the same time periods. Moreover, each of the utility territories has different demographic profiles. Matching by store allows the process to reflect differences at the IOU level.

We limit the lamps to be in the same lumen bin category. That is a consumer looking for a high lumen lamp from seeing high lumen LED lamps as an available choice. Our assumption is that a consumer is only willing to accept lamps that are functionally equivalent.

This technique is known as simulation. The technique samples observed records in order to form the distribution of prices and lamp attributes. A contrasting approach uses the average sales price as the input to the LCM. Sales prices do not tend to follow a normal distribution nor are they always symmetrical around the mean. Figure 14 gives an example of lamp prices using shelf data from fall 2011 in the Home Improvement retail channel. The mean price, shown with a dashed blue line, is close to $0.50 more than the most common price. Using the full distribution of observed prices closely mimics what purchasers encounter in stores and is what survey respondents saw during the stated preference choice ranking.

Figure 14: Price Distribution and Mean Price of Incandescent A-Lamp in Home Improvement



Each of the lamp records contains the lamp price, rated life, watts, and the amount program discount in the price, if any.

Construct choice sets: The lamp prices need to reflect prices that are consistent with the scenario. For the baseline scenario, this step removes the IOU discounts from the price of incentivized products. In some retail channels, for example, discount, stores do not regularly stock more expensive lamps as the store caters to very price sensitive customers. Where this is the case, this step marks the alternative as not available for the LCM.
This step results in choice sets for the LCM.
Apply the LCM: The LCM uses the choice sets developed in step 0 and a set of estimated parameter values as inputs. The model assigns a probability to each alternative for each choice set.
Compute market shares: The market shares are the summation of individual level probabilities computed in step 0 over all records by retail channel and lamp style. The overall market share is the sales weighted average across retail channels by lamp style.

6.3.1.11 Net-to-Gross Ratio Calculation

Utility incentive programs attract purchasers who would have otherwise bought the incentivized product. This situation is usually termed free ridership. Since a free rider does not change her or his choice as a result of the incentives, the program cannot claim savings for this activity. The NTG ratio is the percentage difference from baseline to program market shares for program lamps as shown in Equation 5. The NTG ratio is 1 when the entire market share is due to the program. The NTG is 0 when the market share is the same under program and non-program conditions.

$$NTG = \frac{Program - Baseline}{Program} \qquad (5)$$

The NTG ratio only applies to what happens with program lamps. Thus the program and baseline variables refer to the market shares of program lamps.

6.3.2 The Supplier Self Report Methodology

This section describes the methodology we used to develop net-to-gross estimates from the supplier self-report methodology.

6.3.2.1 Background

The Supplier Self Report methodology asks market actors at three different levels of the lighting supply chain – lighting manufacturers, lighting buyers for large retail chains, and store/product managers at individual stores – to estimate how their lighting sales would be affected if the ULP and its buydown/markdown price discounts were not available. Program evaluators have been using the Supplier Self Report methodology to estimate net-to-gross ratios for the California ULP since the 2004-2005 program cycle. Evaluators have also been using this methodology to estimate net-to-gross methodologies for ULPs in a number of other states including Massachusetts, New Jersey, Illinois, and New Mexico.

Like all net-to-gross methodologies, the Supplier Self Report method it has its advantages and disadvantages. The following subsections discuss these advantage and disadvantages.

Advantages of the Supplier Self Report Methodology

Some of the advantages of the methodology include:

- T***he supplier net-to-gross questions mirror the "real-world" sale estimates that the suppliers must make through their participation in the ULP:*** The Supplier Self Report methodology asks suppliers to estimate the change in their volume of lighting product sales in the absence of the program. These types of questions align well with the "real world" sales estimations that these suppliers must make to successfully participate in the program. As part of their participation, manufacturers and large retail lighting buyers must submit proposals to the California IOUs on which types and volumes of light bulbs they expect to sell through which retail channels. There are negative consequences if they significantly overestimate or underestimate these expected sales.
    - Significantly overestimating these expected sales can make the retailers they supply unhappy because most retailers do not like to dedicate limited floor space to products that have slow sell-through and many smaller retailers have very limited storage/warehousing capacity. In addition, overestimating expected sales can make ULP program managers unhappy because it creates a risk that retailers with overstocks of lighting products will try to resell these bulbs, which could lead to "leakage" – the sale of ULP-discounted bulbs outside of California.
    - Significantly underestimating expected sales can also make retailers unhappy because if they run out of the ULP-discounted lighting products before their competitors do, they will be at a competitive disadvantage. ULP program managers also do not like significant underestimates of expected sales because it means that they have reserved incentive dollars that did not produce the expected energy savings.

    These constraints mean that lighting suppliers are forced to take the task of estimating program-induced lighting products sales very seriously and it is not an "academic exercise" for them.
- ***The methodology can produce NTG estimates that cover a very large percentage of program bulbs:*** Because the Supplier Self Report methodology includes interviews with lighting manufacturers at the very top of the supply chain, the methodology can produce NTG estimates that cover a very large percentage of the program-discounted lighting products. For example, the 2013 (Wave 2) lighting manufacturer interviews produced

NTG estimates for over 97 percent of the 2010-2012 program-discounted lighting products with only a couple dozen interviews.

- ***The methodology can produce NTG estimates for retail channels and bulb types which can be difficult to obtain through other methods:*** Some retail stores can be difficult to cover through shopper intercept surveys because they have a very low volume of lighting sales (for example, grocery and drug stores), or there are language barriers (for example ethnic grocery stores), or because the retailer's corporate office did not give permission for the surveys. Similarly, some lighting products, that have relatively low volumes of sales, can be difficult to cover through shopper intercept surveys because surveyors must wait, in some cases, for hours or even days for a single purchase. However, the Supplier Self Report methodology can provide NTG estimates for these retail channels and lighting products relatively easily.
- T***he suppliers have useful market knowledge about product availability:*** Interviews with lighting suppliers can collect very useful information about which lighting products retailers are likely to stock or even whether they would stock any lighting products at all absent the ULP. For example, our supplier interviews have revealed in past years that dollar/99 cent stores cannot sell ENERGY STAR CFLs without program support because the production costs of these CFLs exceed the dollar/99 cent retail price caps.
- T***he methodology can allow for consistency checks at different levels of the supply chain:*** Because the Supplier Self Report can collect up to three different NTG estimates (lighting manufacturer, retail lighting buyer, store manager) for the same "stream" of bulbs (for example, bulbs of a certain type sold through a certain retail chain), it can allow for some internal consistency checks between these NTG estimates. These consistency checks can help alert the program evaluators to possible gaming of NTG estimates and otherwise increase evaluator confidence in these estimates.

Disadvantages of the Supplier Self Report Methodology

Some of the disadvantages of the methodology include:

- ***Lighting suppliers have some incentive to overestimate program effects on lighting sales:*** Because the Supplier Self Report methodology has been used to produce NTG estimates for ULPs for many years, many lighting suppliers are aware that producing a higher NTG ratio for a given lighting program or lighting product category can increase the chance that buydown discounts and other program subsidies will continue to be available for those programs or lighting product types. This awareness may produce a "don't kill the golden goose" type of bias in which some lighting suppliers purposely overestimate the program effects on lighting sales to increase the chance that the program lighting subsidies will continue.

- ***Lighting retailers may have biases that cause them to underestimate program effects on lighting sales:*** A 2008 report from the DEER Consultant Team for the CPUC Energy Division pointed to the potential for major retailers who promote energy-efficient lighting as part of their corporate "green" strategy to overestimate the relative impacts of these "green" promotional campaigns compared to the price impacts of the ULP buydown discounts.[16] "There is at least some evidence to suggest that the sales executives in this segment may have an interest in describing the surge in sales for their chain as the results of a private initiative to become green or responsible retailers as opposed to working with government/utility programs," the report said.
- ***Some market actors may provide NTG estimates based on incomplete market knowledge:*** The best example of this is the sale of ENERGY STAR CFLs in dollar/99 cent stores. As noted above, lighting manufacturers have consistently reported that even basic spiral ENERGY STAR CFLs cannot be produced for less than $1 per bulb. Therefore there is no way that lighting manufacturers could profitably supply these dollar/99 cent stores with ENERGY STAR CFLs. Yet because they lack this crucial market knowledge, many store managers in dollar/99 cent stores still estimate that their stores would sell some ENERGY STAR CFLs in the absence of ULP buydown discounts.

Data Collection Efforts

We attempted in-depth interviews with lighting manufacturer and large retail lighting buyers in two waves. The first wave of interviews occurred in the third and fourth quarters of 2012. The second wave occurred in the third and fourth quarters of 2013.

We used various sample frames depending on the data available at the time and the research objectives. The 2012 wave of interviews used a participant sample frame that only included manufacturers and retailers who had participated in the program during the 2010-Q3 2011 program period (this was the most current program tracking dataset available at the time). The 2013 wave of interviews used a participant sample frame that was based on the complete 2010-2012 tracking data.

In the 2012 wave we added a few nonparticipating lighting manufacturer interviews to make sure that for the lighting market trends we were exploring (for example, the impacts of EISA legislation, the development of the LED market), the nonparticipating manufacturers did not have a different perspective on these market trends than the participating manufacturers. For these 2012 nonparticipant lighting manufacturer interviews we developed a sample frame by

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16 "Documentation for DEER Net to Gross Update," Prepared by DEER Consultant Team for the CPUC Energy Division, May 2, 2008.

first using our retailer light bulb inventories to identify all the manufacturers who were selling light bulbs at retail in California and then removing from this larger list the program-participating manufacturers. For the 2013 wave we focused only on participating lighting manufacturers and large retail lighting buyers.

Table 77 shows the number of in-depth interviews by wave and market actor category. It also shows what percent of the ULP shipments were represented by the market actors with which we completed interviews. The higher number of interviews in the 2013 wave was due to a more sustained effort by the evaluation team, assistance by the IOUs in providing better contact information and persuading program participants to complete the interviews, and a larger sample frame (the introduction of LED bulbs in 2012 increased the number of participating manufacturers from 24 to 30).

Table 77: Summary of In-Depth Interviews with Lighting Manufacturers and Retail Lighting Buyers

Market Actor Category	2012 Wave (Q3-Q4 2012)		2013 Wave (Q3-Q4 2013)	
	# of Interviews	% of ULP Bulb Shipments Represented by Interviewees	# of Interviews	% of ULP Bulb Shipments Represented by Interviewees
Participating lighting manufacturers	12.5	95%	25.5	98%
Nonparticipating lighting manufacturers	3	Not applicable	None attempted	Not applicable
Participating retail lighting buyers	0	0%	7	13%
Total	**15.5**		**32.5**	

Notes: For the 2012 wave the number of interviews included 11 complete interviews and three partial interviews. For the 2013 wave the number of interviews included 25 complete interviews and one partial interview. For the 2012 wave, the percent of bulb shipments was for the shipments that had occurred from 2010 through the third quarter of 2011. For the 2013 wave, the percent of bulb shipments was for the shipments that had occurred from 2010 through the fourth quarter of 2012.

Deriving Net-to-Gross Estimates from the Interview Questions

From our experience evaluating the ULP over many years, we know that many participating lighting manufacturers report that they would not be able to supply certain retail channels or sub-channels without the ULP discounts. This is especially true of those lighting manufacturers who serve retail channels such as Discount or sub-channels such as small, ethnic Grocery where retailers will only take bulbs if they are free or heavily discounted. So the initial question in our standard battery of net-to-gross questions is the following screening question:

Question 6-1: *Do you think your company would have been selling CFL products during this 2010-2012 time period if the discounts of $0.15 to $3.50 per bulb from this program had not been available?*

Question 61 (a): *[IF YES] Which retailers or retailer categories?*

For all cases where the lighting manufacturers identified that they would not be selling CFLs through a specific retail channel without the ULP, we assigned a net-gross ratio of 100 percent (0 percent free ridership) to these bulbs. For all cases where the manufacturers indicated they would have sold CFLs through a retail channel without the program (for example, they responded "Yes" to question 6-1), we asked them a follow-up question similar to 6-2.[17]

Question 6:2: *According to our records, in the 2010-2012 period you received California Upstream Lighting Program manufacturer buydown discounts of $0.15 to $2.75 per bulb for the sale of non-specialty CFL bulbs through [RETAILER CATEGORY] such as [NAME RETAILER EXAMPLE]. If these manufacturer buydown discounts and program promotional materials had not been available during this 2010-2012 period, do you think your sales of these types of non-specialty Energy Star CFL bulbs would have been about the same, lower, or higher?*

Question 6:2 (a): *[IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE]*

Question 6.2 (b): *[IF LOWER] By what percentage do you estimate your sales of non-specialty Energy Star CFL bulbs through [RETAILER CATEGORY] would be lower during this 2010-2012 period if these manufacturer buydowns and program promotional materials for non-specialty CFLs had not been available? [RECORD % DECREASE]***]**

Follow-up: I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM QUESTION 0] percent lower without the manufacturer buydowns. So if you actually sold 100 non-specialty CFLs in a given week, you think

[17] The questions for other bulb types were similar with the substitution of the bulb type names and the discount amounts.

you'd have sold only about [100 – (PERCENTAGE FROM QUESTION *o.* * 100)] in that period if the manufacturer buydowns hadn't been available? [IF RESPONSE IS ≠ YES THEN CLARIFY ESTIMATED SALES DECREASE]

We used the manufacturer's reply to question 6-2 (a) or 6-2 (b) to estimate the net-to-gross ratios for that retailer category and bulb type. For example, if Manufacturer X said that their sales of non-specialty CFLs through the Grocery channel would decline 60 percent in the absence of the program, we would assign a net-to-gross ratio of 0.6 to the volume of ULP-discounted non-specialty CFLs that manufacturer X sold through this channel. We used a very similar set of free ridership questions for the large retail lighting buyers except we asked them to only estimate the impact of the unavailability of the ULP on their own lighting product sales.

The next step was to provide retail channel-specific net-to-gross ratios for each major bulb type (non-specialty CFLs, specialty CFLs, and LED bulbs). We combined the bulb-specific and channel-specific NTG estimates using sales/shipment weights. For example, if Manufacturer X sold 1 million non-specialty CFLs through the ULP and Manufacturer Y sold 2 million non-specialty CFLs through the ULP, we gave Manufacturer Y's net-to-gross estimate twice the weight of Manufacturer X's net-to-gross estimate.

In addition to the standard battery of net-to-gross questions, we also asked the lighting manufacturers and large retail lighting buyers a number of other questions that also explored the program's impact on their lighting sales. As discussed above, lighting manufacturers especially have the incentive to "game" their responses to exaggerate the program impacts. Therefore these questions served as additional "checks" to make sure that the lighting manufacturers or retail buyers were telling a consistent story. These "consistency check" questions included:

- 2.8 In the past year did you experience any periods where program-discounted CFLs or LED bulbs were not available due to delays in program startup or because product allocations for program-discounted bulbs ran out?
- 2.9 When discounts from the Upstream Lighting Program were not available, did you sell Energy Star CFL or LED bulbs in California?
- 2.10 Now I am going to ask you what percentage of your California sales of non-specialty CFLs are through the program. As a reminder, by non-specialty CFLs I mean basic spiral CFLs that fit into a medium-base socket. Please provide your best estimate of what percent of non-specialty CFL bulbs that you sold in California during the 2010-2012 period fit into the following categories:
    - First consider the non-specialty CFL bulbs that were discounted by the California Upstream Lighting Program (ULP). About what percent non-specialty CFL bulbs that you sold in California during the 2010-2012 period did these account for?

- Next consider the non-specialty CFL bulbs that were not discounted by the program. About what percent of non-specialty CFL bulbs that you sold in California during the 2010-2012 period did these account for?

- 10.6 If California eliminated its CFL rebate and discount programs starting in 2014 what effects would this have on the sales levels of specialty CFL products in California?

6.3.3 Retail Manager Telephone CATI Survey

The net-to-gross rates for the retailer analysis were estimated using a series of attribution questions posed to store managers in the sample. The attribution questions related to basic CFLs were labeled in the survey instrument as A1 through A6, whereas attribution for specialty CFLs was determine by questions A7 through A14. These attribution questions were designed to identify what would have happened in the absence of the program. The net-to-gross is then calculated as the ratio of the increase in sales of energy efficient bulbs and the total number of program bulbs sold.

All net-to-gross results in the retailer analysis were weighted by the volume of sales of basic or specialty CFLs of each of the retailers in the sample. In other words, a retailer that sold a larger number of CFLs during the analysis period would have a larger weight in the net-to-gross results. The volume of CFL sales were calculated from tracking data provided by the California IOUs, and matched to the stores by retailer name, address, and phone number. Prior to calculating the sales weights, the tracking data was cleaned to avoid including accounting artifacts, such as "adder for specialty bulbs" in SDG&E or carry-over "CFL installations from the 2006-2009 cycle" in PG&E.

Confidence intervals at the 90 percent level were calculated for all net-to-gross estimates. These confidence intervals were derived taking into several issues that could affect the standard errors of a ratio estimator. The confidence intervals took into account both the sample stratification and the clustering around the respondent, that is, the primary sampling unit. In addition, DNV GL used robust statistical procedures to estimate the standard errors of the ratio. The reported confidence intervals were calculated via Taylor series, but replication methods were also tested and did not yield distinguishable results.

6.3.3.1 Notes

Order of Questions

- A1. Would have sold any CFLs without program?
    - Yes
        - A2. Without the program, would the sales be:
            - Same
            - Lower
                - A4. By what percentage lower?

- Higher
    - o A6. By what percentage higher?
- o No

Table 78: Calculation Example

	A1: If the discounts of \$0.30-\$3.50 per standard spiral CFL were not available, do you think your store(s) would have sold these types of CFLs in the 2010-2012 period?	A2: If the discounts of \$0.30-\$3.50 per standard spiral CFL were not available, do you think your sales of these CFL bulbs would be about the same, lower, or higher?	A4: By what percentage do you estimate your store's sales of these standard spiral CFLs would be lower during this 2010-2012 period if <IOU> discounts per CFL bulb were not available?	NTG estimate	# of standard CFLs sold through program	Product/ Channel NTG Estimate
Store Manager 1	2			100%	5,000	69%
Store Manager 2	1	2	40	40%	10,000	
Store Manager 3	1	2	90	90%	2,000	
Store Manager 4	1	2	80	80%	8,000	

6.3.4 Multi-State Model

A full methodology of the Multi-State Model can be found in Appendix F of this report.

The results from the MSM were assigned a weight of zero in the NTG framework. The decision to not give any weight in the NTG framework was reached after considering the strengths and weaknesses of the MSM when applying it to the California market. The weakness in the MSM included multiple factors; the time lapse between the original data collection and modeling effort to the current evaluations, the model only producing statewide results, as well as the differences between the more mature California market and the comparison markets used in the model estimation. Ultimately, it was decided that these weaknesses outweighed the strengths of a market wide approach for this evaluation, and the MSM was not factored into the final NTG framework.

7. References

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8. Glossary

ANCOVA	analysis of covariance
CATI	Computer-Aided Telephone Interview
CARE	California Alternate Rates for Energy
CCD	Cooling Degree Days
CF	coincidence factor
CFL	compact fluorescent lamp
CLASS	California Lighting and Appliance Saturation Survey
CPUC	California Public Utilities Commission
CSS	Commercial Market Share Tracking Commercial Saturation Study
DEER	Database for Energy Efficient Resources
EISA	Energy Independence and Security Act of 2007
FERA	Family Electric Rate Assistance
GWh	Gigawatt hour
HIM	high-impact measure
HOU	hours-of-use
IOU	investor-owned utility
IPF	iterative proportional fitting
ITF	iterative proportional fitting
kW	kilowatt
kWh	kilowatt hour
LCM	Lamp Choice Model
LED	light-emitting diode
MSB	medium screw base
MW	Megawatt
n/a	not applicable
NTG	net-to-gross
NTGR	net-to-gross-ratio
PG&E	Pacific Gas and Electric Company
RASS	Residential Appliance Saturation Survey
SCE	Southern California Edison Company
SDG&E	San Diego Gas & Electric Company
UES	unit energy savings
ULP	Upstream Lighting Program

W	watt
WO	work order

9. Appendices

A. Appendix A – Ex Post Savings Calculations by Measure

The imbedded spreadsheet in Appendix A contains a measure-by-measure comparison of ex ante savings claims from the program tracking data with the corresponding evaluated parameters and UES calculations.

FINAL SPREADSHEET WILL BE INCLUDEDWITH FINAL REPORT

B. Appendix B – Statistical Tests of Differences

B.1 Saturation

Table 79: Residential Saturation Levels: Basic Spiral and A-Lamps (Table 13)

	Lamp Type	PG&E	SCE	SDG&E	Overall
2012 Saturation Levels	**CFL Spiral**	50.5%	47.8%	49.0%	49.1%
	CFL A-lamp	1.9%	1.7%	2.7%	1.9%
	Incandescent A-lamp	46.9%	49.6%	47.1%	48.1%
	LED A-lamp	0.6%	0.5%	0.5%	0.6%
	Other A-lamp	0.1%	0.4%	0.7%	0.3%
2012 Number of Households	**CFL Spiral**	798	788	397	1,983
	CFL A-lamp	798	788	397	1,983
	Incandescent A-lamp	798	788	397	1,983
	LED A-lamp	798	788	397	1,983
	Other A-lamp	798	788	397	1,983
2012 90% CI Bound	**CFL Spiral**	0.02	0.02	0.03	0.01
	CFL A-lamp	0	0	0.01	0
	Incandescent A-lamp	0.02	0.02	0.03	0.01
	LED A-lamp	0	0	0	0
	Other A-lamp	0	0	0	0
2009 Saturation Levels	**CFL Spiral**	37.9%	35.8%	33.8%	36.5%
	CFL A-lamp	1.4%	1.0%	1.0%	1.2%
	Incandescent A-lamp	60.5%	62.8%	64.2%	61.9%
	LED A-lamp	0.0%	0.0%	0.0%	0.0%
	Other A-lamp	0.3%	0.3%	1.1%	0.4%
2009 Number of Households	**CFL Spiral**	497	486	248	1,231
	CFL A-lamp	497	486	248	1,231
	Incandescent A-lamp	497	486	248	1,231
	LED A-lamp	497	486	248	1,231
	Other A-lamp	497	486	248	1,231

	Lamp Type	PG&E	SCE	SDG&E	Overall
2009 90% CI Bound	**CFL Spiral**	0.03	0.02	0.04	0.02
	CFL A-lamp	0	0	0.01	0
	Incandescent A-lamp	0.03	0.02	0.04	0.02
	LED A-lamp	0	0	0	0
	Other A-lamp	0	0	0	0
Difference	**CFL Spiral**	*12.6%*	*11.9%*	*15.2%*	*12.7%*
	CFL A-lamp	0.5%	0.7%	1.7%	0.7%
	Incandescent A-lamp	-13.6%	-13.2%	-17.1%	-13.9%
	LED A-lamp	0.6%	0.5%	0.5%	0.6%
	Other A-lamp	-0.2%	0.1%	-0.4%	-0.1%
Difference t-statistic	**CFL Spiral**	149.69	146.66	78.65	369.78
	CFL A-lamp	35.34	46.7	47.39	122.07
	Incandescent A-lamp	-160.24	-159.5	-89.4	-401.56
	LED A-lamp	109.64	65.95	47.54	209.79
	Other A-lamp	-38.46	17.86	-20.73	-38.33
Difference p value	**CFL Spiral**	0	0	0	0
	CFL A-lamp	0	0	0	0
	Incandescent A-lamp	0	0	0	0
	LED A-lamp	0	0	0	0
	Other A-lamp	0	0	0	0

Table 80: Residential Saturation Levels: Basic Spirals and A-Lamps (Table 21)

	Lamp Type	PG&E	SCE	SDG&E	Overall
2012 Saturation Levels	CFL Spiral	50.5%	47.8%	49.0%	49.1%
	CFL A-lamp	1.9%	1.7%	2.7%	1.9%
	Incandescent A-lamp	46.9%	49.6%	47.1%	48.1%
	LED A-lamp	0.6%	0.5%	0.5%	0.6%
	Other A-lamp	0.1%	0.4%	0.7%	0.3%
2012 Number of Households	CFL Spiral	798	788	397	1,983
	CFL A-lamp	798	788	397	1,983
	Incandescent A-lamp	798	788	397	1,983
	LED A-lamp	798	788	397	1,983
	Other A-lamp	798	788	397	1,983
2012 90% CI Bound	CFL Spiral	0.02	0.02	0.03	0.01
	CFL A-lamp	0	0	0.01	0
	Incandescent A-lamp	0.02	0.02	0.03	0.01
	LED A-lamp	0	0	0	0
	Other A-lamp	0	0	0	0
2009 Saturation Levels	CFL Spiral	37.9%	35.8%	33.8%	36.5%
	CFL A-lamp	1.4%	1.0%	1.0%	1.2%
	Incandescent A-lamp	60.5%	62.8%	64.2%	61.9%
	LED A-lamp	0.0%	0.0%	0.0%	0.0%
	Other A-lamp	0.3%	0.3%	1.1%	0.4%
2009 Number of Households	CFL Spiral	497	486	248	1,231
	CFL A-lamp	497	486	248	1,231
	Incandescent A-lamp	497	486	248	1,231
	LED A-lamp	497	486	248	1,231
	Other A-lamp	497	486	248	1,231
2009 90% CI Bound	CFL Spiral	0.03	0.02	0.04	0.02
	CFL A-lamp	0	0	0.01	0
	Incandescent A-lamp	0.03	0.02	0.04	0.02
	LED A-lamp	0	0	0	0
	Other A-lamp	0	0	0	0

	Lamp Type	PG&E	SCE	SDG&E	Overall
Difference	CFL Spiral	*12.6%*	*11.9%*	*15.2%*	*12.7%*
	CFL A-lamp	0.5%	0.7%	1.7%	0.7%
	Incandescent A-lamp	-13.6%	-13.2%	-17.1%	-13.9%
	LED A-lamp	0.6%	0.5%	0.5%	0.6%
	Other A-lamp	-0.2%	0.1%	-0.4%	-0.1%
Difference t-statistic	CFL Spiral	149.69	146.66	78.65	369.78
	CFL A-lamp	35.34	46.7	47.39	122.07
	Incandescent A-lamp	-160.24	-159.5	-89.4	-401.56
	LED A-lamp	109.64	65.95	47.54	209.79
	Other A-lamp	-38.46	17.86	-20.73	-38.33
Difference p value	CFL Spiral	0	0	0	0
	CFL A-lamp	0	0	0	0
	Incandescent A-lamp	0	0	0	0
	LED A-lamp	0	0	0	0
	Other A-lamp	0	0	0	0

Table 81: Residential Saturation Levels: Reflectors (Table 29)

	Lamp Type	PG&E	SCE	SDG&E	Overall
2012 Saturation Levels	**CFL reflector**	13.4%	21.1%	18.6%	17.6%
	Incandescent reflector	59.7%	52.9%	67.9%	57.7%
	LED reflector	2.0%	0.9%	1.5%	1.4%
	Other reflector	24.9%	25.1%	12.0%	23.3%
2012 Number of Households	**CFL reflector**	546	601	296	1,443
	Incandescent reflector	546	601	296	1,443
	LED reflector	546	601	296	1,443
	Other reflector	546	601	296	1,443
2012 90% CI Bound	**CFL reflector**	0.03	0.03	0.04	0.02
	Incandescent reflector	0.04	0.03	0.05	0.02
	LED reflector	0.01	0	0.01	0.01
	Other reflector	0.03	0.03	0.03	0.02

	Lamp Type	PG&E	SCE	SDG&E	Overall
2009 Saturation Levels	**CFL reflector**	9.3%	14.3%	12.9%	12.0%
	Incandescent reflector	63.2%	64.2%	68.3%	64.3%
	LED reflector	0.3%	0.0%	0.0%	0.1%
	Other reflector	27.3%	21.5%	18.8%	23.6%
2009 Number of Households	**CFL reflector**	330	316	170	816
	Incandescent reflector	330	316	170	816
	LED reflector	330	316	170	816
	Other reflector	330	316	170	816
2009 90% CI Bound	**CFL reflector**	0.02	0.03	0.04	0.02
	Incandescent reflector	0.04	0.03	0.05	0.03
	LED reflector	0	0	0	0
	Other reflector	0.04	0.03	0.04	0.02
Difference	**CFL reflector**	*4.2%*	*6.7%*	*5.7%*	*5.6%*
	Incandescent reflector	-3.5%	-11.3%	-0.4%	-6.6%
	LED reflector	1.7%	0.9%	1.4%	1.3%
	Other reflector	-2.4%	3.6%	-6.8%	-0.3%
Difference t-statistic	**CFL reflector**	42.72	53.26	24.34	120.09
	Incandescent reflector	-21.3	-67.1	-1.35	-99.12
	LED reflector	46.3	76.12	39.8	125.58
	Other reflector	-15.9	25.23	-28.63	-4.89
Difference p value	**CFL reflector**	0	0	0	0
	Incandescent reflector	0	0	0.18	0
	LED reflector	0	0	0	0
	Other reflector	0	0	0	0

Table 82: Residential Saturation Levels: Globes (Table 37)

	Lamp Type	PG&E	SCE	SDG&E	Overall
2012 Saturation Levels	**CFL Globes**	14.9%	15.3%	16.7%	15.3%
	Incandescent Globes	84.4%	84.0%	83.1%	84.1%
	LED Globes	0.6%	0.7%	0.2%	0.6%
	Other Globes	0.0%	0.0%	0.0%	0.0%
2012 Number of Households	**CFL Globes**	351	328	167	846
	Incandescent Globes	351	328	167	846
	LED Globes	351	328	167	846
	Other Globes	351	328	167	846
2012 90% CI Bound	**CFL Globes**	0.03	0.03	0.05	0.02
	Incandescent Globes	0.04	0.03	0.05	0.02
	LED Globes	0	0.01	0	0
	Other Globes	0	0	0	0
2009 Saturation Levels	**CFL Globes**	17.6%	11.9%	10.6%	14.3%
	Incandescent Globes	81.7%	88.1%	88.4%	85.2%
	LED Globes	0.0%	0.0%	0.0%	0.0%
	Other Globes	0.7%	0.0%	1.0%	0.5%
2009 Number of Households	**CFL Globes**	242	210	122	574
	Incandescent Globes	242	210	122	574
	LED Globes	242	210	122	574
	Other Globes	242	210	122	574
2009 90% CI Bound	**CFL Globes**	0.04	0.04	0.04	0.03
	Incandescent Globes	0.04	0.04	0.04	0.03
	LED Globes	0	0	0	0
	Other Globes	0.01	0	0.02	0
Difference	**CFL Globes**	-2.6%	3.4%	6.2%	1.0%
	Incandescent Globes	2.7%	-4.1%	-5.3%	-1.1%
	LED Globes	0.6%	0.7%	0.2%	0.6%
	Other Globes	-0.7%	0.0%	-1.0%	-0.5%

	Lamp Type	PG&E	SCE	SDG&E	Overall
Difference t-statistic	**CFL Globes**	-13.31	17.67	17.98	12.99
	Incandescent Globes	13.42	-21.22	-15.05	-14.81
	LED Globes	42.81	30.51	15.22	81.79
	Other Globes	-22.07		-11.09	-41.56
Difference p value	**CFL Globes**	0	0	0	0
	Incandescent Globes	0	0	0	0
	LED Globes	0	0	0	0
	Other Globes	0		0	0

B.2 Hours-of-Use (HOU)

Table 83: Comparison of 2006-2008 and 2010-2012 Residential HOU Estimates: Basic Spiral CFLs (Table 14)

	PG&E		SCE		SDG&E		Overall	
	HOU	**90% CI**	**SCE**	**90% CI**	**SDG&E**	**90% CI**	**Overall**	**90% CI**
2010-2012	**1.6**	0.2	**1.9**	0.2	**1.4**	0.2	**1.7**	0.1
2006-2008[18]	1.8	0.3	2.1	0.3	1.5	0.3	1.9	0.3
Difference	-0.2		-0.2		-0.1		-0.2	
Percentage Difference	-9%		-9%		-9%		-9%	
Difference t-statistic	-3.34		-3.39		-1.18		-4.38	
Difference p value	0		0		0.24		0	

[18] In the 2006-2008 evaluation (KEMA, Inc. and Cadmus Group 2010), Spiral and A-lamp results were combined.

Table 84: Comparison of 2006-2008 and 2010-2012 Residential HOU Estimates: A-Lamp CFLs (Table 22)

	PG&E		SCE		SDG&E		Overall	
	HOU	**90% CI**	**SCE**	**90% CI**	**SDG&E**	**90% CI**	**Overall**	**90% CI**
2010-2012	1.5	0.2	1.9	0.2	1.3	0.3	1.6	0.2
2006-2008[19]	1.8	0.3	2.1	0.3	1.5	0.3	1.9	0.3
Difference	-0.3		-0.2		-0.2		-0.3	
Percentage Difference	-18%		-10%		-13%		-15%	
Difference t-statistic	-1.82		-1.44		-0.87		-2.41	
Difference p value	0.07		0.15		0.39		0.02	

Table 85: Comparison of 2006-2008 and 2010-2012 Residential HOU Estimates: Reflector CFLs (Table 30)

	PG&E		SCE		SDG&E		Overall	
	HOU	90% CI	SCE	90% CI	SDG&E	90% CI	Overall	90% CI
2010-2012	1.7	0.3	1.9	0.2	1.2	0.4	1.7	0.2
2006-2008	1.7	0.4	2.2	0.3	1.4	0.4	1.9	0.3
Difference	0.0		-0.3		-0.2		-0.2	
Percentage Difference	-3%		-12%		-14%		-9%	
Difference t-statistic	-0.33		-1.89		-1.06		-1.84	
Difference p value	0.74		0.06		0.29		0.07	

19 In the 2006-2008 evaluation (KEMA, Inc. and Cadmus Group 2010), Spiral and A-lamp results were combined.

Table 86: Comparison of 2006-2008 and 2010-2012 Residential HOU Estimates: Globe CFLs (Table 38)

	PG&E		SCE		SDG&E		Overall	
	HOU	**90% CI**	**SCE**	**90% CI**	**SDG&E**	**90% CI**	**Overall**	**90% CI**
2010-2012	1.2	0.3	1.6	0.3	1.0	0.4	1.3	0.2
2006-2008	1.4	0.3	1.7	0.3	1.3	0.3	1.5	0.3
Difference	-0.2		-0.1		-0.3		-0.2	
Percentage Difference	-15%		-5%		-22%		-11%	
Difference t-statistic	-1.61		-0.63		-1.35		-1.78	
Difference p value	0.11		0.53		0.18		0.08	

B.3 Peak CFs

Table 87: Comparison of 2006-2008 and 2010-2012 Residential Peak CF Estimates: Basic Spiral CFLs (Table 15)

	PG&E		SCE		SDG&E		Overall	
	Peak CF	90% CI	Peak CF	90% CI	Peak CF	90% CI	Peak CF	90% CI
2010-2012	**5.4%**	1.3%	**6.7%**	1.4%	**4.4%**	1.8%	**5.8%**	1.0%
2006-2008[20]	5.6%	2.8%	7.2%	2.8%	4.4%	2.9%	6.1%	2.8%
Difference	-0.2%		-0.5%		0.0%		-0.3%	
Percentage Difference	-4%		-7%		0%		-5%	
Difference t-statistic	-0.701		-1.6087		0		-1.1266	
Difference p value	0.4833		0.108		1		0.26	

[20] In the 2006-2008 evaluation (KEMA, Inc. and Cadmus Group 2010), Spiral and A-lamp results were combined.

Table 88: Comparison of 2006-2008 and 2010-2012 Residential Peak CF Estimates: A-Lamp CFLs (Table 23)

	PG&E		SCE		SDG&E		Overall	
	Peak CF	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**
2010-2012	4.6%	1.6%	6.2%	1.5%	4.4%	2.0%	5.2%	1.2%
2006-2008[21]	5.6%	2.8%	7.2%	2.8%	4.4%	2.9%	6.1%	2.8%
Difference	-1.0%		-1.0%		0.0%		-0.9%	
Percentage Differences	-18%		-14%		0%		-15%	
Difference t-statistic	-1.144		-1.1196		0		-1.3777	
Difference p value	0.2541		0.2644		1		0.169	

Table 89: Comparison of 2006-2008 and 2010-2012 Residential Peak CF Estimates: Reflector CFLs (Table 31)

	PG&E		SCE		SDG&E		Overall	
	Peak CF	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**
2010-2012	5.4%	2.1%	6.5%	1.9%	3.8%	2.5%	5.7%	1.7%
2006-2008	6.5%	3.2%	7.6%	2.8%	3.2%	3.3%	6.5%	2.9%
Difference	-1.1%		-1.1%		0.6%		-0.8%	
Percentage Differences	-17%		-14%		19%		-12%	
Difference t-statistic	-1.66		-1.8409		0.6011		-1.7236	
Difference p value	0.0982		0.0666		0.5486		0.0852	

[21] In the 2006-2008 evaluation (KEMA, Inc. and Cadmus Group 2010), Spiral and A-lamp results were combined.

Table 90: Comparison of 2006-2008 and 2010-2012 Residential Peak CF Estimates: Globe CFLs (Table 39)

	PG&E		SCE		SDG&E		Overall	
	Peak CF	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**	**Peak CF**	**90% CI**
2010-2012	5.4%	2.2%	6.9%	1.9%	4.2%	2.4%	5.8%	1.8%
2006-2008	5.9%	2.8%	7.4%	2.8%	5.0%	2.9%	6.3%	2.8%
Difference	-0.5%		-0.5%		-0.8%		-0.5%	
Percentage Difference	-8%		-7%		-16%		-8%	
Difference t-statistic	-0.7135		-0.8598		-0.7171		-1.004	
Difference p value	0.4768		0.3918		0.4765		0.3162	

C. Appendix C – Shelf Survey and Shopper Intercept Survey Methods

Field researchers conducted complete shelf inventories of replacement lamps[22] for sale in California retail stores throughout PG&E, SCE and SDG&E service territories. At the same time, field staff conducted shopper intercept surveys[23] with consumers who were shopping for lamps. This report draws on shelf survey and shopper intercept data collected during August through September 2012 (Summer 2012), late November 2012 through February 2013 (Winter 2012-2013), and May through July 2013 (Summer 2013). Shopper intercept surveys were conducted during Winter 2012-2013 and Summer 2013 phases only. Below we provide brief descriptions of shelf survey and shopper intercept survey databases and describe the methods used to analyze these data in support of the 2010-2012 Upstream Lighting Program (UPL) Impact Evaluation Report. Furthermore, we provide brief descriptions of how shelf survey and intercept survey data were collected.

The shelf survey sample targeted approximately 200 stores per survey phase. Researchers stratified the sample by retail channel and IOU service territory (for PG&E, SCE, and SDG&E territories) and designed the sample to represent the retail market for residential replacement lamps in these areas. Field staff conducted surveys in chain and independent retail stores, including stores that participated in the IOUs' 2010-2012 ULP as well as non-participating stores. The sample targeted roughly equal numbers of stores in each retail channel to ensure enough sample points per channel to enable channel-to-channel comparisons.

Researchers spent a minimum of four hours in each store completing the shelf surveys and attempting to intercept shoppers for a total of roughly 1,800 hours[24] across Winter 2012-2013 and Summer 2013 data collection phases.

The comprehensive shelf survey databases[25] have lamp inventories containing nearly 66,000 records (about 22,000 records in each database). Each record includes key information for every

[22] Advanced lamps and non-advanced lamps were surveyed. Advanced lamps include all LED replacement lamps, all cold cathode lamps, and all CFLs, except basic CFLs. Non-advanced lamps include all incandescent lamps, all halogen lamps, and basic CFLs. Basic CFLs are medium screw base (MSB) spiral/twister shape CFLs less than or equal to 30 watts. All basic CFLs are also non-dimmable and single wattage (for example, basic CFLs exclude dimmable and 3-way lamps).

[23] In prior memos and reports, the DNV GL team has used the term "in-store customer intercept survey." Going forward, we will instead use the term "shopper intercept survey" to avoid any potential confusion regarding the meaning of the term "customer" (which could mean a retail customer and/or a utility customer of PG&E, SCE, or SDG&E). While the vast majority of shopper intercept surveys were conducted with PG&E, SCE, and SDG&E customers, field researchers also conduct surveys with respondents from outside of these service territories.

[24] Including all three phases of data collection, researchers spent more than 2,200 hours in stores.

store visited such as the retail channel, store name, IOU service territory, and store address as well as information specific to each package of lamps in the store, including model number, lamp type, base type, lamp shape, manufacturer, wattage, and number of lamps in each package. Additionally, field staff recorded the number of packages, whether or not the lamps were 3-way or dimmable, full price, discounted price and discount provider (if relevant), rated life, color temperature, lamp coating, lumens, wattages, and whether each model was 3-way, dimmable, and/or Energy Star labeled for each package of lamps. Field staff recorded these data across seven retail channels as shown in Table 91 below.

Table 91: Number of Completed Store Visits by Channel, Summer 2012, Winter 2012-2013, Summer 2013

Channel	Summer 2012 Stores Surveyed	Winter 2012-13 Stores Surveyed	Summer 2013 Stores Surveyed	Total Stores Survey
Discount	28	29	29	86
Drug	28	29	29	85
Grocery	29	28	28	86
Hardware	28	29	29	86
Home Improvement	29	28	29	86
Mass Merchandise	29	29	29	87
Membership Club	29	28	28	85
Total Stores	**200**	**200**	**201**	**601**

C.1 Shelf Survey Sample Overview

This section provides an overview of the shelf survey sample.

C.1.1 Shelf Survey Sample Design

The shelf survey sample frames were developed to represent the retail market for lighting in the IOU service territories. DNV GL staff started with the retail store lists from the 2010-2012 ULP tracking databases, added in non-participating stores known to be selling lighting in 2011 based on shelf survey research completed in Fall 2011 as well as online research, and then layered in new data from the 2010-2012 ULP tracking databases to identify previously participating

[25] DNV GL staff has created a California lighting retail shelf survey searchable online database that contains California retail shelf survey data from research dating back to 2008 and includes the Summer 2012, Winter 2012-2013, and Summer 2013 databases. To access the database and learn more about the online tool's capabilities, please visit: https://www.bulbstockdata.com.

retailers (based on 2006-2008 tracking databases) that were no longer active during the 2010-2012 ULP program years.

To ensure that the sample frame had the potential to include all locations of retail stores, and not just those locations included in the ULP tracking databases, DNV GL staff used Google Maps and conducted internet research for specific retail chains and independent stores to identify non-participating store fronts within each retail channel and IOU territory. Researchers gathered key identifying information such as store name, address, city, zip code and telephone number from the Google search engine.

In addition, DNV GL researchers made phone calls to stores in the non-participant list to confirm that these stores were selling replacement lamps in Summer 2012, Winter 2012-2013, and Summer 2013. Stores that did not sell replacement lamps were excluded from the sample frame.

The resulting list of participating and non-participating stores was used as a proxy to represent the retail market for lighting in Summer 2012, Winter 2012-2013, and Summer 2013. For the purposes of this study, "participating stores" (participants) describe those stores that received IOU-discounted CFL shipments during 2010, 2011 and/or 2012. Stores which received IOU-discounted CFL shipments in 2006, 2007 or 2008 but not during 2010, 2011 or 2012 are considered "non-participating stores" (non-participants). Also included in this category of "non-participating stores" are those retail chains and independent stores that never participated in the 2006-2008 or 2010-2012 ULP program years.

C.1.2 Shelf Survey Sample Frame Targets and Actual Distribution of Stores

DNV GL's sampling approach for all three-shelf survey field research phases involved four key principles:

1. **Ensure enough sample points per channel to enable channel-to-channel comparisons:** Shelf surveys conducted in 2009 utilized a sampling approach in which the number of stores visited per channel was roughly proportional to the share of overall lamp shipments for each channel. This resulted in a small number of sample points for some channels (such as drug and discount) and a large number of sample points for others (such as membership club and home improvement stores), making it difficult to compare results across channels. As such, the approach for the past four phases of shelf survey research (Summer 2013, Winter 2012-2013, Summer 2012, and Fall 2011) included a more balanced distribution of sample points across retail channels within each IOU service territory. The distribution of stores is roughly equal across channels. By targeting a balanced distribution of stores, we ensured enough sample points to enable comparison across channels. Table 92, Table 93, and Table 94 show the target sample

sizes for stores by IOU and overall for the Summer 2012, Winter 2012-2013, and Summer 2013 shelf survey efforts. Targets included 75 stores each for PG&E and SCE, and 50 stores for SDG&E for each shelf survey phase.

Table 92: Target Sample Sizes for Shelf Survey Store Visits by Channel and IOU, Summer 2012

Channel	IOU Service Territory			Total
	PG&E	SCE	SDG&E	
Discount	10	11	7	28
Drug	11	10	7	28
Grocery	11	10	8	29
Hardware	10	11	7	28
Home Improvement	11	11	7	29
Mass Merchandise	11	11	7	29
Membership Club	11	11	7	29
Total Stores	**75**	**75**	**50**	**200**

Table 93: Target Sample Sizes for Shelf Survey Store Visits by Channel and IOU, Winter 2012-2013

Channel	IOU Service Territory			Total
	PG&E	SCE	SDG&E	
Discount	11	11	7	29
Drug	11	11	7	29
Grocery	10	11	7	28
Hardware	11	11	7	29
Home Improvement	11	10	7	28
Mass Merchandise	10	11	8	29
Membership Club	11	10	7	28
Total Stores	**75**	**75**	**50**	**200**

Table 94: Target Sample Sizes for Shelf Survey Store Visits by Channel and IOU, Summer 2013

Channel	IOU Service Territory			Total
	PG&E	SCE	SDG&E	
Discount	11	11	7	29
Drug	11	11	7	29
Grocery	10	11	7	28
Hardware	11	11	7	29
Home Improvement	11	10	7	28
Mass Merchandise	10	11	8	29
Membership Club	11	10	7	28
Total Stores	**75**	**75**	**50**	**200**

1. **Ensure that both chain stores and independent stores are targeted within each retail channel.** Data developed as part of the 2010-2012 ULP impact evaluation was used to classify stores as chain or independent. Sample sizes were set to represent the proportion of IOU-discounted lamps shipped to chain stores versus independent stores across all IOUs.
2. **Target stores that are participating in the IOUs' ULPs as well as those that are not participating.** Prior research suggests that the majority of CFLs sold through retail channels in California are discounted by the IOU programs. As such, DNV GL staff set targets for each shelf survey phase of 150 "participating stores" (75 percent of the targeted 200) and 50 non-participants (25 percent) for each phase. The one exception is the membership club channel for which, in California during 2010-2013, there were no non-participating stores.
3. Ba**lance the need for geographic representativeness with budget and timing constraints.** As done for the Spring 2009 and Fall 2011 shelf survey research efforts, DNV GL staff created regional "clusters" within the sample frame and targeted a range of geographic regions when choosing sample points based on the proportion of IOU-discounted lamps shipped to each region for each shelf survey phase. While other practical considerations constrained our ability to select stores in a given region—such as which retail stores were available in each region within each retail channel, and the travel distance between stores—the ultimate selection of sample points attempted to reflect reasonable geographic distribution within each IOU service territory.

Based on these principles, DNV GL staff developed the Summer 2012 shelf survey sample targets shown in Table 95:, Winter 2012-2013 shelf survey sample targets shown in Table 96; and Summer 2013 shelf survey sample targets shown in Table 97.

We should note that DNV GL did not target the lighting and electronics retail channel during these three shelf survey phases, because a major lighting and electronics chain refused to allow DNV GL researchers into their stores during a prior wave of shelf surveys (Fall 2011; see Section C.2 below for further details).

Table 95: Targeted Distribution of Completed Store Visits by Chain/Independent, Participating/Non-Participating, Retail Channel, and IOU, Summer 2012

Channel	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Discount	Part	4	4	8	5	4	9	3	2	5	12	10	22
	NP	0	2	2	1	1	2	1	1	2	2	4	6
Discount Subtotal	**Total**	4	6	10	6	5	11	4	3	7	14	14	28
Drug	Part	7	2	9	6	1	7	6	0	6	19	3	22
	NP	2	0	2	2	1	3	1	0	1	5	1	6
Drug Subtotal	**Total**	9	2	11	8	2	10	7	0	7	24	4	28
Grocery	Part	2	4	6	2	4	6	2	2	4	6	10	16
	NP	2	3	5	1	3	4	2	2	4	5	8	13
Grocery Subtotal	**Total**	4	7	11	3	7	10	4	4	8	11	18	29
Hardware	Part	3	3	6	3	3	6	2	2	4	8	8	16
	NP	2	2	4	3	2	5	2	1	3	7	5	12
Hardware Subtotal	**Total**	5	5	10	6	5	11	4	3	7	15	13	28
Home Improvement	Part	8	0	8	8	1	9	6	0	6	22	1	23
	NP	3	0	3	2	0	2	1	0	1	6	0	6
Home Improv. Subtotal	**Total**	11	0	11	10	1	11	7	0	7	28	1	29

Channel	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Mass Merchandise	Part	8	0	8	9	0	9	5	0	5	22	0	22
	NP	3	0	3	2	0	2	2	0	2	7	0	7
Mass Merch Subtotal	**Total**	11	0	11	11	0	11	7	0	7	29	0	29
Membership	Part	11	0	11	11	0	11	7	0	7	29	0	29
	NP	0	0	0	0	0	0	0	0	0	0	0	0
Membership Subtotal	**Total**	11	0	11	11	0	11	7	0	7	29	0	29
Total Part Stores	Part	43	13	56	44	13	57	31	6	37	118	32	150
Total NP Stores	NP	12	7	19	11	7	18	9	4	13	32	18	50
All Stores	**Total**	**55**	**20**	**75**	**55**	**20**	**75**	**40**	**10**	**50**	**150**	**50**	**200**

Table 96: Targeted Distribution of Completed Store Visits by Chain/Independent, Participating/Non-Participating, Retail Channel, and IOU, Winter 2012-2013

Channel	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Discount	Part	5	4	9	5	3	8	4	1	5	14	8	22
	NP	0	2	2	1	2	3	1	1	2	2	5	7
Discount Subtotal	**Total**	5	6	11	6	5	11	5	2	7	16	13	29
Drug	Part	7	2	9	6	2	8	6	0	6	19	4	23
	NP	2	0	2	2	1	3	1	0	1	5	1	6
Drug Subtotal	**Total**	9	2	11	8	3	11	7	0	7	24	5	29

Channel	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Grocery	Part	2	4	6	2	5	7	1	3	4	5	12	17
	NP	2	2	4	2	2	4	1	2	3	5	6	11
Grocery Subtotal	**Total**	4	6	10	4	7	11	2	5	7	10	18	28
Hardware	Part	3	4	7	3	3	6	2	2	4	8	9	17
	NP	2	2	4	3	2	5	2	1	3	7	5	12
Hardware Subtotal	**Total**	5	6	11	6	5	11	4	3	7	15	14	29
Home Improvement	Part	8	0	8	8	0	8	6	0	6	22	0	22
	NP	3	0	3	2	0	2	1	0	1	6	0	6
Home Impr Subtotal	**Total**	11	0	11	10	0	10	7	0	7	28	0	28
Mass Merchandise	Part	7	0	7	8	0	8	6	0	6	21	0	21
	NP	3	0	3	3	0	3	2	0	2	8	0	8
Mass Merch Subtotal	**Total**	10	0	10	11	0	11	8	0	8	29	0	29
Membership Club	Part	11	0	11	10	0	10	7	0	7	28	0	28
	NP	0	0	0	0	0	0	0	0	0	0	0	0
Membership Subtotal	**Total**	11	0	11	10	0	10	7	0	7	28	0	28
Total Part Stores	Part	43	14	57	42	13	55	32	6	38	117	33	150
Total NP Stores	NP	12	6	18	13	7	20	8	4	12	33	17	50
All Stores	**Total**	**55**	**20**	**75**	**55**	**20**	**75**	**40**	**10**	**50**	**150**	**50**	**200**

Table 97: Targeted Distribution of Completed Store Visits by Chain/Independent, Participating/Non-Participating, Retail Channel, and IOU, Summer 2013

Channel	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Discount	Part	5	4	9	5	3	8	4	1	5	14	8	22
	NP	0	2	2	1	2	3	1	1	2	2	5	7
Discount Subtotal	**Total**	5	6	11	6	5	11	5	2	7	16	13	29
Drug	Part	7	2	9	6	2	8	6	0	6	19	4	23
	NP	2	0	2	2	1	3	1	0	1	5	1	6
Drug Subtotal	**Total**	9	2	11	8	3	11	7	0	7	24	5	29
Grocery	Part	2	4	6	2	5	7	1	3	4	5	12	17
	NP	2	2	4	2	2	4	1	2	3	5	6	11
Grocery Subtotal	**Total**	4	6	10	4	7	11	2	5	7	10	18	28
Hardware	Part	3	4	7	3	3	6	2	2	4	8	9	17
	NP	2	2	4	3	2	5	2	1	3	7	5	12
Hardware Subtotal	**Total**	5	6	11	6	5	11	4	3	7	15	14	29
Home Improvement	Part	8	0	8	8	0	8	6	0	6	22	0	22
	NP	3	0	3	2	0	2	1	0	1	6	0	6
Home Impr Subtotal	**Total**	11	0	11	10	0	10	7	0	7	28	0	28
Mass Merchandise	Part	7	0	7	8	0	8	6	0	6	21	0	21
	NP	3	0	3	3	0	3	2	0	2	8	0	8
Mass Merch Subtotal	**Total**	10	0	10	11	0	11	8	0	8	29	0	29

Channel	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Membership Club	Part	11	0	11	10	0	10	7	0	7	28	0	28
	NP	0	0	0	0	0	0	0	0	0	0	0	0
Membership Subtotal	**Total**	11	0	11	10	0	10	7	0	7	28	0	28
Total Part Stores	Part	43	14	57	42	13	55	32	6	38	117	33	150
Total NP Stores	NP	12	6	18	13	7	20	8	4	12	33	17	50
All Stores	**Total**	55	20	75	55	20	75	40	10	50	150	50	200

Table 98, Table 99, and Table 100 below shows the actual distribution of stores by channel and IOU, broken out by chain and independent stores as well as participating and non-participating stores for Summer 2012, Winter 2012-2013, and Summer 2013 research phases. As the tables below show, there are slight differences between the actual distribution of stores and the targeted distribution for the three research phases. The primary reason for this variation is because of lack of available store types in a given region that DNV GL researchers targeted; for instance, if a manager of a non-participating mass merchandise store in a given region denied field staff permission to conduct shelf survey research in that store, the only available back-up store in the area might have been a participating mass merchandise store. Likewise, if an independent drug store in a targeted region sold out all of its lamp stock, the only available alternative might have been a chain drug store. Because of these practical considerations, DNV GL researchers slightly oversampled chain stores beyond the original target (76 percent chain stores visited in Summer 2012 and 77 percent chain stores visited in Winter 2012-2013 and Summer 2013 phases compared to a target of 75 percent chain stores for all three periods).

Table 98: Actual Distribution of Completed Store Visits by Chain/Independent, Participating/Non-Participating, Retail Channel, and IOU, Summer 2012

Chain	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Discount	Part	4	4	8	5	4	9	3	2	5	12	10	22
	NP	0	2	2	1	1	2	1	1	2	2	4	6
Discount Subtotal	**Total**	4	6	10	6	5	11	4	3	7	14	14	28
Drug	Part	7	2	9	6	1	7	6	0	6	19	3	22
	NP	2	0	2	2	0	2	1	0	1	5	0	5
Drug Subtotal	**Total**	9	2	11	8	1	9	7	0	7	24	3	27
Grocery	Part	2	4	6	2	4	6	2	2	4	6	10	16
	NP	3	2	5	1	4	5	2	2	4	6	8	14
Grocery Subtotal	**Total**	5	6	11	3	8	11	4	4	8	12	18	30
Hardware	Part	4	3	7	3	3	6	2	2	4	9	8	17
	NP	1	2	3	3	2	5	2	1	3	6	5	11
Hardware Subtotal	**Total**	5	5	10	6	5	11	4	3	7	15	13	28
Home Improvement	Part	8	0	8	8	1	9	6	0	6	22	1	23
	NP	3	0	3	2	0	2	1	0	1	6	0	6
Home Impr Subtotal	**Total**	11	0	11	10	1	11	7	0	7	28	1	29
Mass Merchandise	Part	8	0	8	8	0	8	5	0	5	21	0	21
	NP	3	0	3	3	0	3	2	0	2	8	0	8
Mass Merch Subtotal	**Total**	11	0	11	11	0	11	7	0	7	29	0	29

Chain	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Membership Club	Part	11	0	11	11	0	11	7	0	7	29	0	29
	NP	0	0	0	0	0	0	0	0	0	0	0	0
Membership Subtotal	**Total**	11	0	11	11	0	11	7	0	7	29	0	29
Total Part Stores	Part	44	13	57	43	13	56	31	6	37	118	32	150
Total NP Stores	NP	12	6	18	12	7	19	9	4	13	33	17	50
All Stores	**Total**	**56**	**19**	**75**	**55**	**20**	**75**	**40**	**10**	**50**	**151**	**49**	**200**

Table 99: Actual Distribution of Completed Store Visits by Chain/Independent, Participating/Non-Participating, Retail Channel, and IOU, Winter 2012-2013

Chain	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Discount	Part	6	3	9	6	2	8	4	1	5	16	6	22
	NP	0	2	2	1	2	3	1	1	2	2	5	7
Discount Subtotal	**Total**	6	5	11	7	4	11	5	2	7	18	11	29
Drug	Part	6	2	8	7	2	9	6	0	6	19	4	23
	NP	3	0	3	2	0	2	1	0	1	6	0	6
Drug Subtotal	**Total**	9	2	11	9	2	11	7	0	7	25	4	29
Grocery	Part	2	4	6	2	5	7	1	3	4	5	12	17
	NP	3	1	4	2	2	4	1	2	3	6	5	11
Grocery Subtotal	**Total**	5	5	10	4	7	11	2	5	7	11	17	28
Hardware	Part	3	4	7	2	3	5	2	2	4	7	9	16
	NP	2	2	4	4	2	6	2	1	3	8	5	13
Hardware Subtotal	**Total**	5	6	11	6	5	11	4	3	7	15	14	29
Home Improvement	Part	8	0	8	8	0	8	6	0	6	22	0	22
	NP	3	0	3	2	0	2	1	0	1	6	0	6
Home Impr Subtotal	**Total**	11	0	11	10	0	10	7	0	7	28	0	28
Mass Merchandise	Part	7	0	7	8	0	8	6	0	6	21	0	21
	NP	3	0	3	3	0	3	2	0	2	8	0	8
Mass Merch Subtotal	**Total**	10	0	10	11	0	11	8	0	8	29	0	29

Chain	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Membership Club	Part	11	0	11	10	0	10	7	0	7	28	0	28
	NP	0	0	0	0	0	0	0	0	0	0	0	0
Membership Subtotal	**Total**	11	0	11	10	0	10	7	0	7	28	0	28
Total Part Stores	Part	43	13	56	43	12	55	32	6	38	118	31	149
Total NP Stores	NP	14	5	19	14	6	20	8	4	12	36	15	51
All Stores	**Total**	**57**	**18**	**75**	**57**	**18**	**75**	**40**	**10**	**50**	**154**	**46**	**200**

Table 100: Actual Distribution of Completed Store Visits by Chain/Independent, Participating/Non-Participating, Retail Channel, and IOU, Summer 2013

Chain	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Discount	Part	6	4	10	6	3	9	4	1	5	16	8	24
	NP	0	1	1	0	2	2	1	1	2	1	4	5
Discount Subtotal	**Total**	6	5	11	6	5	11	5	2	7	17	12	29
Drug	Part	6	2	8	7	2	9	6	0	6	19	4	23
	NP	3	0	3	2	0	2	1	0	1	6	0	6
Drug Subtotal	**Total**	9	2	11	9	2	11	7	0	7	25	4	29
Grocery	Part	2	4	6	2	5	7	1	3	4	5	12	17
	NP	2	2	4	2	2	4	1	2	3	5	6	11
Grocery Subtotal	**Total**	4	6	10	4	7	11	2	5	7	10	18	28
Hardware	Part	4	3	7	2	4	6	2	2	4	8	9	17
	NP	2	2	4	3	2	5	2	1	3	7	5	12
Hardware Subtotal	**Total**	6	5	11	5	6	11	4	3	7	15	14	29
Home Improvement	Part	9	0	9	8	0	8	6	0	6	23	0	23
	NP	3	0	3	2	0	2	1	0	1	6	0	6
Home Impr Subtotal	**Total**	12	0	12	10	0	10	7	0	7	29	0	29
Mass Merchandise	Part	7	0	7	8	0	8	5	0	5	20	0	20
	NP	3	0	3	3	0	3	3	0	3	9	0	9
Mass Merch Subtotal	**Total**	10	0	10	11	0	11	8	0	8	29	0	29

Chain	Part / Non	PG&E			SCE			SDG&E			Total		
		Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total	Chain	Indep	Total
Membership Club	Part	11	0	11	10	0	10	7	0	7	28	0	28
	NP	0	0	0	0	0	0	0	0	0	0	0	0
Membership Subtotal	**Total**	11	0	11	10	0	10	7	0	7	28	0	28
Total Part Stores	Part	43	13	56	43	12	55	32	6	38	119	33	152
Total NP Stores	NP	14	5	19	14	6	20	8	4	12	34	15	49
All Stores	**Total**	**58**	**18**	**76**	**55**	**20**	**75**	**40**	**10**	**50**	**154**	**46**	**201**

C.1.3 Shopper Intercept Survey Overview and Respondent Disposition

Among the primary objectives of the shopper intercept surveys was to conduct interviews with shoppers who were planning to purchase common MSB replacement lamps across four major lamp technologies: CFLs, LED, incandescent, and halogen lamps. Shoppers who planned to purchase any type of replacement lamp were eligible to take the survey, but researchers attempted to interview only purchasers[26] of MSB twister, A-shape, reflector, and globe style lamps while they were conducting shelf surveys in the lighting aisle.

Once field researchers identified a purchaser of one of these common lamp types, they would then ask the respondent if he or she would be willing to participate in the survey.[27] The first question researchers would ask purchasers was whether they were purchasing replacement lamps for a home (see Appendix C for the full shopper intercept survey guide). If purchasers answered “yes” to the question, field researchers would then collect information about the lamp package(s) they planned to purchase and continue with the survey.[28] Researchers used the same barcode scanner that they used to conduct shelf surveys to scan lamp packages. After scanning the barcode of each package of a given purchaser, the barcode would link to a reference database, which contained key lamp specifications, such as lamp technology, style, wattage, lumens, and number of lamps per package. Lamp characteristics would then auto-populate[29] in fields on the tablet computer, which the researcher would verify. Researchers would then enter the price of each package, record whether or not packages were discounted, and record the discount provider, if any.

After recording lamp specifications for all the packages that a respondent planned to purchase, researchers would ask purchasers about their installation intentions (see Section 6.3.3 for further details) and whether or not they came to the store planning to purchase replacement lamps (for example, whether or not their purchase was planned or bought on impulse). After

[26] For the sake of simplicity, we refer to intercepted shoppers with lamps in their shopping carts or baskets as “purchasers” –while each shopper has not yet purchased his or her lamp(s) at the time of the surveys, the expectation is that each shopper will do so shortly after the survey is complete.

[27] All survey participants were offered a $5 or $10 gift card incentive (depending on the store) for completing the survey. The gift card was usually for the store in which the respondent was shopping. For smaller independent stores and retail chains that did not offer gift cards for their respective stores, researchers would typically give out gift cards for large chain coffee shops.

[28] If purchasers answered “no” or “don’t know” to this question, they were then asked whether they were contractors or builders. Purchasers who said that they were not contractors or builders were asked whether or not they planned to install their lamps at a business or other location outside of their homes. After collecting this information from non-residential purchasers, the survey would terminate.

[29] For lamp packages that had not yet been encountered in the field, researchers would have to manually enter all lamp specifications.

collecting this information, purchasers were asked about past CFL purchases, and then proceeded with the lamp choice series of questions (see Section 6.3.3 for further details). After answering questions about lamp choices, respondents were then asked about why they chose CFLs or LED lamps (if applicable) and why they did not choose CFLs or LED lamps (if applicable).[30] Lastly, researchers asked respondents household characteristic questions to conclude the survey.

Field researchers also interviewed non-purchaser respondents in those stores that had few or no lamp purchasers, such as grocery and drug stores, and in those stores where shopper traffic was light. Researchers began the survey by asking non-purchasers about prior CFL purchases and then moved on to the lamp choice series of questions. Non-purchasers were also asked why they chose CFLs or LED lamps (if applicable) and why they did not choose CFLs or LED lamps (if applicable) as well as household characteristic questions.

As mentioned above, researchers spent a minimum of 4 hours in each store conducting shelf survey and shopper intercept surveys. Researchers conducted as many purchaser surveys as possible during their time in stores. With respect to non-purchaser surveys, researchers attempted to complete at least 5 of these surveys in those stores that had no purchasers. Likewise, researchers were encouraged to complete at least 5 total surveys (with purchasers and non-purchasers) in a stores that had fewer than 5 purchasers who were willing to complete the survey.

Table 101: below provides details on the number of lamp purchasers and non-purchasers intercepted during each survey phase. Altogether, field staff intercepted a total of 822 lamp purchasers (472 during the Winter 2012-2013 phase and 350 during the Summer 2013 phase) and 1,236 non-purchasers (598 during the Winter 2012-2013 phase and 638 during the Summer 2013 phase) for a total of 2,058 completed shopper intercept surveys. Note that for purchasers, the table includes all purchasers across all lamp technologies, base types, and lamp shapes.[31]

[30] For further details on reasons respondents chose CFLs and LED lamps as well as barriers to purchasing CFLs and LED lamps, please see the (forthcoming) *California Residential Replacement Lamp Market Characterization Study*. Prepared for: California Public Utilities Commission, Energy Division 2010-2012 EM&V Work Order 13 – Residential Lighting Process Evaluation and Market Characterization.

[31] Of the total 822 intercepted lamp purchasers, only 12 reported that they were purchasing lamps with the intent to install them in non-residential applications (approximately 1% of intercepted purchasers).

Table 101: Number of Intercepted Lamp Purchasers and Non-Purchasers, Winter 2012-2013 and Summer 2013

Channel	Winter 2012–2013		Summer 2013		Overall	
	Intercepted Purchasers	Intercepted Non-Purchasers	Intercepted Purchasers	Intercepted Non-Purchasers	Intercepted Purchasers	Intercepted Non-Purchasers
Discount	42	115	25	104	67	219
Drug	13	122	11	113	24	235
Grocery	5	116	8	99	13	215
Hardware	61	75	33	87	94	162
Home Improvement	125	60	111	65	236	125
Mass Merchandise	122	52	71	98	193	150
Membership Club	104	58	91	72	195	130
Total	**472**	**598**	**350**	**638**	**822**	**1,236**

C.2 Fieldwork Overview

This section provides an overview of fieldwork procedures and protocols, including brief descriptions of shelf survey and intercepts field researcher training sessions and tablet data collection.

C.2.1 Fieldwork Procedures, Protocols, and Training

The DNV GL field research manager conducted a full-day shelf survey training session in late July 2012 with a team of field researchers for the Summer 2012 research wave, in mid-November 2012 for the Winter 2012-2013 wave, and in mid-May for the Summer 2013 wave. The training focused primarily on identifying key lamp characteristics, including product types (for example, CFLs, LED, incandescent, and halogen lamps), lamp shapes (for example, A-lamps, spiral/twister lamps, globe lamps, etc.), base types (for example, MSB, candelabra base, GU-type base, etc.), and wattage. The field research manager developed a detailed training guide and list of field research protocols prior to the training session. Additionally, the field research manager took field researchers to a home improvement store and a mass merchandise store to conduct partial shelf surveys as part of the training process.

Each field researcher conducted shelf surveys and intercept surveys with an assigned list of stores clustered geographically. In many cases, field researchers spoke with a store manager prior to conducting shelf surveys and provided the store managers with a letter from an Energy Division project manager explaining the purpose of the study. Field researchers would then go to the lighting aisle(s) and complete the shelf survey and conduct intercept surveys for a given store. Researchers recorded the information on a tablet computer (see below for further details).

The field research manager developed a list of targeted stores in advance of beginning field research, and as mentioned above, assigned geographically clustered groups of stores to each field researcher. Field researchers were able to complete shelf surveys in their assigned stores in the majority of cases. However, occasionally there were impediments to conducting shelf surveys, such as store closures, a store running out of replacement lamps, or a store manager refusing to allow a researcher to conduct a shelf survey. If a field researcher was unable to conduct a survey in an assigned store, he or she would go to a pre-assigned back-up store in the area or, in some cases, call the field research manager to find a replacement store. The protocol for finding replacement stores was to identify another store in the same retail channel in the same geographic area with the same chain/independent and IOU program participation/non-participation status as a replacement store. In most cases, the staff manager identified a replacement store before the planned field research. However, on a few occasions practical constraints, such as available stores in a given region, caused the field staff manager to choose a replacement store that was not exactly equivalent (for example, the chain/independent or program participation status for the replacement store might have been different than the store in the original sample).

As mentioned above, a major lighting and electronics chain refused to allow DNV GL field researchers to conduct shelf surveys in their stores. DNV GL staff members and utility representatives made repeated efforts to reach out to the corporate management team for this chain via email and phone (including a conference call with the CFO and lighting buyer for this chain). In spite of promising to deliver lamp inventory data to DNV GL during a conference call in Fall 2011, the CFO for this chain never responded to repeated requests to deliver these data. Given the significance of this chain in the lighting and electronics channel, the DNV GL shelf survey and intercept survey task manager and WO28 project manager made the decision not to target lighting and electronics stores in Summer 2012, Winter 2012-2013, and Summer 2013 research phases since data collected for the channel would not be representative.

C.2.2 Tablet Computer Data Collection

The Summer 2012, Winter 2012-2013, and Summer 2013 shelf survey and intercept survey data were collected on a tablet computer (iPad) instead of collecting data on traditional paper forms, as was done in previous waves of shelf and intercept surveys. The data collection instrument consists of four key sections:

- The first tab of the instrument contains important store-level data including the site/store ID, store address, and researcher name.

The next tab (the “Signage” page) contains questions on whether or not a store has any signage that promotes CFLs, LED lamps, energy efficient halogen lamps (EISA compliant lamps), traditional incandescent lamps, and other replacement lamp products.

The next tab of the shelf survey instrument is the lamp “Inventory” page, which is where researchers record key lighting characteristics for each unique lamp type encountered in a given store.

The last tab of the instrument is the “Intercept” survey start page where researchers can launch shopper intercept surveys.

Figure 15 shows the opening page of the instrument where key store-level information is collected. Once the field researcher entered the site ID for the store, the address information would auto-populate from a DNV GL store database and additional information would auto-populate on the Site Level tab, such as the retail channel, store name, store city, zip code, and the IOU where the store is located.

Figure 15: Shelf Survey Store Identification Page

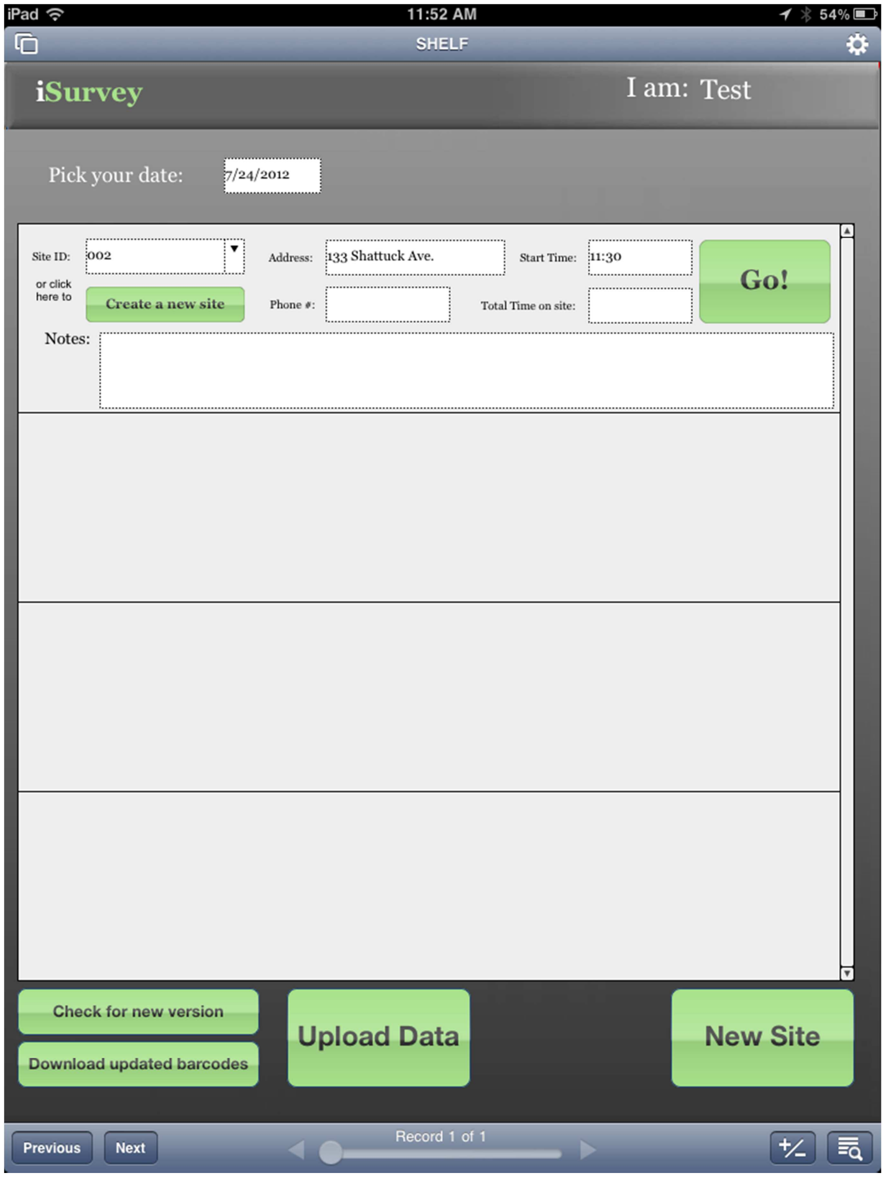


Figure 16 shows the page of the data collection instrument that allows researchers to collect information on in-store lighting promotions and education materials available in stores. Researchers were able to record information on which lighting technologies were being promoted (for example, CFLs, LED, and EISA-compliant halogen lamps), the type of promotional materials present (for example, sign on the shelf, sign hanging from ceiling, in-store display, etc.), the location of promotional materials (for example, lighting aisle, end-cap, front of store, etc.), and whether or not the promotional materials were referring to a specific lamp model or manufacturer. Researchers could also take a photo of the signage.

Figure 16: Lamp Signage Page

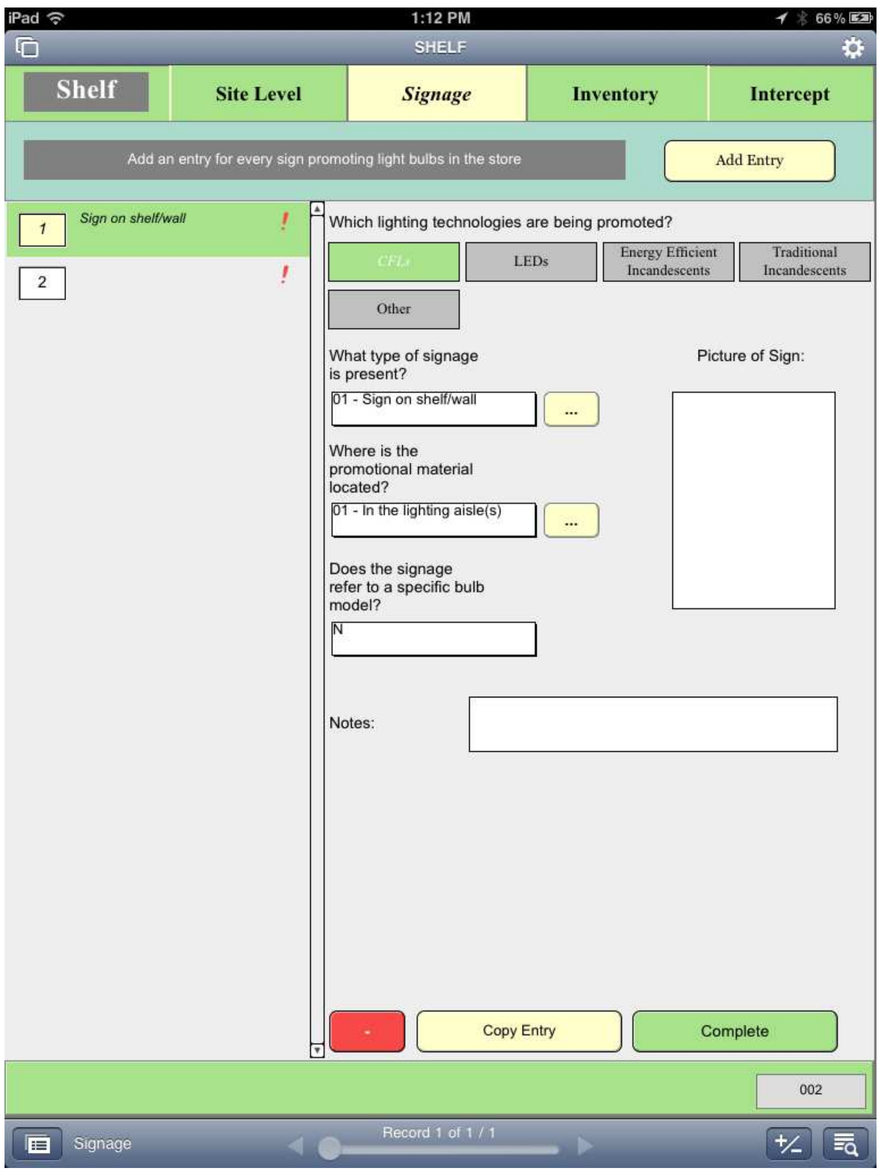


Figure 17 shows the lamp inventory page of the data collection instrument. Data collected from this section gives us a detailed understanding about the pricing, availability, and diversity of lighting products for a given store. Field researchers scanned each lamp package with a Bluetooth-enabled scanner and the barcode number was used to cross-check with a lamp reference database containing thousands of records of unique manufacturers and lamp models.[32] Once the barcode was scanned, the model number, manufacturer, brand, technology type, base type, lamp style, wattage, lumens, and other key lamp features would auto-populate in the appropriate fields in the data collection instrument if the barcode existed in the reference database. Field researchers then had to verify each field, record the price, record whether or not there was a discounted price and the discount provider, the location of the lamp package, and the number of packages of that model available on the shelf.

[32] The lamp reference database was initially created from a cleaned list of unique models of lamps from prior shelf survey research. New barcodes and model number are automatically added to the lamp reference database.

Figure 17: Lamp Inventory Page

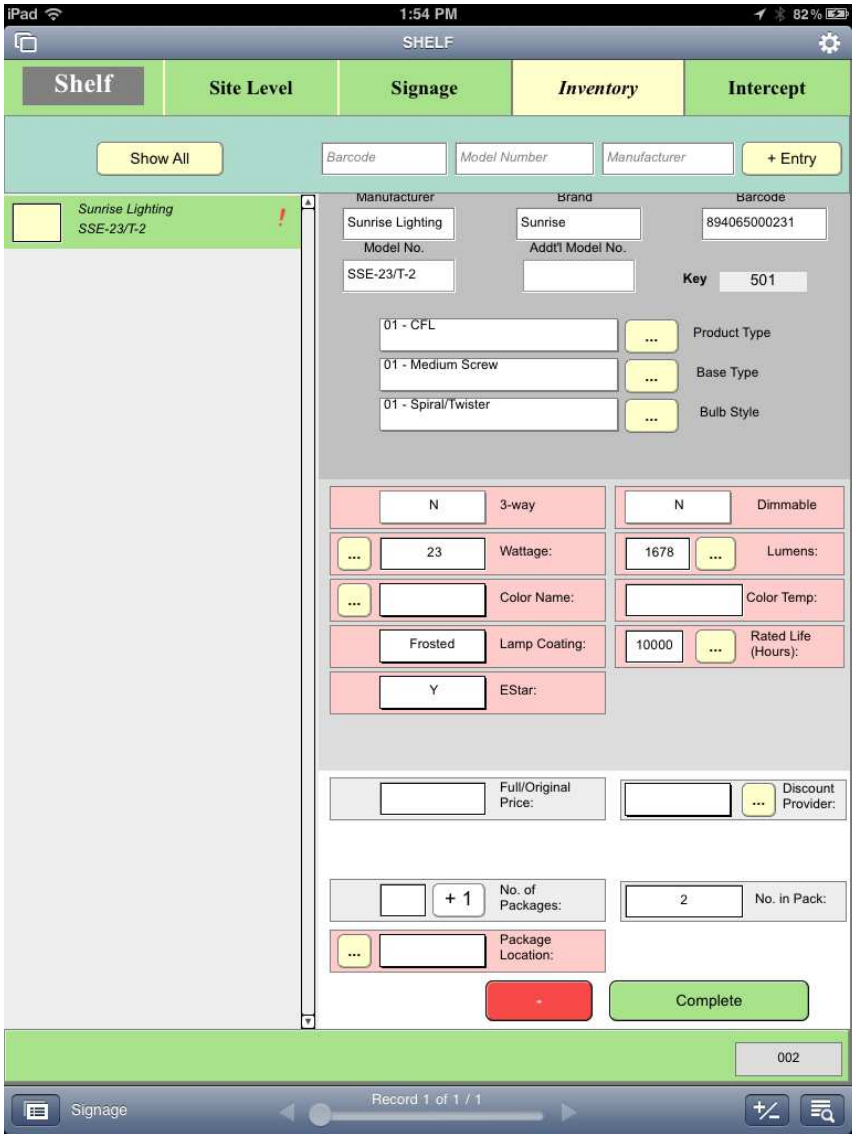


Figure 18 shows the intercept survey start page where researchers were able to launch shopper intercept surveys. In addition to launching surveys, researchers had the ability to track the number of respondents who refused to take the survey at a given store.

Figure 18: Shopper Intercept Survey Start Page

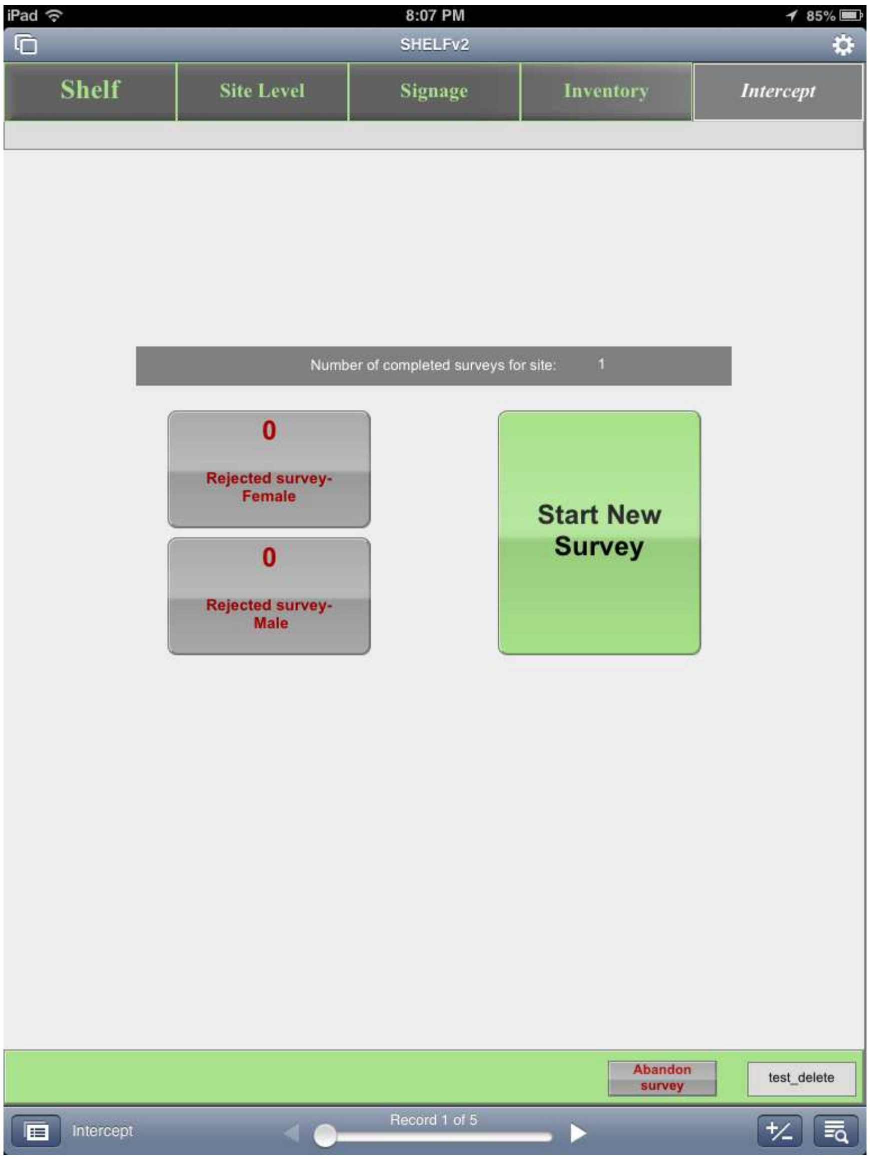


Figure 19 shows the intercept survey lamp inventory page where researchers entered lamp package characteristics from purchaser respondents. This page is very similar to the lamp inventory page (see Figure 17) except that it has fewer required lamp characteristic fields and contains the first installation intention question near the bottom of the page.

Figure 19: Shopper Intercept Survey Lamp Inventory Page

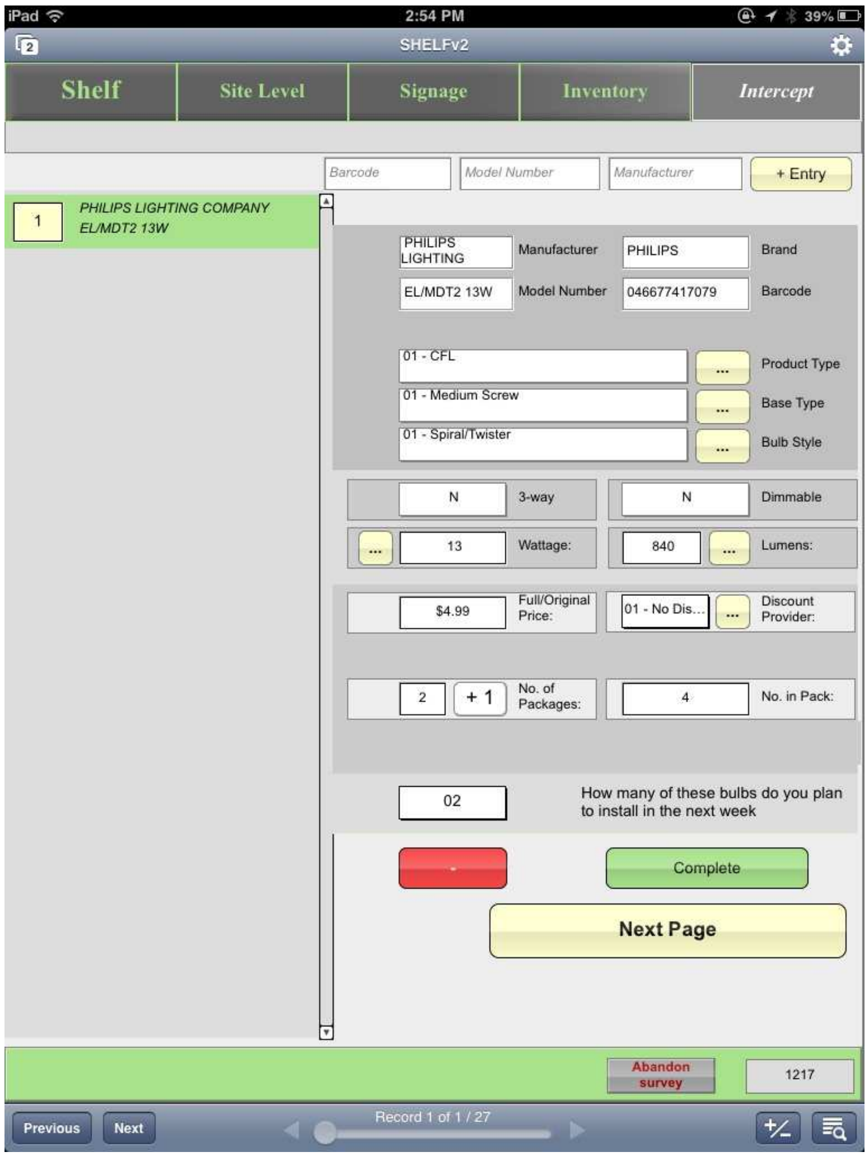


Figure 20 contains key lamp installation intention questions, including where the purchaser plans to install their lamp and what type of lamp they will be replacing.

Figure 20: Shopper Intercept Lamp Installation Intentions Page

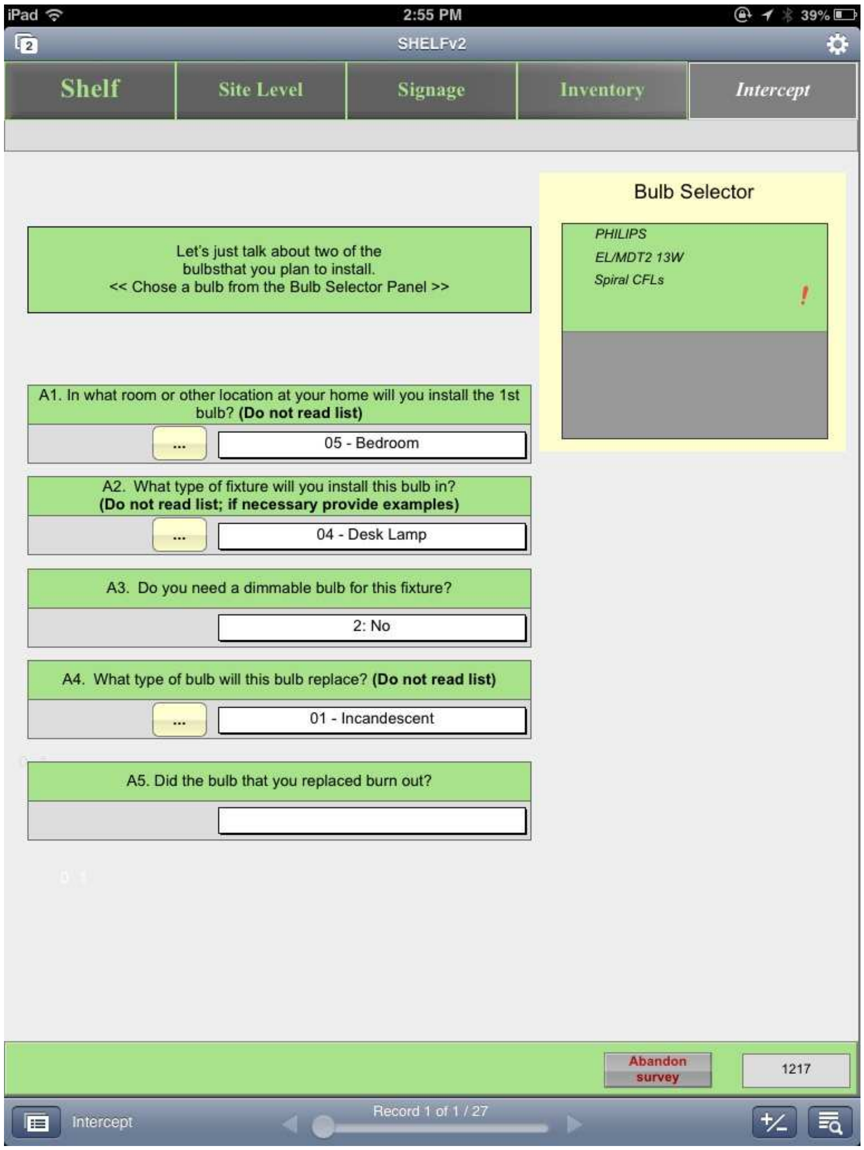


Figure 21 shows the series of questions on whether or not respondents planned their purchase as well as whether or not respondents would have gone to another store had they not found the lamp package they were looking for.

Figure 21: Shopper Intercept Survey Planned or Impulse Purchase Page

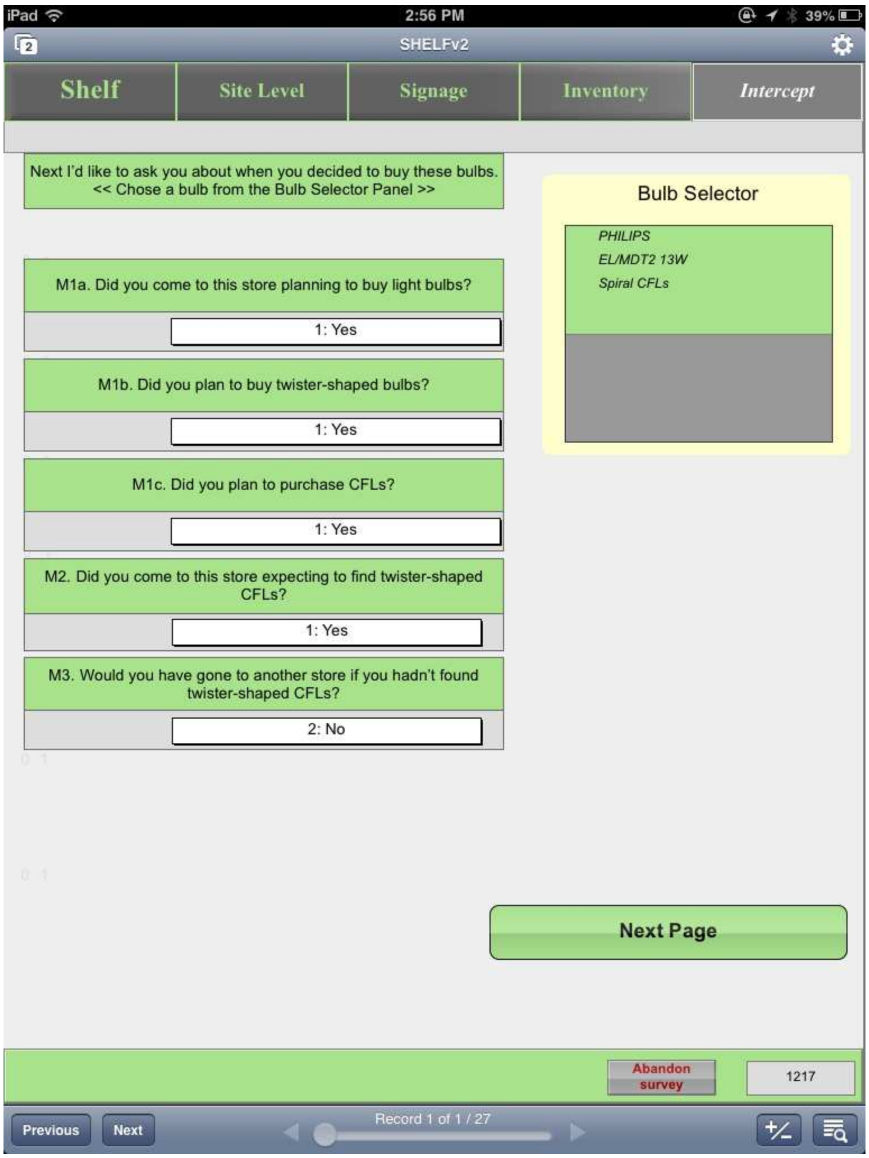


Figure 22 shows the reasons for choosing CFLs question, and includes several pre-coded response options as well as an option for other reasons not captured in the pre-coded answers.

Figure 22: Shopper Intercept Survey Reasons for Choosing CFLs Page

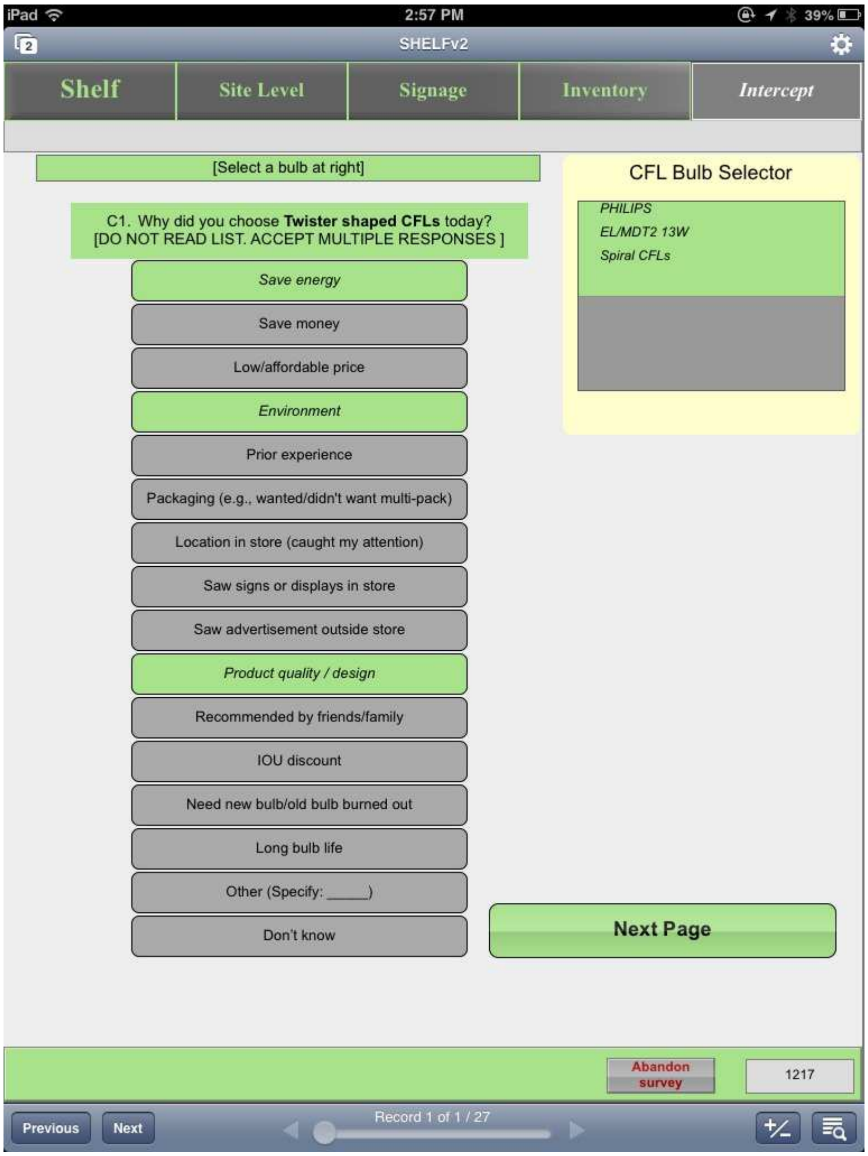
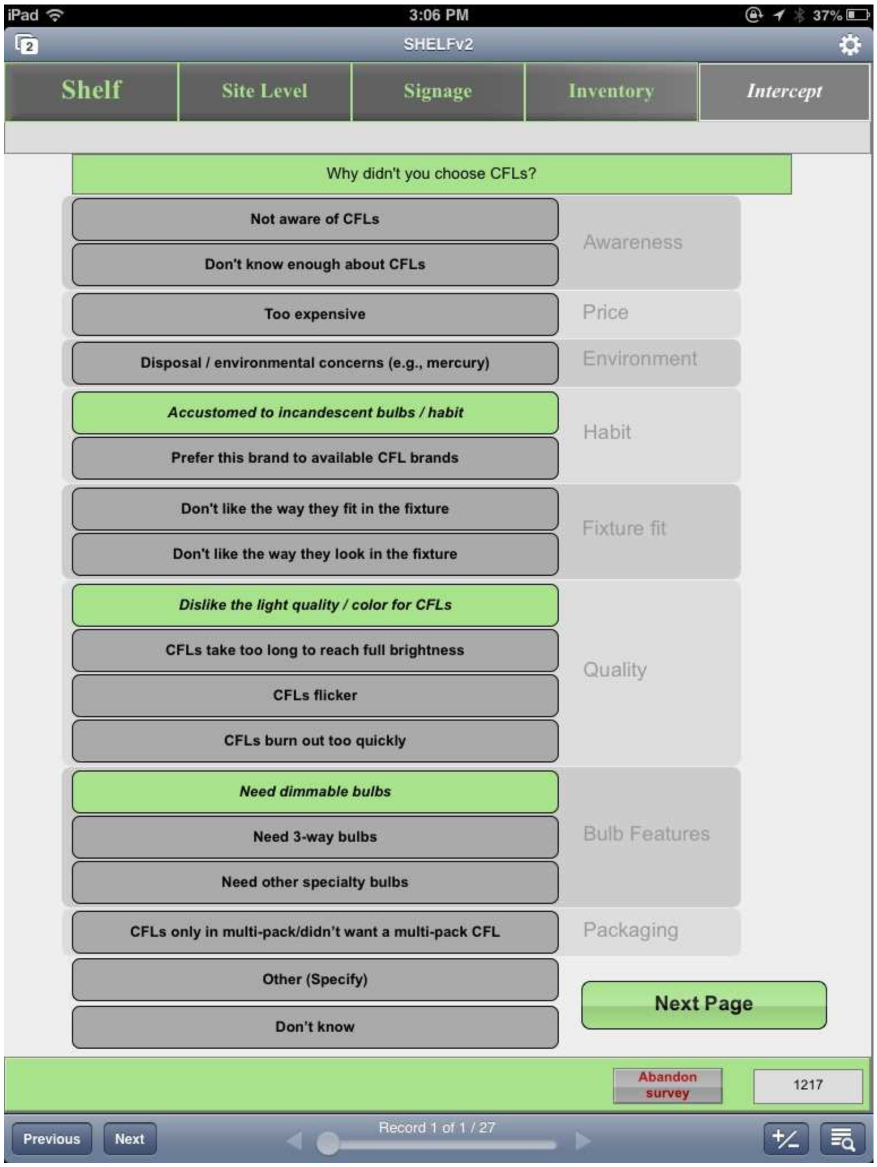


Figure 23 shows the reasons for not choosing CFLs question, and includes several pre-coded response options as well as an option for other reasons not captured in the pre-coded answers.

Figure 23: Shopper Intercept Survey Reasons for Not Choosing CFLs Page



C.3 Database Cleaning and Analysis

One of the many efficiency gains with collecting shelf survey and intercept survey data on a tablet computer is the elimination of the need to enter data from a paper data collection form into a database after completing a shelf survey. Having the ability to scan barcodes on lamp packages and auto-populate key lamp specifications eliminates most of the manual data entry that took place in prior shelf survey research phases. Furthermore, presenting channel-specific lamp choices to consumers with randomly adjusted, dynamic pricing tied to observed prices for each channel would not have been possible on a paper survey. Nevertheless, DNV GL staff still needed to take steps to check and clean shelf survey and intercept survey data that was collected. Before DNV GL staff could analyze data, the following steps were necessary:

- **Clean the Shelf Survey Data.** DNV GL analysts reviewed the shelf survey database a number of times to identify obvious outliers and irregularities for key lamp characteristics, such as product type, base type, lamp style, and wattage. These irregularities were the flagged and corrected. In some cases, analysts researched lamp models on the internet to verify specific lamp specifications. To ensure that the data were clean and consistent, analysts ran key variables in the dataset through standardization procedures. The variables included brand, model number, product type, base type, lamp type and a handful of other lamp characteristics variables. The procedures ensured that the variables were consistent and that there were no outliers in the database.
- **Identify EISA-Compliant and Non-Compliant Lamps in the Shelf Survey Database.** A key initial step in the analysis phase was to identify which lamps in the database were compliant with EISA regulations and which did not comply with the regulations. To do this, DNV GL staff isolated MSB incandescent and halogen A-lamps in the database, flagged lamps models that were exempt from EISA regulations (for example, 3-way lamps, rough service incandescent lamps, and those lamps that exceed the lumen ranges regulated by EISA), and categorized each record as general (normal) service incandescent or modified spectrum lamps. Once that determination was made, each record was flagged and placed in one of four appropriate lumen bins for general service lamps and modified spectrum lamps. The last step involved checking each record to see whether or not it exceeded the maximum allowable wattage based on the lumen output for that record. If a given record was less than or equal to the maximum allowable wattage, then it was flagged as EISA compliant, and if a record exceed the maximum allowable wattage it was flagged as EISA non-compliant.
- **Clean the Shopper Intercept Survey Database.** DNV GL analysts reviewed each intercept survey record to ensure that it was a completed survey. As with cleaning the shelf survey database (see [1] above), analysts reviewed key lamp characteristics, such as product type, base type, lamp style, and wattage to identify obvious outliers and errors. Analysts also had the ability to cross-check any potential data entry errors with the cleaned shelf survey database for any intercept survey lamp record.
- **Post-Code Responses in Shopper Intercept Survey Database.** Having pre-coded response records for the vast majority of the shopper intercept survey minimized the need for data cleaning for most of the questions. However, there were key questions that required post-coding or re-coding of responses. These questions included the reasons for choosing CFLs or LED lamps as well as the reasons for not choosing CFLs or LED

lamps. Analysts carefully reviewed each verbatim response listed in the “other” field for these questions and developed a set of generalized responses for these verbatim responses, which were then post-coded as possible answer choices. In some cases, verbatim “other” responses were re-coded into one of the pre-coded answer choices.

D. Appendix D – Consumer CATI Methodology

D.1 Purpose

The Lighting Consumer Survey was completed using a Computer Aided Telephone Interview (CATI) that asked residential IOU customers about the awareness, purchase, installation, and storage of various energy efficient lighting technologies. The primary goal was to gather this information for four high-impact measures (HIMs): basic spiral/twister, A-shape, flood/reflector, globe-shape CFLs.

D.2 Instrument Design

The survey instrument was modelled on components of the 2006-2008 evaluation survey and included a set of new questions on HIMs besides basic spiral/twister CFLs. The new version of the survey captures details about the wattage of the installed HIMs, bulbs they replaced, and where they were installed. Respondents were asked about their awareness and purchases of light-emitting diodes (LEDs) and energy efficient incandescent bulbs, as well as awareness of Energy Independence Security Act (EISA) and California Assembly Bill 1109 legislations.

D.3 Sampling Plan

D.3.1 Background

In order to achieve consistency among the major evaluation studies of the IOU's PY2010-2012 Residential Energy Efficiency Programs, Work Order 28 utilizes the same stratification as WO 21 (CLASS) and WO 54 (Market Effects and Transformation Research).

This memo includes a brief description of the CLASS stratification,[33] and a detailed explanation of how this stratification is applied to the six WO 28 sampling phases.

D.3.2 Stratification

The stratification for the current IOU's PY2010-2012 Residential Energy Efficiency Programs studies is based on a sampling frame developed with 2010 billing data, and consists of 42 strata defined by:

- Utility (PG&E, SCE, SDG&E)
- Climate zone groups (Mild, Inland, Desert)

[33] A detailed explanation of this stratification is available in the memo "Final Sample Design for WO21: California Lighting and Appliance Saturation Study (CLASS)" dated May 25, 2012.

- CARE/FERA status (Yes or No)
- Daily kWh (Average daily kWh for 2010)

The stratification variables are explained in greater detail below.

D.3.2.1 Climate Zone Groups

DNV GL analyzed the climate zone Cooling Degree Days that are associated with the 2009 RASS to group T24 climate zones into climate zone groups. These CDDs are presented in Column D of Table 116.

Table 116 shows that there is a substantial difference in Cooling Degree Days between Climate Zone 15 and the other zones.

- CZ 15 has over twice the amount of CDDs than the second highest zone, CZ 13. Because of this, CZ 15 was placed in its own group ("Desert").
- The second group, "Inland", groups CZs 8 through 14. These CZs have CDDs between 700 and 2,000 approximately.
- The third group, "Mild", groups the remainder of the climate zones: CZs 1 through 7 and CZ 16. These range between 0 and 470 CDDs.

Table 102: Climate Zone Groups for CLASS Stratification (Sorted by Descending Cooling Degree Days)

A	B	C	D
Climate Zone Group	T24 Climate Zone	2009 HDD (65°F Base)	2009 CDD (65°F Base)
Desert	15	950	4,015
Inland	13	2,355	1,930
Inland	14	3,107	1,769
Inland	11	2,841	1,325
Inland	10	1,799	1,268
Inland	9	1,487	948
Inland	12	2,812	792
Inland	8	1,551	720
Mild	7	1,430	470
Mild	2	3,232	426
Mild	6	1,669	321

A	B	C	D
Climate Zone Group	T24 Climate Zone	2009 HDD (65°F Base)	2009 CDD (65°F Base)
Mild	4	2,512	283
Mild	16	5,593	255
Mild	3	2,792	38
Mild	5	2,704	34
Mild	1	4,149	0

D.3.2.2 CARE / FERA[34] Status

The Energy Division and the IOUs have expressed interest in obtaining a representation of customers that participate in the CARE and FERA programs. The sample stratification has incorporated the CARE/FERA status by coding utility customers that participated in CARE and/or FERA in 2010 as Yes and coding all other customers as No.

When looking at CARE/FERA status, the proportion of energy used per stratum closely follows the proportion of customers in the stratum, as shown in the pairs of Columns D/G or E/H, based on the 2010 data utilized in this sampling frame. In PG&E service territory, 28 percent of customers have CARE/FERA status, and they use 31 percent of the energy. The corresponding proportions are 32 percent and 31 percent for SCE, and 23 percent and 22 percent for SDG&E.

[34] CARE, the California Alternate Rates for Energy program, provides a monthly discount on energy bills for income-qualified households and housing facilities. Qualifications are based on the number of persons living in the home and the total annual household income. FERA, the Family Electric Rate Assistance program, provides a monthly discount on electric bills for income-qualified households of three or more persons.

Table 103: CARE/FERA Status by IOU

A	B	C	D	E	G	H	I
IOU	CARE FERA Status	Number of Customers	Percent Customers Overall	Percent Customers IOU	Average Daily kWh	Percent Daily kWh Overall	Percent Daily kWh IOU
PGE	N	4,017,574	32%	72%	66,439,652	32%	69%
PGE	Y	1,573,317	13%	28%	30,507,941	15%	31%
SCE	N	3,640,787	29%	68%	60,350,520	29%	69%
SCE	Y	1,703,287	14%	32%	27,575,663	13%	31%
SDG&E	N	1,253,097	10%	77%	18,046,401	9%	78%
SDG&E	Y	368,341	3%	23%	4,985,869	2%	22%
TOTAL		**12,556,403**	**100%**		**207,906,045**	**100%**	

D.3.2.3 Daily Average kWh

For each customer, DNV GL summed all of the 2010 billed kWh and divided by the sum of the number of billed days in 2010. This produced average daily kWh for each customer that can be compared to other customers even if a customer does not have all of the billing months available in 2010.[35]

Within each stratum identified by the variables described above, we: (a) sorted customers by their average daily consumption, (b) calculated the total average daily consumption in the stratum, and (c) calculated the individual daily average kWh cut-off points that would place approximately one third of the energy in three usage strata within each stratum. These cut-off points define the daily average kWh strata.

D.3.3 Sampling Frame

The stratification described above results in 42 strata. The strata, the number of customers and the average daily kWh associated with each stratum are provided in. Table 104.

[35] DNV GL recognizes that this is an imperfect way of comparing consumption across all customers. For example, if a customer has only the summer months available, he/she is likely to have a higher daily average than if the only months available are in the winter. However, in the absence of complete annual consumption for some customers, daily average kWh provides a better way to compare consumption among customers than total annual usage.

Table 104: Sampling Frame (Based on 2010 Billing Data)

Stratum	IOU	Climate Zone Group	CARE FERA	Daily kWh	Number of Customers	Percent Customers Overall	Percent Customers IOU	Average Daily kWh	Percent Daily kWh	Std Dev Daily kWh
1	PGE	I	N	<= 20.9	939,212	7.50%	16.80%	9,979,587	4.80%	6.1
2	PGE	I	N	<= 33	388,491	3.10%	6.90%	10,177,432	4.90%	3.4
3	PGE	I	N	> 33	224,254	1.80%	4.00%	10,177,563	4.90%	21.3
4	PGE	I	Y	<= 20.6	467,446	3.70%	8.40%	5,946,164	2.90%	4.8
5	PGE	I	Y	<= 32.7	232,332	1.90%	4.20%	5,991,679	2.90%	3.4
6	PGE	I	Y	> 32.7	123,785	1.00%	2.20%	6,005,512	2.90%	91.9
7	PGE	M	N	<= 14.9	1,533,933	12.20%	27.40%	11,910,622	5.70%	4.1
8	PGE	M	N	<= 25.4	627,322	5.00%	11.20%	12,075,995	5.80%	2.9
9	PGE	M	N	> 25.4	304,362	2.40%	5.40%	12,118,454	5.80%	39.2
10	PGE	M	Y	<= 15.2	465,218	3.70%	8.30%	4,127,128	2.00%	3.5
11	PGE	M	Y	<= 28	209,521	1.70%	3.70%	4,226,823	2.00%	3.5
12	PGE	M	Y	> 28	75,015	0.60%	1.30%	4,210,634	2.00%	166.9
13	SCE	D	N	<= 27.1	79,399	0.60%	1.50%	954,642	0.50%	7.7
14	SCE	D	N	<= 48.1	26,808	0.20%	0.50%	961,120	0.50%	5.9
15	SCE	D	N	> 48.1	12,976	0.10%	0.20%	962,392	0.50%	46.4
16	SCE	D	Y	<= 24.2	24,353	0.20%	0.50%	362,100	0.20%	5.8
17	SCE	D	Y	<= 36.9	12,295	0.10%	0.20%	367,191	0.20%	3.6
18	SCE	D	Y	> 36.9	7,600	0.10%	0.10%	369,300	0.20%	12.5
19	SCE	I	N	<= 18.2	1,612,167	12.80%	30.20%	14,696,925	7.10%	5.4

Stratum	IOU	Climate Zone Group	CARE FERA	Daily kWh	Number of Customers	Percent Customers Overall	Percent Customers IOU	Average Daily kWh	Percent Daily kWh	Std Dev Daily kWh
20	SCE	I	N	<= 29.7	640,260	5.10%	12.00%	14,791,400	7.10%	3.2
21	SCE	I	N	> 29.7	352,762	2.80%	6.60%	14,872,178	7.20%	21.4
22	SCE	I	Y	<= 15.6	800,106	6.40%	15.00%	7,763,625	3.70%	3.5
23	SCE	I	Y	<= 24.8	400,663	3.20%	7.50%	7,843,450	3.80%	2.6
24	SCE	I	Y	> 24.8	234,996	1.90%	4.40%	7,914,104	3.80%	9.9
25	SCE	M	N	<= 14.8	575,692	4.60%	10.80%	4,320,386	2.10%	4.2
26	SCE	M	N	<= 25.5	228,303	1.80%	4.30%	4,385,988	2.10%	3
27	SCE	M	N	> 25.5	112,420	0.90%	2.10%	4,405,490	2.10%	25.6
28	SCE	M	Y	<= 12.5	126,138	1.00%	2.40%	969,106	0.50%	2.8
29	SCE	M	Y	<= 20.5	62,214	0.50%	1.20%	988,140	0.50%	2.3
30	SCE	M	Y	> 20.5	34,922	0.30%	0.70%	998,648	0.50%	9.7
31	SDG&E	I	N	<= 18.4	219,329	1.70%	13.50%	2,090,941	1.00%	5.2
32	SDG&E	I	N	<= 31.1	88,816	0.70%	5.50%	2,104,734	1.00%	3.6
33	SDG&E	I	N	> 31.1	47,423	0.40%	2.90%	2,119,819	1.00%	17.9
34	SDG&E	I	Y	<= 14.8	63,893	0.50%	3.90%	603,105	0.30%	3.2
35	SDG&E	I	Y	<= 25.2	32,483	0.30%	2.00%	619,430	0.30%	2.9
36	SDG&E	I	Y	> 25.2	16,766	0.10%	1.00%	615,817	0.30%	13.7
37	SDG&E	M	N	<= 13.5	565,791	4.50%	34.90%	3,886,287	1.90%	3.7
38	SDG&E	M	N	<= 23.5	221,662	1.80%	13.70%	3,901,656	1.90%	2.8
39	SDG&E	M	N	> 23.5	110,076	0.90%	6.80%	3,942,963	1.90%	20.3

Stratum	IOU	Climate Zone Group	CARE FERA	Daily kWh	Number of Customers	Percent Customers Overall	Percent Customers IOU	Average Daily kWh	Percent Daily kWh	Std Dev Daily kWh
40	**SDG&E**	**M**	**Y**	**<= 11.5**	143,281	1.10%	8.80%	1,035,485	0.50%	2.5
41	**SDG&E**	**M**	**Y**	**<= 18.9**	72,179	0.60%	4.50%	1,055,179	0.50%	2.1
42	**SDG&E**	**M**	**Y**	**> 18.9**	39,739	0.30%	2.50%	1,056,853	0.50%	9.4
TOTAL					**12,556,403**	**100.00%**		**207,906,045**	**100.00%**	

D.3.4 Sample Allocation and Sample Size

DNV GL estimated the statistical precision of four different allocation methods:

1. Proportional to the number of customers in each stratum
2. Proportional to the average daily kWh in each stratum
3. Forty percent of the sample for each of PG&E and SCE, and 20 percent to SDG&E, then proportional to the number of customers in each stratum
4. Forty percent of the sample for each of PG&E and SCE, and 20 percent to SDG&E, then proportional to the average daily kWh in each stratum

All methods produce high statistical precision at the statewide level. The 40/40/20 methods improve the precision in the SDG&E service territory with very little impact on the precision of the PG&E and SCE service territories. Method 4 (40/40/20 with allocation proportional to kWh within each utility) was adopted.

D.4 Survey Implementation

The survey was fielded in two waves, Q2 2012 and Q2 2013, comprised of a simple random sample of IOU customers. Each wave was divided into two parts, A and B, in order to ensure that the targeted number of purchasers was met for each HIM:

- **Wave A (1A/2A):** The first segment of each wave (A) was designed to capture recent CFL purchasers as well as respondents who had not purchased one of the five HIMs. The latter group is also referred to as "non-purchasers." One of the goals here was to keep track of how many recent CFL purchasers completed the survey as specific targets were set for each HIM. Wave 1A reached 791 respondents and Wave 2A reached 800 respondents.
- **Wave B (1B/2B):** The second segment of each wave (B) was designed to specifically target CFL purchasers from each HIM where targets had not been met.

Targets were set for each HIM according to the time period in which they were purchased. Basic spiral CFLs purchasers were limited to three months prior to the date of the survey and all other HIMs were asked about their purchases since January 1st, 2010. These targets along with the actual number of completed surveys can be seen in Table 4 below:

Table 105: Purchaser Targets versus Actual Completes by HIM per IOU

HIM	Target per Wave	Wave 1		Wave 1 Total	Wave 2		Wave 2 Total
		1A	1B		2A	2B	
Spiral (last 3 months)	100	82	33	**115**	90	22	**112**
PGE		26	16	**42**	33	5	**38**
SCE		36	12	**48**	34	10	**44**
SDG&E		20	5	**25**	23	7	**30**
A-shape	75	33	47	**80**	23	17	**40**
PGE		9	27	**36**	9	8	**17**
SCE		12	16	**28**	7	7	**14**
SDG&E		12	4	**16**	7	2	**9**
Flood	75	52	61	**113**	61	45	**106**
PGE		15	33	**48**	29	16	**45**
SCE		20	20	**40**	19	17	**36**
SDG&E		17	8	**25**	13	12	**25**
Globe	75	27	53	**80**	52	39	**91**
PGE		6	25	**31**	14	14	**28**
SCE		13	16	**29**	21	21	**42**
SDG&E		8	12	**20**	17	4	**21**
Dimmable	75	27	35	**62**	31	26	**57**
PGE		7	22	**29**	9	12	**21**
SCE		12	10	**22**	14	8	**22**
SDG&E		8	3	**11**	8	6	**14**

E. Appendix E – Retail Manager CATI Methodology

E.1 Purpose

The Retail Store Manager Survey was completed using a Computer Aided Telephone Interview (CATI) which asked various businesses about different types of IOU-discounted products (for example, basic CFLs, specialty CFLs, CF fixtures, LEDs, etc.). The retail store managers will consist of eight retail channels including discount, drug, grocery, large home improvement, mass merchandise, membership club, small hardware, and lighting and electronics chains.

E.2 Instrument Design

The survey instrument was modelled on components of the 2006-2008 evaluation survey which included questions about product offerings; CFL stocking/re-stocking practices; program attribution of standard CFLs and specialty CFLs; possible leakage of IOU-discounted bulbs; specialty CFLs; hard-to-reach customers and effects of the Energy Independence Security Act (EISA).

E.3 Sampling Plan

E.3.1 Background

A two-prong approach was used to sample retail stores for these surveys. The main goal was to select a random sample of participating and non-participating stores in IOU service territories that sell the types of products sold through the IOU programs during 2010-2012. Another goal was to expand the frame to include retail stores that sold other type of lighting products such as LED, energy efficient incandescents, etc.

E.3.2 Sample Allocation and Sample Size

The sample for this research was based on utility tracking data and was allocated in a similar manner to other supplier and consumer research efforts conducted with WO13 and WO28. The overall sample was distributed by IOU as follows: 40 percent for PG&E, 40 percent for SCE and 20 percent for SDG&E. The utility tracking data helped identify stores that received shipments of IOU program bulbs and were characterized as "participants;" all other stores that did not meet this criteria were considered "non-participants." Targets were set according to each store type or channel per IOU, but were also stratified by participant/non-participant status and store type (chain/independent).

E.4 Survey Implementation

The survey was fielded in two waves, Q2 2012 and Q2 2013, comprised of a random sample of retail stores within the three IOUs.

Both phases of retail store manager interviews had different targets. The targeted number of completed surveys was set to 310 for Wave 1 and increased to 400 for Wave 2. However, due to many non-responses and a limited population in the sample we were unable to meet the quota in both waves. A total of 268 surveys were completed in Wave 1 and 368 were completed in Wave 2. A summary of these targets and completes are shown below.

E.4.1 Targets per channel by IOU

Targets per channel were divided according to the 40 percent/40 percent/20 percent split by IOU. A comparison of the targets and actual completed surveys can been seen below in Table 106.

Table 106: Targets per Channel by IOU, Wave 1 and Wave 2

Channel	WAVE 1						WAVE 2					
	PGE		SCE		SDG&E		PGE		SCE		SDG&E	
	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
Discount	15	**9**	16	**16**	11	**5**	19	**18**	21	**22**	16	**5**
Drug	17	**13**	18	**16**	9	**5**	22	**22**	22	**22**	12	**12**
Grocery	16	**15**	16	**17**	14	**14**	20	**20**	20	**21**	18	**15**
Hardware	16	**25**	16	**19**	13	**5**	20	**26**	20	**25**	18	**8**
Home Improvement	8	**12**	9	**9**	6	**6**	10	**16**	13	**13**	11	**3**
Ltg & Electronics	15	**13**	16	**12**	10	**3**	19	**18**	21	**23**	16	**4**
Mass Merchandise	17	**19**	12	**10**	13	**6**	19	**24**	11	**13**	16	**9**
Membership Club	9	**9**	9	**7**	9	**3**	12	**7**	12	**5**	12	**1**
Total	113	**115**	112	**106**	85	**47**	141	**151**	140	**144**	119	**57**
Total by Wave	**268**						**352**					

E.4.2 Participants versus Non-Participants

The targets were also divided based on a retail store's participation in the ULP. Participating stores comprised of approximately two thirds of the total target for each wave. A summary of targets per channel and actual completes can be seen in Table 107 below.

Table 107: Targets per Channel by Participant and Non-Participant status, Wave 1 and Wave 2

Channel	WAVE 1				WAVE 2			
	Participant		Non-Participant		Participant		Non-Participant	
	Target	Actual	Target	Actual	Target	Actual	Target	Actual
Discount	26	**27**	16	**3**	36	**42**	20	**3**
Drug	24	**21**	20	**13**	30	**30**	26	**26**
Grocery	24	**28**	22	**18**	30	**27**	28	**29**
Hardware	23	**23**	22	**26**	30	**30**	28	**29**
Home Improvement	23	**27**	-	-	34	**32**	-	-
Ltg & Electronics	26	**20**	15	**8**	36	**18**	20	**27**
Mass Merchandise	24	**17**	18	**18**	30	**30**	16	**16**
Membership Club	27	**19**	-	-	36	**13**	-	-
Total	197	**182**	113	**86**	262	**222**	138	**130**
Total by Wave	**268**				**352**			

E.4.3 Chain Versus Independent

The upstream program shipped many discounted lamps to certain types of stores. These included independent discount, drug, grocery, hardware, home improvement and lighting and electronic stores which had to be accounted for in our stratification. Below are targets for chain and independent stores by channel for each wave of the study and a summary of completed surveys (Table 108).

Table 108: Targets per Channel by Chain and Independent status, Wave 1, and Wave 2

Channel	WAVE 1				WAVE 2			
	Chain		Independent		Chain		Independent	
	Target	Actual	Target	Actual	Target	Actual	Target	Actual
Discount	14	**18**	28	**12**	18	**28**	38	**17**
Drug	27	**27**	17	**7**	34	**51**	22	**5**
Grocery	23	**18**	23	**28**	29	**31**	29	**25**
Hardware	23	**27**	22	**22**	29	**30**	29	**29**
Home Improvement	19	**26**	4	**1**	25	**32**	9	-
Ltg & Electronics	14	**11**	27	**17**	18	**5**	38	**40**
Mass Merchandise	42	**35**	-	-	46	**46**	-	-
Membership Club	27	**19**	-	-	36	**13**	-	-
Total	189	**181**	121	**87**	235	**236**	165	**116**
Total by Wave	**268**				**352**			

F. Appendix F – Multi-State Model

F.1 Introduction

This report summarizes the effort of applying California data collected for the California Public Utilities Commission (CPUC) to the 2010 CFL multistate modeling (MSM) effort, highlighting the results as they pertain to the net-to-gross ratio (NTG). California did not originally take part in the 2010 MSM effort, but this 2010 effort was built on an earlier MSM effort that included California. In April of 2010, NMR delivered a report to the CPUC as part of the 2006 to 2008 Compact Fluorescent Lamp (CFL) Market Effects evaluation describing the results of a MSM effort meant to describe CFL purchases in the 2008 program year. This model incorporated household-level data on CFL use and purchase behavior in 2008 from multiple CFL program administrators (PAs)—including the California investor-owned utilities (IOUs)—as well as non-program areas across the nation. After completing this 2008 effort, NMR collaborated with Cadmus, KEMA, Itron, and others to perform a similar MSM study for a somewhat different group of program administrators covering the period of January 1, 2009 through June 2010. The CPUC decided not to take part in this second MSM effort. However, individuals familiar with both the 2008 and 2009/2010 MSM efforts asked NMR to apply residential CPUC lighting data, to be collected in 2012, to the final 2009 and 2010 MSM models. This document summarizes this application of lighting data collected for the CPUC to the existing 2009 and 2010 MSM models.

F.1.1 Changing CFL Market and the Multistate Modeling Approach

CFL program evaluators nationwide are finding it increasingly difficult to provide valid and defensible estimates of NTG ratios for CFLs. In fact, the comprehensive evaluation of the ULP in California completed in the Spring of 2010 for the CPUC assessed NTG using six different methods, while a more recent effort in Massachusetts, finalized in June 2011, turned to five different approaches to estimating NTG and then relied on a Delphi Panel to arrive at the final NTG ratio recommended to the program administrators.[36]

These and other recent NTG studies make clear that all available estimation methods have strengths and weaknesses that ultimately influence the results. Former "best practices" (*for example*, self-reports of free ridership and spillover and simple comparison-state approaches) have become increasingly problematic. Numerous circumstances underlie the struggle to provide valid estimates of NTG, but chief among these is the rapid expansion of CFL programs

[36] 1) KEMA. 2010. *Final Evaluation Report: Upstream Lighting Program*. Delivered to the CPUC February 8. 2) NMR Group, Inc. 2010. *Massachusetts ENERGY STAR Lighting Program: 2010 Annual Report*. Delivered to the Program Administrators on June 30, 2011.

throughout the nation, the increased availability of CFLs regardless of CFL program activity, and limited access to CFL sales data from participating and non-participating retailers in both program and non-program areas. The implementation of the Energy Independence and Security Act of 2007 (EISA) only increases the challenges of understanding how to isolate net program impacts. Although the increased lighting efficiency standards mandated by EISA were not yet in place in the 2009 to 2010 time period of this study, moving forward, its implementation, which began in 2011 in California and 2012 nationwide, must be taken into account when considering net program impacts.[37] Not only do such circumstances limit the usefulness of former best practices to estimating NTG, but no clear methodology currently presents itself as the latest best practice in NTG estimation. For this reason, many PAs across the nation are embracing innovative approaches to estimating NTG in an effort to identify new ways of determining the impact of CFL program activity on actual CFLs purchases and energy savings.

Multistate modeling is one of these approaches. Numerous PAs and their evaluators have employed multistate—really multi-area—modeling as one possible avenue for estimating NTG. In this approach, data from households in multiple PA service territories are entered into a statistical model that captures the effect of program activity on CFL purchase and use behavior, net the impact of demographic, economic, and social factors that also affect such behavior.[38]

This report utilizes the 2009/2010 multistate models and applies CPUC data to those models. The principal goals of the multistate models were to identify and examine factors associated with CFL purchases from January 2009 to June 2010—and expanded to all of 2010 for the California IOUs—and isolate the effect of CFL programs during that time period on those purchases. The evaluation team effort yielded two CFL purchase models: a model that best describe CFL purchases for the entire original MSM 18-month period as well as a model limited to the more recent 2010 time period. The original analysis drew from data gathered over the telephone or at the homes of 1,495 households (Table 109). The coefficients generated by the MSM models were then applied to the 2012 CPUC data (n=71) to generate backward looking NTG for the 2009/2010 periods.

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[37] Because they estimate CFL NTG in 2009 and 2010, EISA impacts are not included in the results presented in this study, as discussed more in the Conclusions and Recommendations section.

[38] 1) KEMA 2010 ULP; NMR 2010 Multistate CFL Modeling. 2) NMR Group, Inc. *Massachusetts Energy Star Lighting Program* (specifically Appendix C. 3) Other similar reports and memos delivered to additional sponsors of the two MSM efforts.

Table 109: Participating Areas and Sample Sizes

Area	On-Site Sample Size
Ameren IL (part Illinois)	92
Ameren MO (part Missouri)	87
ComEd (part Illinois)	98
Consumers Energy (part Michigan)	61
Dayton Power and Light (part Ohio)	72
EmPower Maryland (most Maryland)	79
Massachusetts (entire state)	150
New York City	100
New York State	200
Rhode Island (entire state)	100
Salt River Project (part Arizona)	101
Houston, Texas (Harris County)	100
Indiana (central portion)	67
Kansas (entire state)	95
Pennington County, SD (portion)	93
TOTAL	**1,495**

F.1.2 Key Differences in the 2008 and 2009 MSM Efforts

As mentioned above, the CPUC was one of the sponsors of the original 2008 MSM effort, but did not contribute to the 2009/2010 effort. These two efforts shared a similar purpose—to estimate NTG for CFL purchases—and relied on a similar approach—modeling purchase behavior in areas with different levels of current and historic CFL program activity. The 2008 MSM effort, of course, was an initial attempt at using a new approach to estimating CFL NTG. In the process of developing the model, having it reviewed by study sponsors, and receiving feedback from the broader energy efficiency and academic community, the original MSM team decided to make some changes in the 2009/2010 effort that they hoped would improve upon to the 2008 effort.[39]

[39] This is analogous to the continuously evolving efforts of survey researchers to tweak free ridership questions in participant surveys. The energy efficiency field has been asking free ridership questions since the early 1980s but has yet to settle on a battery that is universally accepted. Instead, such question batteries vary across evaluation cycles, program administrators, and even programs supported by the same administrators, sometimes to meet the unique needs of the program but other times because the administrators and evaluators believe they can improve upon the free ridership estimation of prior efforts. See NMR Group, Inc. and Research Into Action. 2010. *Net Savings Scoping Paper*. Delivered to the

This section summarizes some of the changes made in the 2009/2010 modeling approach. Given the volatility of the CFL market together with the improvements in data collection and model choice described below, it is not surprising that the 2009/2010 MSM effort yielded different models of CFL purchases, as described, along with the implications of the changes, below in Section F.4.3.

F.1.2.1 Data Collection

The data collection efforts for the 2008 MSM effort were not performed in a uniform manner; some of the study sponsors—notably the CPUC, which included data for the IOUs and three comparison states—gathered data prior to the initiation of the MSM model and later decided to join the effort; for this reason, their telephone survey and onsite protocols differed from those of the program sponsors who coordinated their data collection specifically for MSM purposes. Because of the discordant 2008 MSM data collection in these areas, the multistate team had to impute data for certain participants and areas and to force these data to fit time frames and purposes for which they not originally collected. Given the difficulties created by variations in data collection, the 2009/2010 MSM team made every effort possible to coordinate protocols for the second modeling effort. All study sponsors agreed to follow relatively strict and uniform data collection protocols and to implement the work in a circumscribed period of time.

F.1.2.2 Model Choice

The 2008 MSM effort relied on negative binomial regression (NBRM) to produce the coefficients that were used to estimate NTG. The team had used NBRM in the 2008 MSM effort because of a decision to treat all non-CFL purchasers the same; in other words, a “zero was a zero,” and the model did not take into consideration the various reasons why a household may not have purchased any CFLs in 2008. However, upon discussion of how to improve the 2009/2010 MSM effort, the evaluation team came to a different conclusion, deciding that it was more likely that purchasing zero CFLs meant different things to different households in the sample. Some households purchased zero CFLs simply because they did not need any CFLs during the time period under question. Other households, however, did not buy CFLs because they did not use CFLs, did not want to use CFLs, or were not aware that CFLs existed. After recognizing that all zero purchasers were not the same, the MSM team was then able to make use of a different type of model—the zero-inflated negative binomial regression model (ZINB)—that explicitly takes into account the fact that not all zeros are equivalent. The team tested the ZINB to see if it supported this theory of underlying differences among non- purchasers and, concluding it did, utilized the more appropriate ZINB in the 2009/2010 MSM effort.

Northeast Energy Efficiency Partnership’s Evaluation, Measurement, and Verification Forum, November 13 2010.

F.1.3 Recruitment Procedures

The data used in the CPUC effort of applying California data to the 2009/2010 models were gathered in order ensure comparability to the data collection originally performed in support of the 2009/2010 effort. NMR and KEMA worked to develop data collection protocols that were similar to those used in the 2009/2010 effort. Therefore, as in the 2009/2010 MSM effort, CPUC data were derived largely from information collected during an onsite saturation survey in which team members counted all lighting products in the home and verified when the installed and stored CFLs were purchased. The onsite data were supplemented with information gathered during telephone surveys and from sources such as the Bureau of Labor Statistics. Households were recruited for the onsite effort through telephone surveys.

F.1.4 Telephone Surveys

In order to identify households to take part in the onsite data collection needed for the MSM effort, the MSM team fielded telephone surveys in each of the program and non-program areas included in the analysis. In areas where the PAs serve most residents and in the comparison areas, the team conducted random digit dial (RDD) surveys of households with residential—and in Massachusetts also cell phone—numbers. In the remaining areas, they called only customers of the specific PA. The CPUC effort mimicked this approach by calling customers of the IOUs; making certain that the survey included questions critical to the 2009/2010 models. A total of XX households answered the telephone survey in the IOU service territories.

F.1.5 Onsite Visits

As mentioned above, the MSM team identified onsite participants through the telephone surveys, and KEMA and NMR turned to the same approach when recruiting the IOU households included in this study. During the telephone survey, households were asked if they would be interested in taking part in the onsite study. After completion of the telephone, the evaluators randomly selected interested households to take part in the onsite study. The original MSM households were offered a $75 to $150 incentive to each homeowner, depending on the cost of living in their area, to entice customers to participate in the onsite visit. In California, households were offered $75 to take part in the onsite. Note that in Massachusetts, New York State, New York City, and Houston some households took part in onsite visits in both 2009 (in support of the 2008 MSM model) and in 2010 (in support of the 2009/2010 MSM models); these are referred to as the revisit households.[40]

[40] For more information see 1) and 2) NMR Group, Inc. *Massachusetts Energy Star Lighting Program* (specifically Appendices A and C); 3) Filiberto, D. *et al.* 2011. *NYSERDA CFL Expansion Program: Random Digit Dial and Onsite Survey Results.* Delivered to NYSERDA May 2011; and 4) Wilson-Wright

F.1.5.1 Conducting the Onsite Visit

The 2009/2010 MSM PAs and the evaluation team cooperatively developed onsite survey instruments, and KEMA and NMR followed suit when gathering the data from IOU customers for application of California to the 2009 and 2010 MSM models. The onsite visits in every area adhered to the following procedure:

> A trained technician arrived at the home at a pre-scheduled time, introduced him or herself, and asked for the contact person who had been identified when scheduling the visit. The respondent and the technician walked through each room of the home examining all lighting sockets to see if they contained a bulb and, if so, the type of lighting technology in use and the switch type; some also noted the base type. If the product was a CFL, the technician noted its manufacturer and model number and any specialty features. The technician also asked the respondent to estimate when he or she purchased that particular CFL. The technician and householder examined bulbs in storage, again noting similar detailed information on stored CFLs.

F.2 Variable Specification

The MSM evaluation team collected nearly all of the MSM data needed for the modeling effort through the telephone and onsite surveys, the same method was utilized for the CPUC data collection effort. A few variables were gathered from sources other than the survey and onsite visits. These include the program variables and unemployment rates at the time of the survey. The development of these other variables as well as specification of some of the survey data are presented below.

F.2.1 Program Variables

The program variables were the key components of the MSM statistical models guiding the calculation of the NTG ratios. Although the MSM team tested other possible specifications of the program variable,[41] ultimately the number of program supported CFLs per household and the years the program had been supporting CFLs served as statistically significant indicators of CFL purchases in the final models. Table 110 presents the values for these significant program variables for the IOUs.

L. and C. Russell. 2011. *Results of the Multistate CFL Modeling Effort*. Delivered to NYSERDA September 2011.

[41] See NMR Group, Inc. 2011. *Massachusetts Energy Star Lighting Program* (specifically Appendix C. 3)

Table 110: Prior Program Support and Current Program Data

Area	Years Supporting CFL	CFL Incented per HH-18 months	CFL Incented per Household-Early 2010
PG&E	10	2.19	0.98
SCE	10	1.55	0.61
SDG&E	10	1.39	0.02
CPUC	10	1.77	0.64

F.2.2 Additional Non-Survey Variables

Certain external factors—including local economic conditions—may have affected CFL sales. The MSM team considered using foreclosure rates to capture these economic conditions but was unable to locate reliable and comparable data across all areas in the study. Therefore, the MSM team turned to county level unemployment rates from the US Bureau of Labor Statistics (BLS) to capture local economic conditions, using this same approach for the California IOUs.[42,43]

F.3 Model Choice and Development

The nature of the MSM data led the team to turn to non-linear models to estimate CFL purchases and use. This section explains model choice, development, and the application of the CPUC data.

F.3.1 Model Choice

The MSM team used a zero-inflated negative binomial (ZINB) model in the 2009/2010 effort to predict CFL purchases. Similar to the related model used in the 2008 study, the negative binomial regression model (NBRM), the ZINB is one of the more common methods of analyzing count data (for example, the number of CFLs) with many cases falling at zero and with a fair degree of variability in the data, which accurately describes the purchase data collected for the MSM effort (Figure 24).[44]

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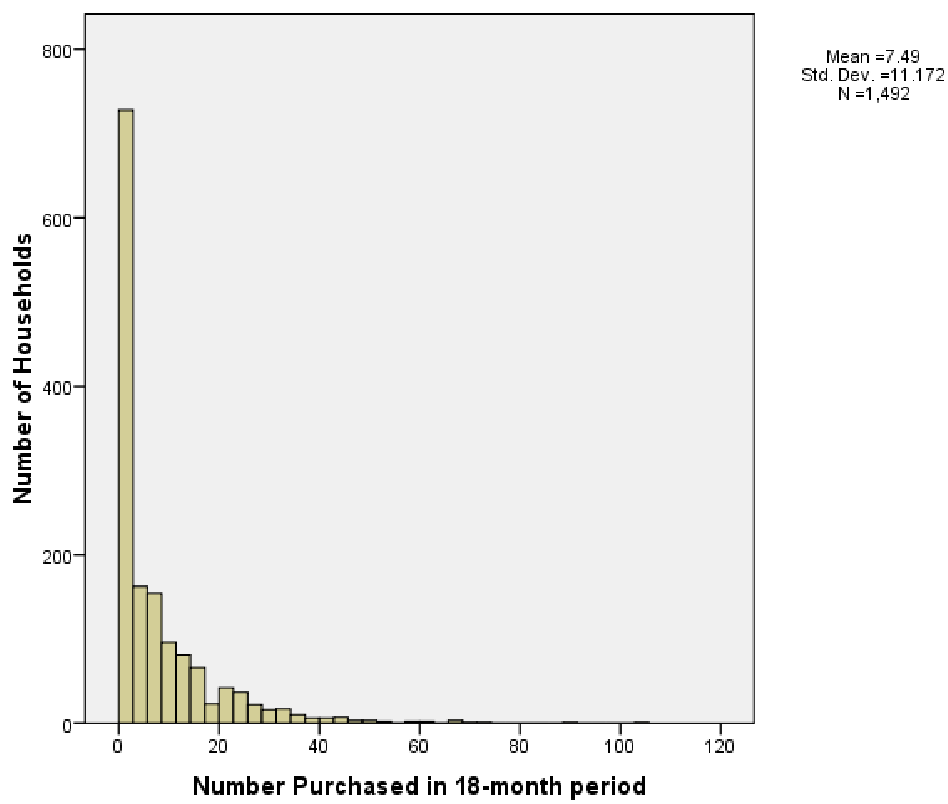
[42] The team also included a question in the telephone surveys about the respondent's satisfaction with their standard of living, which is included in some of the final models.

[43] The BLS defines unemployment as jobless workers actually seeking employment; the measure excludes so-called "discouraged" jobless, those who have given up their job search.

[44] 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.

The ZINB model runs two simultaneous models, a logistic model and a negative binomial model. The logistic model distinguishes between the zeros, identifying the households that had a higher probability of never buying CFLs (*for example,* the always zero group)[45] and those households who had a higher probability of simply not purchasing during the observation period (*for example,* the not-always zero group). The negative binomial portion of the procedure runs models that predict the number of purchases using those households from the logistic portion weighted based on their classification of being an always zero or not-always zero group as well as households that actually reported purchasing CFLs in the observation period.

Figure 24: Histogram of CFLs Reported Purchased for the 18-month Period (original MSM data)



45 Recall that the data and the model precede the EISA implementation period, and it is possible that after EISA some of these "always zero" households may try CFLs as incandescent bulb availability decreases.

F.3.2 Model Development

The team developed models using the different program variables and other explanatory variables, including the following:

- Demographic, economic, and social characteristics
- Concentration and travel time to Big Box stores
- Duration of household CFL use
- CFL storage, CFL use, and CFL saturation prior to the purchase period under consideration
- Various measures of environmental opinions and early adoption behavior

The models presented in Section F.4 are parsimonious in that every variable in them has a statistically significant net effect on CFL use or purchases (at the 0.10 level of significance); removing any of the variables reduces the strength of the model as determined by diagnostics such as the maximum likelihood R^2, the predictive capability of the model, or the statistical significance of other explanatory variables in the model. In short, they represent the best models yielded by the analyses.

F.4 Results and Implications for NTG

The MSM team presented two different recommended purchase models for the MSM effort. The first model, shown in Table 111, covers the entire 18-month period of January 1, 2009 to June 30, 2010. Table 112 on page F-11, in contrast, predicts purchases for the first-half of 2010 only. The MSM team created these two models at the request of the various sponsors of the study, who had different program schedules and reporting needs. Some advisors to the effort also argued that the 18-month model likely suffered from reduced self-report error regarding when households obtained CFLs, as they could be more confident that the purchase happened sometime in the past 18 months than in the past six months. This discussion, however, raises a concern about the application of the 2009/2010 model to CPUC data—respondents were asked in 2012 to recall which CFLs they bought in 2009 and 2010, meaning two to three years ago. The evaluation team would be remiss if it did not point out that this lag increases the chances of self-reporting error among the CPUC respondents.

For each of the purchase models presented below, the logistic portion looks only at households not purchasing CFLs in the time period and indicates which will likely never purchase CFLs and those more likely to be purchasers. In the logistic portion, a positive coefficient means the characteristic is associated with being an “always zero” home. The model’s negative binomial portion is limited to those buying CFLs and zero purchasers who nevertheless have characteristics of households more likely to buy CFLs. It estimated how many CFLs these households purchased in the time period and shows the explanatory variables and their coefficients. The direction of the coefficients in the negative binomial portion behaves similarly to ordinary least squares regression—a positive correlation signifies that the characteristics is associated with buying a greater number of CFLs.

F.4.1 Purchase Model for 18-month Period

The logistic portion of the 18-month model predicts that:

- Households that own their homes were more likely to purchase some CFLs (that is, not be in the “always zero” group).
- Households with a greater CFL saturation at the beginning of 2009 were less likely to buy any CFLs, so they were considered to be in the always zero group, which the MSM team understands is counterintuitive. However, they concluded that this presumably reflects the fact that such households already purchased CFLs and did not need them when asked (for example, until their current CFLs burn out or they exhaust their stock of stored CFLs).
- Households that strongly agree that it is expensive to reduce energy use (that is were more likely to report a three or four on the scale) were less likely to buy any CFLs, presumably because they have already taken such low-cost options as buying CFLs or because they believe that CFLs are too expensive to purchase.

The 18-month model’s negative binomial portion predicts that the number of bulbs the program incented per household had a significant and positive effect on CFL purchases. Other factors influencing the number of CFLs purchased included:

- Households with a higher saturation of CFLs at the beginning of 2009 also were likely to buy fewer CFLs than those with a lower CFL saturation. Similar to the model’s logistic portion, this implies that those households with high levels of saturation simply did not need to buy CFLs because they already had enough.
- Households living in counties with high unemployment purchased fewer CFLs; considered with the logistic portion, this implies that households living in such areas bought CFLs, but not very many of them.
- The larger the participant’s home the more CFLs they purchased.
- Households satisfied with their standard of living were more likely to buy CFLs, perhaps reflecting their greater comfort level with paying the higher price for CFLs.
- Households in which the respondent self-identified as white bought more CFLs.
- Finally, households that bought CFLs at various types of Big Box stores purchased more CFLs, presumably due to the larger package size typically sold at these stores versus grocery or lighting specialty stores. Note that, in the 2010 model presented below, a combined Big Box store variable performed better than these individual variables, but the individual variables performed better in the 18-month model.

Table 111: Best Fit 18-Month Purchase Model*

Variables	Coefficient	Probability of z
Logistic Model		
Intercept	-1.169	0.000
Homeownership (owner coded as 1)	-0.656	<0.001
CFL Saturation at Beginning of 2009	0.023	<0.001
Not expensive to reduce energy use (1 to 4, strongly agree coded as 1)	0.179	0.055
Negative Binomial		
Intercept	1.457	<0.001
Bulbs supported/household	0.062	0.012
CFL Saturation at the beginning of 2009	-0.012	<0.001
County unemployment rate at the beginning of 2009	-0.050	0.006
Size of home (by 2K sq. ft., ascending scale)	0.302	<0.001
Satisfaction with standard of living (1 to 5, strongly agree coded as 5)	0.054	0.066
Self-identify as white	0.328	<0.001
Purchase CFLs at Warehouse Store**	0.858	<0.001
Purchase CFLs at Home Improvement Store**	0.405	<0.001
Purchase CFLs at Mass Merchandise Store**	0.279	0.002

* Sample size = 1,239 and Maximum Likelihood R2 = 18 percent. Reduction in sample size from full 1,495 cases reflects exclusion of households who knew purchase date for fewer than 75 percent of CFLs in home (105 cases), no response for the energy question (73 cases; question was mistakenly excluded from one telephone survey; efforts to collect onsite yielded responses for only some households), and refusal to answer demographic (51 cases) and standard of living (23 cases). Note that some households were excluded for more than one of these reasons.
** In the 2010 model below, combining these variables into one "shop at Big Box store" dummy variable performed as well as treating them separately. In this 18-month model, doing so reduced model fit.

F.4.2 Purchase Model for 2010

The logistic portion of the 2010 model predicts that:

- Households with higher education levels had a greater probability of purchasing any CFLs, that is, of not being in the always zero group.
- Households visited in both 2009 and 2010 were more likely to purchase CFLs.
- Households with a greater CFL saturation at the beginning of 2010 were less likely to buy any CFLs, so they were considered to be in the always zero group, again presumably because they already purchased CFLs and did not need them when asked.

- Households that like to have new technology were more likely to buy CFLs than those who do not like to have new technology. Conversely, households that did not like to have new technology (indicated by responses of three or four) were more likely to have zero purchases, indicating a lower likelihood of buying CFLs.

The 2010 model's negative binomial portion predicts that the number of bulbs the program incented per household had a significant and positive effect on CFL purchases. Other factors influencing the number of CFL purchased included:

- Homeowners were more likely to purchase a greater number of CFLs in 2010.
- The larger the participant's home the more CFLs they purchased in 2010.
- Even though they were more likely to buy CFLs than their counterparts who were skeptical of new technology, participants who responded that they like to have the latest technology purchased fewer CFLs than those technology skeptics that did buy CFLs, presumably because the early adopters already had a greater number of CFLs in their homes than the skeptics.
- Households with a higher saturation of CFLs at the beginning of 2010 also were likely to buy fewer CFLs than those with a lower CFL saturation. Similar to the model's logistic portion, this implies that those households with high levels of saturation simply did not need to buy CFLs because they already had enough.
- Those in areas with longer running programs were less likely to buy more CFLs. This variable indicates the cumulative impact of older programs, specifically that households in those areas have more CFLs because of the long program history. Therefore, they did not need to buy as many in 2010 compared to areas with newer programs. The program successfully shifted purchase to earlier years, thereby garnering savings earlier than had the program not existed.
- Households who purchased CFLs at Big Box stores were more likely to buy a greater number of CFLs, presumably due to the larger package size typically sold at these stores versus grocery or lighting specialty stores.
- Finally, two dummy variables associated with data collection were evident in the model. Those revisit households surveyed in both 2009 and 2010 purchased fewer CFLs in 2010 than households visited only in 2010. In addition, those areas where onsite technicians did not require residents to guess their purchase period when they responded "don't know" to when the CFLs was purchased were likely to have lower CFL purchases. This could be because those asked to "guess" when bulbs were purchased, tended to guess more recently (a common memory bias).

Table 112: Best Fit Early 2010 Purchase Model*

Variables	Coefficient	Probability of z
Logistic Model		
Intercept	-0.453	0.185
Some college or higher education	-0.491	0.003
Revisit (yes coded 1; to account for potential impact of our first visit as evidenced in some MA, NY, Houston data	-0.517	0.007
CFL Saturation at Beginning of 2010	0.015	<0.001
Like to have new technology (1 to 4, strongly agree coded as 1)	0.318	0.001
Negative Binomial		
Intercept	1.000	<0.001
2010 Bulbs supported/household	0.385	<0.001
CFL Saturation at the beginning of 2010	-0.015	<0.001
Purchase CFLs at Big Box Store	0.441	0.008
Years supporting CFLs	-0.038	<0.001
Data Collection Protocol treatment of Don't Know	-0.801	<0.001
Homeowner	0.441	<0.001
Size of home (by 2K sq. ft., ascending scale)	0.353	<0.001
Likes to have new technology (1 to 4, strongly agree coded as 1)	0.157	0.008
Revisit household	-0.403	0.009

* Sample size = 1,349 and Maximum Likelihood R^2 = 12 percent. Reduction in sample size from full 1,495 cases reflects exclusion of households who knew purchase date for fewer than 75 percent of CFLs in home (105 cases) and refusal to answer demographic or early adopter questions (41 cases).

F.4.3 Specific Differences between the 2008 MSM and the 2009/2010 MSM Purchase Models

As mentioned earlier, the CPUC was among the sponsors of the 2008 MSM effort but not the 2009/2010 effort. It stands to reason that the CPUC would be interested in understanding the similarities and differences between the models developed in the two efforts—and their implications. The predictors in the 2008 MSM purchase model and the 2009/2010 MSM purchase models did share some similarities, but the final models were very different. The team attributes many of these differences to the improved quality of the data collection and methodology in the 2009/2010 MSM effort described above (Section F.1.2) but also to the testing of new variables and the rapidly changing CFL market. Unfortunately, the MSM team is not able to isolate the portion of change due to these various potential sources of differences.

Table 113 compares the variables in the final models that informed NTG estimation in the 2008 and 2009/2010 MSM efforts. Both MSM efforts produced models that showed significant program impact on CFL purchases—the 2008 model utilized a composite program score that combined various aspects of program activity but individual program components performed better in the 2009/2010 models. Household involvement with CFL lighting was a significant predictor of purchases across all time periods, although the 2008 model was different in that it utilized households' duration of CFL use while the later models utilized CFL saturation at the beginning of 2009 or 2010 (depending on the model). Another commonality between the 2008 models and the 2009/2010 models was the significance of variables that tried to address data collection differences within the specific MSM period indicating that the lack of uniformity in data collection has a substantial impact on a model. Yet, the models also differed in large part because the 2009/2010 models included variables never considered in the 2008 effort or that were found not to be significant in the later models although they were in the 2008 one. Not surprisingly, the different models also yielded different NTG estimates as shown in the table and discussed more below.

Table 113: Variables Used in the MSM Purchase Models

Variables	2008 Model	2009/2010 Model	Early 2010 Model
Composite program score	X		
Bulbs supported/household		X	X
Years program has supported CFLs			X
Number of sockets in home	X		
Years using CFL	X		
CFL saturation at the beginning of period		X	X
County unemployment rate at the beginning of period		X	
Number of persons in household	X		
Size of home		X	
Self-identify as white	X	X	
Homeowner			X
Purchase CFLs at mass merchandise store		X	
Purchase CFLs at warehouse store		X	
Purchase CFLs at home improvement store		X	
Purchase CFLs at big box store			X
Likes to have new technology			X
Satisfaction with standard of living		X	
Revisit household			X
Conducted during fall season	X		
Data collection protocol treatment of don't know			X
CPUC NTG	0.23	0.44	1.60

F.4.4 Calculation of 2009/2010 NTG for the CPUC

To develop the actual 18-month and 2010 NTG estimates, the evaluators used STATA to hold the coefficients from the 18-month and early 2010 models and applied the coefficients to the CPUC data. They then calculated the predicted purchases in the presence of the program (Row A, Table 114) and the absence of the program for both the 18-month and 2010 models (Row B). The non-program scenario removes *only* the impact associated with the number of CFLs incented per household. These calculations *predict* that each CPUC household purchased an average 7.40 CFLs across the entire 18-month period and 4.71 in the first half of 2010. The predicted non-program scenario suggests that 6.62 CFLs would have been purchased in the absence of the program across the entire period, and 3.69 in the absence of the program in early

2010. Subtracting the without-program estimates from the predicted program scenario yields an estimate of net predicted program purchases (Row C). Dividing the net program purchase estimates by the incented CFLs per household (Row D) yields NTG estimates in Row E. The estimate for the entire 18-month period is 0.44 and for the first half of 2010 is 1.60.[46]

Table 114: CPUC NTG Ratio Calculations

Input	Full 18 Months	First half of 2010
A. Per-household purchases with program	7.40	4.71
B. Per-household purchases without program	6.62	3.69
C. Net program purchases per household	0.77	1.02
D. Incented CFLs per household	1.83	0.64
E. Total NTG	0.44	1.60

* Results subject to rounding error.

The NTG ratio for the first half of 2010 is most likely higher than the 18-month model precisely because it isolates the effect of the 2010 program from the cumulative and long-standing effects of prior program activity; unfortunately, this variable was not statistically significant in the 18-month model, suggesting that the CFL market may very well have changed over that time period. In addition, the increase in NTG from the 2008 model to both the 18-month and 2010 models may also reflect changes in the CFL market, but it is also likely that the improvements in data collection and model specification contributed to the higher NTG in the later models.

F.5 Conclusions and Recommendations

The 18-month CFL purchase model yields a NTG ratio of 0.44 for the period of January 2009 to June 2010, while the model limited to the first half of 2010 yields a NTG of 1.60. The difference in the estimates reflects economic, statistical, and programmatic factors, as described below.

First, the slowly improving economy may have boosted the NTG in 2010. National CFL shipment data point to a dramatic improvement in CFL sales in 2010 compared to 2009. Given that all areas included in the model enjoyed a higher NTG ratio in 2010 than in 2009, the model likely captured the improved CFL sales that accompanied the slowly improving national economy.

[46] The 18-month NTG ratios in Massachusetts (0.45) and New York (0.41) are nearly identical to that calculated for the CPUC, while the 2010 NTG ratios are somewhat lower at 0.83 in Massachusetts and 0.89 in New York. See 1) NMR Group, Inc. *Massachusetts Energy Star Lighting Program* (specifically Appendix C); 2) Wilson-Wright L. and C. Russell. 2011. *Results of the Multistate CFL Modeling Effort*.

Second, from a statistical standpoint, in the 2010 model the team successfully isolated the impact of prior program activity on 2010 purchases, but the variable capturing prior activity was not significant in the 2009 model. The successful isolation of this variable is the principal *statistical* factor boosting NTG in the 2010 estimate.

The evaluation team recommends that for the purpose of estimating NTG, the 2009 model is superior to the 2010 model, as evidenced by the larger maximum likelihood R^2 of 0.18 for the former compared to 0.12 for the latter. This may be at least partially because respondents could not accurately differentiate CFL purchases in 2009 from purchases in the first six months of 2010, whereas they could give more accurate estimates for the entire 18-month period.

The team also stresses that both NTG estimates are backwards looking. Because of the rapidly changing CFL market and particularly the EISA implementation that began in 2011 in California and its inevitable impact on the lighting market, it would be inappropriate to apply the NTG estimates to time periods after 2010.

G. Appendix G – 2006-2008 Residential Lighting Metering Study

The 2006-2008 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.

Table 115: 2006-2008 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	1,280	622				-174	-1,280	-622									
Wave 2																		
# Sites				118	181	15					-118	-181	-15					
# Meters				814	1,249	104					-814	-1,249	-104					
Wave 3																		
# Sites									188	76	213	133		-24	-231		-155	-200
# Meters									1,297	524	1,470	918				-524	-1,470	-2,570
# 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**	**1,454**	**2,076**	**2,890**	**4,139**	**4,243**	**4,069**	**2,789**	**3,464**	**3,988**	**4,644**	**4,313**	**4,209**	**4,500**	**4,564**	**4,040**	**2,570**	**0**

Initially, the required metering sample size for achieving 90/10 precision for coincidence 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 percent confidence for this design was +/- 7 percent for average daily HOU and +/- 19 percent for percent on at peak.

Estimates of average daily HOU and peak use were developed from the metering data in two ways. The first was a direct expansion using the sampling weights. The second was a leveraged expansion. The leveraged analysis first estimated HOU 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 HOU was +/- 3 percent for the state as a whole, and +/- 8 percent or better for each IOU. Achieved precision for peak was +/- 8.7 percent for the state as a whole and +/- 21 percent or better for each IOU.

H. Appendix H – CLASS Sampling Methodology

Appendix H is the CLASS sampling design memo that was distributed on May 25, 2012 under WO 21. This provides full background of how the CLASS sample was designed.

To:	IOUs, CPUC Energy Division and their Consultants	Date:	May 25, 2012
From:	Claire Palmgren, Paula Ham-Su, Jarred Metoyer, - DNV KEMA		
Copy:	Dina Mackin, Carmen Best		
Subject:	Final Sample Design for WO21: California Lighting and Appliance Saturation Study (CLASS)		

The approved research plan for the California Lighting and Appliance Saturation Study (CLASS) discussed the possible sampling dimensions for the study. This memo defines the final stratification that will be used in the sample design for the 2012 CLASS study.

H.1 Background

The previous (2005) CLASS study utilized a sample design with stratification by rate classes known as "long rates" that contained information such as baseline territory, low income status and electric heat. By stratifying along these older rate classes, the sample was implicitly stratified along the attributes contained in the rates.

The current IOU CIS systems have some of this information contained in separate variables, so the individual variables need to be included separately into the sample design to include this information. The approved research plan also listed several dimensions that would be considered in the development of the sampling plan beyond the characteristics embedded in the 2005 sample design: multi-family dwellings, manufactured homes, and new construction. These dimensions were not consistently available in the data received from the IOUs, so were not incorporated in the sample design.

H.2 Proposed Stratification

The stratification for the current 2012 CLASS study consists of 42 strata defined by:

- Utility (PG&E, SCE, SDG&E)

- Climate zone groups (Mild, Inland, Desert)
- CARE/FERA status (Yes or No)
- Daily kWh (Average daily kWh for 2010)

The stratification variables are explained in greater detail below.

H.2.1 Climate Zone Groups

DNV KEMA analyzed the climate zone Cooling Degree Days (CCDs) that are associated with the 2009 RASS to group T24 climate zones into climate zone groups. These CDDs are presented in Column D of Table 116.

Table 116 shows that there is a substantial difference in CCDs between Climate Zone 15 and the other zones.

- CZ 15 has over twice the amount of CDDs than the second highest zone, CZ 13. Because of this, CZ 15 was placed in its own group ("Desert").
- The second group, "Inland", groups CZs 8 through 14. These CZs have CDDs between 700 and 2,000 approximately.
- The third group, "Mild", groups the remainder of the climate zones: CZs 1 through 7 and CZ 16. These range between 0 and 470 CDDs.

Table 116: Climate Zone Groups for CLASS Stratification Sorted by Descending CCDs

A	B	C	D
Climate Zone Group	T24 Climate Zone	2009 HDD (65°F Base)	2009 CDD (65°F Base)
Desert	15	950	4,015
Inland	13	2,355	1,930
Inland	14	3,107	1,769
Inland	11	2,841	1,325
Inland	10	1,799	1,268
Inland	9	1,487	948
Inland	12	2,812	792
Inland	8	1,551	720
Mild	7	1,430	470
Mild	2	3,232	426

A	B	C	D
Climate Zone Group	T24 Climate Zone	2009 HDD (65°F Base)	2009 CDD (65°F Base)
Mild	6	1,669	321
Mild	4	2,512	283
Mild	16	5,593	255
Mild	3	2,792	38
Mild	5	2,704	34
Mild	1	4,149	0

H.2.2 CARE / FERA[47] Status

The Energy Division and the IOUs have expressed interest in obtaining a representation of customers that participate in the CARE and FERA programs. The sample stratification has incorporated the CARE/FERA status by coding utility customers that participated in CARE and/or FERA in 2010 as "Yes" and coding all other customers as "No".

When looking at CARE/FERA status, the proportion of energy used per stratum closely follows the proportion of customers in the stratum, as shown in the pairs of Columns D/G or E/H, based on the 2010 data utilized in this sampling frame. In the PG&E service territory, 28 percent of customers have CARE/FERA status, and they use 31 percent of the energy. These proportions are 32 percent and 31 percent for SCE, and 23 percent and 22 percent for SDG&E.

47 CARE, the California Alternate Rates for Energy program, provides a monthly discount on energy bills for income-qualified households and housing facilities. Qualifications are based on the number of persons living in the home and the total annual household income. FERA, the Family Electric Rate Assistance program, provides a monthly discount on electric bills for income-qualified households of three or more persons.

Table 117: CARE/FERA Status by IOU

A	B	C	D	E	F	G	H
IOU	CARE FERA Status	Number of Accounts	Percent Accounts Overall	Percent Accounts IOU	Average Daily kWh	Percent Daily kWh Overall	Percent Daily kWh IOU
PGE	No	4,017,574	32%	72%	66,439,652	32%	69%
PGE	Yes	1,573,317	13%	28%	30,507,941	15%	31%
SCE	No	3,640,787	29%	68%	60,350,520	29%	69%
SCE	Yes	1,703,287	14%	32%	27,575,663	13%	31%
SDG&E	No	1,253,097	10%	77%	18,046,401	9%	78%
SDG&E	Yes	368,341	3%	23%	4,985,869	2%	22%
TOTAL		12,556,403	100%		207,906,045	100%	

H.2.3 Daily Average kWh

For each account, DNV KEMA summed all of the 2010 kWh and divided by the sum of the number of days in 2010. This produced average daily kWh for each customer that can be compared to other customers even if a customer does not have all of the billing months available in 2010.[48]

Within each stratum identified by the variables described above, we: (a) sorted customers by their average daily consumption, (b) calculated the total average daily consumption in the stratum, and (c) calculated the individual daily average kWh cutoff points that would place approximately one third of the energy in three usage strata within each stratum. These cutoff points define the daily average kWh strata.

[48] DNV KEMA recognizes that this is an imperfect way of comparing consumption across all customers. For example, if a customer has only the summer months available, it is likely to have a higher daily average than if the only months available are in the winter. However, in the absence of complete annual consumption for some customers, daily average kWh provides a better way to compare consumption among customers than total annual usage.

I. Appendix I– Net-To-Gross Sensitivity

This Appendix presents an analysis of uncertainty in the Lamp Choice Model results and a sensitivity analysis to the weights used in the Net-to-gross framework..

I.1 Uncertainty Analysis for Lamp Choice Model

There are two principle sources of uncertainty:

1. Estimated coefficients. We estimated the model from an opportunistic sample of customers that were willing to talk to our field staff. Had we interviewed customers on different days, we would have had a different sample and different coefficients. The less precision, as measured by the standard error of the estimate, the more likely the estimated coefficient value would have been different.
2. Shelf survey samples. The simulation uses the recorded stock to form the lamp choices for consumers. The data in the simulation is from the stores e surveyed in summer of 2012 and the fall/winter of 2012-2013. Had we surveyed on different days, we would have likely seen a different mix of lamps on retailer shelves.

The uncertainty analysis that this appendix presents addresses the first source. How sensitive are the NTG ratios to the estimation results? If the generic price coefficient for the A-Lamp/Twister model was -0.45 instead of -0.38, how much would the NTG ratios change? We do not attempt to address how sensitive the NTG results are to what we observed on the shelf. Quantifying changes in stocking patterns is beyond the scope of this project. Additionally, we do not attempt to propagate the error into the recommend NTG ratios. The recommended NTG ratios combine the LCM results with qualitative information where error bound calculations are not possible.

The coefficients in the LCM are the result of maximum likelihood estimation. We calculated the error bounds by exhaustively searching contour levels around the optimal solution using the following procedure:

1. **Estimated simplified models.** In order to exhaustively search for parameters on the contour level, we needed to reduce the number of parameters to make the problem computationally feasible. The simplified model retains alternative specific constants and technology varying price coefficients as the explanatory variables. Since we are using a simplified model to approximate error bounds, the error bounds that we calculated are larger than would result from the full model.
2. **Grid searched for the contour level.** We permutated each of the estimated coefficients to find the 90% confidence interval. This involved calculating the log likelihood for each combination of permutation of

3. **Calculated NTG ratios with the extreme critical parameters.** We then took the maximum and minimal values for each of the parameters on the estimated contour level. We then re-ran the NTG calculation with the extreme critical parameters. The result was a high and low bound on the NTG for each technology by IOU and retail channel.

Table 118 presents the NTG range for the A-Lamp/Twister model, Price and Availability scenario[49]. The table shows the NTG ratios along with color coding to show how the LCM results contributed to the recommended NTG ratios. In some instances, the confidence intervals are asymmetrical. This is expected as logit model are nonlinear. The probabilities from a logit model are constrained to fall within the range of 0 to 1. Additionally, the simulation process contributes to the asymmetry of the confidence intervals, particularly in the Price and Availability scenario where the availability of lamps drives the result within some channels.

In general, we placed more emphasis on the LCM result (compared to supplier interviews) where the LCM had tighter error bounds. Conversely, where the model performs poorly (in the Membership Club channel, for example), we did rely on the LCM results.

Table 118 also highlights on of the issues a disentangling the program influence between A-Lamps and Twisters. The error bounds on the overall CFL estimates are much tighter than either A-Lamp or Twisters. The model has some difficulty distinguishing between the two CFL technologies. This result underscores that program implementers need to design programs that address both A-Lamps and Twisters. Programs that incent only one of the technologies inherently shifts market share to one efficient technology at the expense of the other. That the error bounds around the overall CFL results are tighter is another indication that programs need to consider CFL A-Lamps and Twisters together.

[49] The recommended NTG values for A-Lamps/Twister are only based on Price and Availability scenario and do not include information from the Price Only scenario.

Table 118: NTG Ratio 90% Confidence Ranges for A-Lamps/Twisters, Price and Availability Scenario

		Twister			A-Lamps			CFL Overall		
Channel	IOU	Min	NTG	Max	Min	NTG	Max	Min	NTG	Max
DISCOUNT	Overall	0.87	0.87	0.88	0.92	0.93	0.95	0.89	0.89	0.89
DRUG	Overall	0.54	0.57	0.60	0.32	0.39	0.46	0.53	0.53	0.54
GROCERY CHAIN	Overall	0.64	0.65	0.67	0.96	1.00	1.00	0.79	0.80	0.80
GROCERY INDEP	Overall	0.45	0.46	0.47	0.43	0.44	0.45	0.45	0.46	0.46
HARDWARE	Overall	0.57	0.59	0.62	0.42	0.48	0.54	0.55	0.56	0.56
HOME IMPROVEMENT	Overall	0.38	0.39	0.40	0.30	0.33	0.37	0.38	0.39	0.39
MASS MERCHANDISE	Overall	0.36	0.36	0.36	0.56	0.60	0.64	0.39	0.40	0.41
MEMBERSHIP CLUB	Overall	-0.01	0.00	0.01	-0.80	-0.75	-0.70	-0.01	0.00	0.01
DISCOUNT	PGE	0.84	0.84	0.84	0.85	0.87	0.88	0.84	0.85	0.85
DRUG	PGE	0.53	0.57	0.61	0.91	1.00	1.09	0.68	0.71	0.74
GROCERY CHAIN	PGE	0.20	0.21	0.22	-1.18	-1.10	-1.02	0.20	0.21	0.22
GROCERY INDEP	PGE	1.00	1.00	1.00	-15.13	1.00	17.13	1.00	1.00	1.00
HARDWARE	PGE	0.33	0.36	0.40	0.42	0.48	0.55	0.42	0.43	0.44
HOME IMPROVEMENT	PGE	0.32	0.32	0.32	-1.71	-1.54	-1.37	0.29	0.30	0.31
MASS MERCHANDISE	PGE									
MEMBERSHIP CLUB	PGE	-0.01	0.00	0.01	-0.92	-0.87	-0.81	-0.01	0.00	0.01
DISCOUNT	SCE	0.91	0.91	0.91	1.00	1.00	1.00	0.94	0.95	0.96
DRUG	SCE	0.51	0.54	0.56	0.05	0.10	0.15	0.41	0.42	0.44
GROCERY CHAIN	SCE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROCERY INDEP	SCE	0.41	0.42	0.43	0.43	0.44	0.45	0.42	0.42	0.42
HARDWARE	SCE	0.74	0.75	0.75	0.45	0.48	0.50	0.71	0.71	0.71
HOME IMPROVEMENT	SCE	0.46	0.48	0.50	0.83	0.96	1.08	0.51	0.52	0.54
MASS MERCHANDISE	SCE	0.48	0.48	0.48	0.50	0.53	0.57	0.48	0.49	0.50
MEMBERSHIP CLUB	SCE									
DISCOUNT	SDGE	0.84	0.86	0.87	0.45	0.47	0.48	0.82	0.83	0.83
DRUG	SDGE	0.60	0.62	0.64	-177.69	-174.29	-170.88	0.60	0.62	0.64
GROCERY CHAIN	SDGE	0.44	0.48	0.52	0.88	0.99	1.11	0.69	0.71	0.72
GROCERY INDEP	SDGE	0.54	0.55	0.57	-3.93	-3.71	-3.48	0.54	0.55	0.57
HARDWARE	SDGE	0.48	0.53	0.58	-54.86	-53.61	-52.37	0.51	0.53	0.55
HOME IMPROVEMENT	SDGE	0.40	0.41	0.43	0.24	0.29	0.33	0.39	0.39	0.40
MASS MERCHANDISE	SDGE	0.32	0.32	0.32	0.58	0.62	0.67	0.36	0.37	0.38
MEMBERSHIP CLUB	SDGE	-0.01	0.00	0.01	-0.65	-0.60	-0.56	-0.01	0.00	0.01

Color Coding for NTG framework values

- Normal output used
- Overall values applied to Grocery
- Overall A-lamp applied to SDGE
- Overall value applied to all Drug A-lamp
- Overall A-lamp applied to SDGE
- Overall values applied to PGE Mass Merch
- Overall values applied to PGE and SDGE HE

Table 119 shows the results for reflectors model. Note that for the reflector model, a shipment weighted average of the overall NTG numbers was used in the NTG frame work, this table only shows the results of the modeling effort. The error bounds on the reflector model are comparable to those for the A-Lamp/Twister model.

Table 119: Reflector 90% Confidence Range NTG Ratios

		Price Only			Price and Availability		
Channel	**IOU**	**Min**	**NTG**	**Max**	**Min**	**NTG**	**Max**
Discount	Overall						
Drug	Overall	0.03	0.04	0.06	0.56	0.57	0.58
Grocery Chain	Overall	0.05	0.10	0.14	0.05	0.10	0.14
Grocery Indep	Overall	0.02	0.02	0.02	0.94	1.00	1.00
Hardware	Overall	0.09	0.12	0.16	0.09	0.13	0.17
Home Improvement	Overall	0.05	0.09	0.13	0.05	0.10	0.14
Mass Merchandise	Overall	0.05	0.10	0.15	0.04	0.08	0.12
Membership Club	Overall	0.02	0.03	0.04	0.02	0.03	0.04

Table 120 shows the error bounds for the globe model. Note that for globe model, a shipment weighted average of the overall NTG numbers was used in the NTG frame work, this table only shows the results of the modeling effort. The error bounds on the globe are comparable to the A-Lamp/Twister model.

Table 120: Globes 90% Confidence Range NTG Ratios

		Price Only			Price and Availability		
Channel	IOU	Min	NTG	Max	Min	NTG	Max
Discount	Overall	0.14	0.16	0.17	1.00	1.00	1.00
Drug	Overall						
Grocery Chain	Overall						
Grocery Indep	Overall						
Hardware	Overall	0.38	0.39	0.40	0.65	0.67	0.69
Home Improvement	Overall	0.18	0.20	0.22	0.18	0.20	0.22
Mass Merchandise	Overall	0.04	0.05	0.06	0.03	0.03	0.04
Membership Club	Overall						

The confidence intervals for all three models show that the model is operating at a reasonable level of precision. There are some retail channels and technology combinations, such as A-

Lamps in the Hardware channel, which have relatively large confidence intervals. However, we tended to rely more heavily on supplier interviews where the precision model was not as strong.

I.2 NTG Framework Weighting Sensitivity Analysis

This section explores how sensitive the final net to gross ratios are to the weights that were used in the NTG framework explained in section XXX. To perform this analysis DNV GL adjusted the weight by 5, 10 and 20 percentage points and recorded how the final NTG numbers changed. Table 121 shows a summary of the overall NTG ratios changed by HIM and IOU. Basic Spiral and A-lamp NTG values ranged between one and two percent at all three levels of variation. There was slightly more variation for the reflector and globe NTG values once the weights were varied by 20 percent. This analysis is meant to provide context as to how much variation the weights applied to the NTG framework affected the final NTG values. Table 122 through Table 148 show the adjustments to the weights at the HIM, IOU, and Channel level.

Table 121: Summary of NTG Framework Sensitivity Analysis

HIM	Adjustments to weights	NTGR Results by Utility					
		PGE		SCE		SDGE	
		+	-	+	-	+	-
Basic Spiral	**Baseline**	**0.60**	**0.60**	**0.66**	**0.66**	**0.57**	**0.57**
	5%	0.59	0.61	0.66	0.67	0.56	0.57
	10%	0.58	0.61	0.65	0.68	0.56	0.58
	20%	0.57	0.63	0.64	0.69	0.56	0.59
A-Lamp	**Baseline**	**0.72**	**0.72**	**0.82**	**0.82**	**0.81**	**0.81**
	5%	0.71	0.73	0.82	0.82	0.81	0.81
	10%	0.71	0.73	0.82	0.82	0.81	0.81
	20%	0.70	0.74	0.81	0.82	0.81	0.81
Reflector	**Baseline**	**0.55**	**0.55**	**0.62**	**0.62**	**0.53**	**0.53**
	5%	0.52	0.58	0.58	0.64	0.50	0.56
	10%	0.49	0.61	0.55	0.67	0.47	0.59
	20%	0.43	0.67	0.48	0.73	0.41	0.64
Globe	**Baseline**	**0.00**	**0.00**	**0.75**	**0.75**	**0.71**	**0.71**
	5%	0.00	0.00	0.71	0.77	0.69	0.73
	10%	0.00	0.00	0.68	0.79	0.66	0.75
	20%	0.00	0.00	0.62	0.79	0.60	0.75

I.2.1 Basic Spiral NTG framework weighting scenarios

Table 122: Basic Spiral Baseline Ex-Post Weighting Scenario

Channel	Basic spirals CFLs weights		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.9	0.1	0.85	0.91	0.87
Drug Store	0.9	0.1	0.57	0.54	0.61
Grocery – Chain	0.5	0.5	0.78	0.78	0.78
Grocery – Independent	0.7	0.3	0.54	0.54	0.54
Hardware	0.9	0.1	0.38	0.73	0.53
Home Improvement	0.9	0.1	0.43	0.51	0.43
Mass Merchandise	0.9	0.1	0.35	0.46	0.31
Membership Club	0	1	0.48	0.48	0.48
Overall	**NA**	**NA**	**0.6**	**0.66**	**0.57**

Table 123: Basic Spiral Minus 5 Percent Weighting Scenario

Channel	Basic spirals CFLs weights		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.85	0.15	0.85	0.91	0.87
Drug Store	0.85	0.15	0.56	0.54	0.61
Grocery – Chain	0.45	0.55	0.79	0.79	0.79
Grocery – Independent	0.65	0.35	0.55	0.55	0.55
Hardware	0.85	0.15	0.38	0.72	0.53
Home Improvement	0.85	0.15	0.44	0.52	0.44
Mass Merchandise	0.85	0.15	0.34	0.45	0.31
Membership Club	0	1	0.48	0.48	0.48
Updated Overall NTG	NA	NA	0.61	0.67	0.57
Ex-Post NTG	NA	NA	0.6	0.66	0.57
Percent Change	**NA**	**NA**	**1.67%**	**1.51%**	**0.00%**

Table 124: Basic Spiral plus 5 Percent Weighting Scenario

Channel	Basic spirals CFLs weights		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.95	0.05	0.84	0.91	0.86
Drug Store	0.95	0.05	0.57	0.54	0.62
Grocery – Chain	0.55	0.45	0.76	0.76	0.76
Grocery – Independent	0.75	0.25	0.52	0.52	0.52
Hardware	0.95	0.05	0.37	0.74	0.53
Home Improvement	0.95	0.05	0.41	0.49	0.41
Mass Merchandise	0.95	0.05	0.35	0.47	0.32
Membership Club	0.00	1.00	0.48	0.48	0.48
Updated Overall NTG	NA	NA	0.59	0.66	0.56
Ex-Post NTG	NA	NA	0.60	0.66	0.57
Percent Change	NA	NA	-0.02	0.00	-0.02

Table 125: Basic Spiral minus 10 percent weighting scenario

Channel	Basic spirals CFLs weights		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.80	0.20	0.85	0.91	0.87
Drug Store	0.80	0.20	0.56	0.54	0.60
Grocery – Chain	0.40	0.60	0.80	0.80	0.80
Grocery – Independent	0.60	0.40	0.56	0.56	0.56
Hardware	0.80	0.20	0.39	0.70	0.53
Home Improvement	0.80	0.20	0.46	0.53	0.46
Mass Merchandise	0.80	0.20	0.34	0.43	0.31
Membership Club	0.00	1.00	0.48	0.48	0.48
Updated Overall NTG	NA	NA	0.61	0.68	0.58
Ex-Post NTG	NA	NA	0.60	0.66	0.57
Percent Change	**NA**	**NA**	**0.02**	**0.03**	**0.02**

Table 126: Basic Spiral Plus 10 Percent Weighting Scenario

Channel	Basic spirals CFLs weights		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	1.00	0.00	0.84	0.91	0.86
Drug Store	1.00	0.00	0.57	0.54	0.62
Grocery – Chain	0.60	0.40	0.75	0.75	0.75
Grocery – Independent	0.80	0.20	0.51	0.51	0.51
Hardware	1.00	0.00	0.36	0.75	0.53
Home Improvement	1.00	0.00	0.39	0.48	0.39
Mass Merchandise	1.00	0.00	0.36	0.48	0.32
Membership Club	0.00	1.00	0.48	0.48	0.48
Updated Overall NTG	NA	NA	0.58	0.65	0.56
Ex-Post NTG	NA	NA	0.60	0.66	0.57
Percent Change	**NA**	**NA**	**-0.03**	**-0.02**	**-0.02**

Table 127: Basic Spiral Minus 20 Percent Weighting Scenario

Channel	Basic spirals CFLs weights		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.70	0.30	0.86	0.91	0.88
Drug Store	0.70	0.30	0.56	0.53	0.59
Grocery – Chain	0.30	0.70	0.83	0.83	0.83
Grocery – Independent	0.50	0.50	0.59	0.59	0.59
Hardware	0.70	0.30	0.41	0.68	0.53
Home Improvement	0.70	0.30	0.50	0.56	0.50
Mass Merchandise	0.70	0.30	0.33	0.41	0.30
Membership Club	0.00	1.00	0.48	0.48	0.48
Updated Overall NTG	NA	NA	0.63	0.69	0.59
Ex-Post NTG	NA	NA	0.6	0.66	0.57
Percent Change	**NA**	**NA**	**5.00%**	**4.55%**	**3.51%**

Table 128: Basic Spiral Plus 20 Percent Weighting Scenario

Channel	Basic spirals CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	1.00	0.00	0.84	0.91	0.86
Drug Store	1.00	0.00	0.57	0.54	0.62
Grocery – Chain	0.70	0.30	0.73	0.73	0.73
Grocery – Independent	0.90	0.10	0.49	0.49	0.49
Hardware	1.00	0.00	0.36	0.75	0.53
Home Improvement	1.00	0.00	0.39	0.48	0.39
Mass Merchandise	1.00	0.00	0.36	0.48	0.32
Membership Club	0.00	1.00	0.48	0.48	0.48
Updated Overall NTG	NA	NA	0.57	0.64	0.56
Ex-Post NTG	NA	NA	0.60	0.66	0.57
Percent Change	**NA**	**NA**	**-0.05**	**-0.03**	**-0.02**

NOTE: Only grocery – chain and grocery – independent were changed by 20%. The rest were changed by 10%.

I.2.2 A-Lamp NTG framework weighting scenarios

Table 129: A-Lamp Baseline Ex-Post Weighting Scenario

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.90	0.10	0.87	0.99	0.93
Drug Store	0.90	0.10	0.55	0.55	0.55
Grocery – Chain	0.50	0.50	0.94	0.94	0.94
Grocery – Independent	0.70	0.30	0.56	0.56	0.56
Hardware	0.90	0.10	0.49	0.49	0.49
Home Improvement	0.90	0.10	0.42	0.93	0.42

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Mass Merchandise	0.90	0.10	0.57	0.50	0.58
Membership Club	0.00	1.00	0.69	0.69	0.69
Overall	**NA**	**NA**	**0.72**	**0.82**	**0.81**

Table 130: A-Lamp Minus 5 Percent Weighting Scenario

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.85	0.15	0.87	0.98	0.92
Drug Store	0.85	0.15	0.55	0.55	0.55
Grocery – Chain	0.45	0.55	0.94	0.94	0.94
Grocery – Independent	0.65	0.35	0.58	0.58	0.58
Hardware	0.85	0.15	0.49	0.49	0.49
Home Improvement	0.85	0.15	0.44	0.92	0.44
Mass Merchandise	0.85	0.15	0.55	0.49	0.57
Membership Club	0.00	1.00	0.69	0.69	0.69
Updated Overall NTG	NA	NA	0.73	0.82	0.81
Ex-Post NTG	NA	NA	0.72	0.82	0.81
Percent Change	**NA**	**NA**	**0.01**	**0.00**	**0.00**

Table 131: A-Lamp Plus 5 Percent Weighting Scenario

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.95	0.05	0.87	0.99	0.93
Drug Store	0.95	0.05	0.54	0.54	0.54
Grocery – Chain	0.55	0.45	0.95	0.95	0.95
Grocery – Independent	0.75	0.25	0.54	0.54	0.54
Hardware	0.95	0.05	0.48	0.48	0.48
Home Improvement	0.95	0.05	0.41	0.95	0.41
Mass Merchandise	0.95	0.05	0.58	0.52	0.60
Membership Club	0.00	1.00	0.69	0.69	0.69
Updated Overall NTG	NA	NA	0.71	0.82	0.81
Ex-Post NTG	NA	NA	0.72	0.82	0.81
Percent Change	**NA**	**NA**	**-0.01**	**0.00**	**0.00**

Table 132: A-Lamp Minus 10 Percent Weighting Scenario

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.80	0.20	0.87	0.98	0.92
Drug Store	0.80	0.20	0.56	0.56	0.56
Grocery – Chain	0.40	0.60	0.93	0.93	0.93
Grocery – Independent	0.60	0.40	0.61	0.61	0.61
Hardware	0.80	0.20	0.50	0.50	0.50
Home Improvement	0.80	0.20	0.45	0.91	0.45

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Mass Merchandise	0.80	0.20	0.53	0.48	0.55
Membership Club	0.00	1.00	0.69	0.69	0.69
Updated Overall NTG	NA	NA	0.73	0.82	0.81
Ex-Post NTG	NA	NA	0.72	0.82	0.81
Percent Change	**NA**	**NA**	**0.01**	**0.00**	**0.00**

Table 133: A-Lamp Plus 10 Percent Weighting Scenario

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	1.00	0.00	0.87	1.00	0.93
Drug Store	1.00	0.00	0.53	0.53	0.53
Grocery – Chain	0.60	0.40	0.96	0.96	0.96
Grocery – Independent	0.80	0.20	0.52	0.52	0.52
Hardware	1.00	0.00	0.48	0.48	0.48
Home Improvement	1.00	0.00	0.39	0.96	0.39
Mass Merchandise	1.00	0.00	0.60	0.53	0.62
Membership Club	0.00	1.00	0.69	0.69	0.69
Updated Overall NTG	NA	NA	0.71	0.82	0.81
Ex-Post NTG	NA	NA	0.72	0.82	0.81
Percent Change	**NA**	**NA**	**-0.01**	**0.00**	**0.00**

Table 134: A-Lamp Minus 20 Percent Weighting Scenario

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.70	0.30	0.87	0.96	0.92
Drug Store	0.70	0.30	0.58	0.58	0.58
Grocery – Chain	0.30	0.70	0.92	0.92	0.92
Grocery – Independent	0.50	0.50	0.65	0.65	0.65
Hardware	0.70	0.30	0.51	0.51	0.51
Home Improvement	0.70	0.30	0.48	0.88	0.48
Mass Merchandise	0.70	0.30	0.50	0.45	0.51
Membership Club	0.00	1.00	0.69	0.69	0.69
Updated Overall NTG	NA	NA	0.74	0.82	0.81
Ex-Post NTG	NA	NA	0.72	0.82	0.81
Percent Change	**NA**	**NA**	**0.03**	**0.00**	**0.00**

Table 135: A-Lamp plus 20 Percent Weighting Scenario

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	1.00	0.00	0.87	1.00	0.93
Drug Store	1.00	0.00	0.53	0.53	0.53
Grocery – Chain	0.70	0.30	0.97	0.97	0.97
Grocery – Independent	0.90	0.10	0.48	0.48	0.48
Hardware	1.00	0.00	0.48	0.48	0.48
Home Improvement	1.00	0.00	0.39	0.96	0.39

Channel	A-LAMP CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Mass Merchandise	1.00	0.00	0.60	0.53	0.62
Membership Club	0.00	1.00	0.69	0.69	0.69
Updated Overall NTG	NA	NA	0.70	0.81	0.81
Ex-Post NTG	NA	NA	0.72	0.82	0.81
Percent Change	**NA**	**NA**	**-0.03**	**-0.01**	**0.00**

NOTE: Only grocery – chain and grocery – independent were changed by 20%. The rest were changed by 10%.

I.2.3 Reflector NTG Framework Weighting Scenarios

Table 136: Reflector Baseline ex-Post Weighting Scenario

Channel	CFL Reflectors		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.00	1.00	0.88	0.88	0.88
Drug Store	0.30	0.70	0.51	0.51	0.51
Grocery – Chain	0.30	0.70	0.65	0.65	0.65
Grocery – Independent	0.30	0.70	0.62	0.62	0.62
Hardware	0.30	0.70	0.42	0.42	0.42
Home Improvement	0.30	0.70	0.51	0.51	0.51
Mass Merchandise	0.30	0.70	0.22	0.22	0.22
Membership Club	0.30	0.70	0.51	0.51	0.51
Overall	**NA**	**NA**	**0.55**	**0.62**	**0.53**

Table 137: Reflector Minus 5 Percent Weighting Scenario

Channel	CFL Reflectors		Results By Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.00	1.00	0.88	0.88	0.88
Drug Store	0.25	0.75	0.54	0.54	0.54

Channel	CFL Reflectors		Results By Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Grocery – Chain	0.25	0.75	0.69	0.69	0.69
Grocery – Independent	0.25	0.75	0.66	0.66	0.66
Hardware	0.25	0.75	0.45	0.45	0.45
Home Improvement	0.25	0.75	0.54	0.54	0.54
Mass Merchandise	0.25	0.75	0.22	0.22	0.22
Membership Club	0.25	0.75	0.54	0.54	0.54
Updated Overall NTG	NA	NA	0.58	0.64	0.56
Ex-Post NTG	NA	NA	0.55	0.62	0.53
Percent Change	**NA**	**NA**	**5.45%**	**3.23%**	**5.66%**

Table 138: Reflector Plus 5 Percent Weighting Scenario

Channel	CFL Reflectors		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.05	0.95	0.84	0.84	0.84
Drug Store	0.35	0.65	0.48	0.48	0.48
Grocery – Chain	0.35	0.65	0.61	0.61	0.61
Grocery – Independent	0.35	0.65	0.59	0.59	0.59
Hardware	0.35	0.65	0.40	0.40	0.40
Home Improvement	0.35	0.65	0.48	0.48	0.48
Mass Merchandise	0.35	0.65	0.21	0.21	0.21
Membership Club	0.35	0.65	0.48	0.48	0.48
Updated Overall NTG	NA	NA	0.52	0.58	0.50
Ex-Post NTG	NA	NA	0.55	0.62	0.53
Percent Change	**NA**	**NA**	**-5.45%**	**-6.45%**	**-5.66%**

Table 139: Reflector Minus 10 Percent Weighting Scenario

Channel	CFL Reflectors		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.00	1.00	0.88	0.88	0.88
Drug Store	0.20	0.80	0.57	0.57	0.57
Grocery – Chain	0.20	0.80	0.73	0.73	0.73
Grocery – Independent	0.20	0.80	0.70	0.70	0.70
Hardware	0.20	0.80	0.47	0.47	0.47
Home Improvement	0.20	0.80	0.57	0.57	0.57
Mass Merchandise	0.20	0.80	0.23	0.23	0.23
Membership Club	0.20	0.80	0.57	0.57	0.57
Updated Overall NTG	NA	NA	0.61	0.67	0.59
Ex-Post NTG	NA	NA	0.55	0.62	0.53
Percent Change	**NA**	**NA**	**10.91%**	**8.06%**	**11.32%**

Table 140: Reflector Plus 10 Percent Weighting Scenario

Channel	CFL Reflectors		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.10	0.90	0.80	0.80	0.80
Drug Store	0.40	0.60	0.45	0.45	0.45
Grocery – Chain	0.40	0.60	0.57	0.57	0.57
Grocery – Independent	0.40	0.60	0.55	0.55	0.55
Hardware	0.40	0.60	0.38	0.38	0.38
Home Improvement	0.40	0.60	0.45	0.45	0.45
Mass Merchandise	0.40	0.60	0.2	0.2	0.2
Membership Club	0.40	0.60	0.45	0.45	0.45
Updated Overall NTG	NA	NA	0.49	0.55	0.47
Ex-Post NTG	NA	NA	0.55	0.62	0.53
Percent Change	**NA**	**NA**	**-10.91%**	**-11.29%**	**-11.32%**

Table 141: Reflector Minus 20 Percent Weighting Scenario

Channel	CFL Reflectors		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.00	1.00	0.88	0.88	0.88
Drug Store	0.10	0.90	0.63	0.63	0.63
Grocery – Chain	0.10	0.90	0.81	0.81	0.81
Grocery – Independent	0.10	0.90	0.78	0.78	0.78
Hardware	0.10	0.90	0.52	0.52	0.52
Home Improvement	0.10	0.90	0.64	0.64	0.64
Mass Merchandise	0.10	0.90	0.25	0.25	0.25
Membership Club	0.10	0.90	0.63	0.63	0.63
Updated Overall NTG	NA	NA	0.67	0.73	0.64
Ex-Post NTG	NA	NA	0.55	0.62	0.53
Percent Change	**NA**	**NA**	**21.81%**	**15.07%**	**20.75%**

Table 142: Reflector Plus 20 Percent Weighting Scenario

Channel	CFL Reflectors		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.20	0.80	0.72	0.72	0.72
Drug Store	0.50	0.50	0.39	0.39	0.39
Grocery – Chain	0.50	0.50	0.49	0.49	0.49
Grocery – Independent	0.50	0.50	0.47	0.47	0.47
Hardware	0.50	0.50	0.33	0.33	0.33
Home Improvement	0.50	0.50	0.39	0.39	0.39
Mass Merchandise	0.50	0.50	0.18	0.18	0.18
Membership Club	0.50	0.50	0.39	0.39	0.39
Updated Overall NTG	NA	NA	0.43	0.48	0.41
Ex-Post NTG	NA	NA	0.55	0.62	0.53
Percent Change	**NA**	**NA**	**-21.82%**	**-22.58%**	**-22.64%**

I.2.4 Globe NTG Framework Weighting Scenarios

Table 143: Reflector Baseline Ex-Post Weighting Scenario

Channel	GLOBE CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.00	1.00	0.88	0.88	0.88
Drug Store	0.10	0.90	0.64	0.64	0.64
Grocery – Chain	0.10	0.90	0.82	0.82	0.82
Grocery – Independent	0.10	0.90	0.79	0.79	0.79
Hardware	0.10	0.90	0.53	0.53	0.53
Home Improvement	0.10	0.90	0.64	0.64	0.64
Mass Merchandise	0.10	0.90	0.26	0.26	0.26
Membership Club	0.10	0.90	0.64	0.64	0.64
Overall	**NA**	**NA**	**0.00**	**0.75**	**0.71**

Table 144: Reflector Minus 5 Percent Weighting Scenario

Channel	GLOBE CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.00	1.00	0.88	0.88	0.88
Drug Store	0.05	0.95	0.67	0.67	0.67
Grocery – Chain	0.05	0.95	0.85	0.85	0.85
Grocery – Independent	0.05	0.95	0.82	0.82	0.82
Hardware	0.05	0.95	0.55	0.55	0.55
Home Improvement	0.05	0.95	0.67	0.67	0.67
Mass Merchandise	0.05	0.95	0.26	0.26	0.26
Membership Club	0.05	0.95	0.66	0.66	0.66
Updated Overall NTG	NA	NA	0.00	0.77	0.73
Ex-Post NTG	NA	NA	0.00	0.75	0.71
Percent Change	**NA**	**NA**	**0.00**	**0.03**	**0.03**

Table 145: Reflector Plus 5 Percent Weighting Scenario

Channel	GLOBE CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.05	0.95	0.85	0.85	0.85
Drug Store	0.15	0.85	0.62	0.62	0.62
Grocery – Chain	0.15	0.85	0.78	0.78	0.78
Grocery – Independent	0.15	0.85	0.75	0.75	0.75
Hardware	0.15	0.85	0.51	0.51	0.51
Home Improvement	0.15	0.85	0.62	0.62	0.62
Mass Merchandise	0.15	0.85	0.25	0.25	0.25
Membership Club	0.15	0.85	0.61	0.61	0.61
Updated Overall NTG	NA	NA	0.00	0.71	0.69
Ex-Post NTG	NA	NA	0.00	0.75	0.71
Percent Change	**NA**	**NA**	**0.00**	**-0.05**	**-0.03**

Table 146: Reflector Minus 10 Percent Weighting Scenario

Channel	GLOBE CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.00	1.00	0.88	0.88	0.88
Drug Store	0.00	1.00	0.70	0.70	0.70
Grocery – Chain	0.00	1.00	0.89	0.89	0.89
Grocery – Independent	0.00	1.00	0.85	0.85	0.85
Hardware	0.00	1.00	0.57	0.57	0.57
Home Improvement	0.00	1.00	0.70	0.70	0.70
Mass Merchandise	0.00	1.00	0.27	0.27	0.27
Membership Club	0.00	1.00	0.69	0.69	0.69
Updated Overall NTG	NA	NA	0.00	0.79	0.75
Ex-Post NTG	NA	NA	0.00	0.75	0.71
Percent Change	**NA**	**NA**	**0.00**	**0.05**	**0.06**

Table 147: Reflector Plus 10 Percent Weighting Scenario

Channel	GLOBE CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.10	0.90	0.81	0.81	0.81
Drug Store	0.20	0.80	0.59	0.59	0.59
Grocery – Chain	0.20	0.80	0.75	0.75	0.75
Grocery – Independent	0.20	0.80	0.72	0.72	0.72
Hardware	0.20	0.80	0.49	0.49	0.49
Home Improvement	0.20	0.80	0.59	0.59	0.59
Mass Merchandise	0.20	0.80	0.25	0.25	0.25
Membership Club	0.20	0.80	0.59	0.59	0.59
Updated Overall NTG	NA	NA	0.00	0.68	0.66
Ex-Post NTG	NA	NA	0.00	0.75	0.71
Percent Change	**NA**	**NA**	**0.00**	**-0.09**	**-0.07**

Table 148: Reflector Plus 20 Percent Weighting Scenario

Channel	GLOBE CFLs		Results by Utility		
	LCM	Supplier Self-Report	PGE	SCE	SDGE
Discount	0.20	0.80	0.74	0.74	0.74
Drug Store	0.30	0.70	0.54	0.54	0.54
Grocery – Chain	0.30	0.70	0.67	0.67	0.67
Grocery – Independent	0.30	0.70	0.65	0.65	0.65
Hardware	0.30	0.70	0.45	0.45	0.45
Home Improvement	0.30	0.70	0.54	0.54	0.54
Mass Merchandise	0.30	0.70	0.24	0.24	0.24
Membership Club	0.30	0.70	0.53	0.53	0.53
Updated Overall NTG	NA	NA	0.00	0.62	0.60
Ex-Post NTG	NA	NA	0.00	0.75	0.71
Percent Change	**NA**	**NA**	**0.00**	**-0.17**	**-0.15**

Note: No minus 20 percent scenario is needed, would produce same results as minus 10 percent

J. Appendix J – Responses to Public Documents

Table 149: Responses to Public Documents

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
1	PGE	Enhance Report's Clarity	Overarch-ing	Question	After reading the report, we remain unclear on key methodological issues. We request extensive additions to the report to improve its clarity such that a reader can follow all key steps of the analyses and be able to replicate the research processes. For example, can a discussion of sources and methods used to develop the key parameter estimates (e.g., installation rates, hours of use, and delta Watts) for each HIM group be added to the report? While not exhaustive, some specific clarifying questions are included in Attachment A. To enhance the presentation of key findings, we request several edits, such as the addition of ex-ante gross savings in Table ES3, and ex-ante net savings in Table ES4, and clarification of gross versus net realization rates in these same tables. Other clarifying requests are included in Attachment A.	We have added ex-ante savings claims to the executive summary.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
2	PGE	Treatment of Lamps Placed into Storage in the Current Cycle	Overarch-ing	Question	The report states, “A CPUC policy decision changed the definition of upstream CFL installation rates, which resulted in an installation rate 22 percent higher than the ex-ante assumptions.” (p XII) The report also states, “For the evaluation of the 2010-2012 ULPs, the installation rate is defined as the proportion of CFLs rebated through the program that are purchased and then eventually get installed. This is a change from how installation rate has been defined for upstream CFLs in previous program cycles; the previous definition would have been the portion of CFLs rebated through the program that were installed by December 31, 2012.” (p 5-7, sec. 5.2.2) The changes in the definition of upstream CFL installation rates, which result in an installation rate 22% higher than ex-ante assumptions, do not appear to be consistent with current Commission policy, established in PY2006, to count savings in year installed. While PG&E is certainly open to prospective Commission policy changes, we believe current evaluations should follow current Commission policy, and request that the evaluation be modified accordingly. We understand this would reflect adjustments to measure savings to PY2010-12; however, this would also reflect carryover measure savings from PY2006-09. We would also point out that the Nonresidential Downstream Lighting Impact Evaluation Report (draft) issued earlier this month did follow D 04.09.060, counting savings in year installed.	Energy Division Response: Energy Division appreciates these comments, but the IOUs should address this issue with Energy Division management as it is outside the scope of this evaluation.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
3	PGE	Greater Detail on Report Recommendations	Overarching	Question	Could the report specifically include the findings, which led to the recommendations provided on page XV? For example, from what data were the recommendations pertaining to LEDs drawn? Also, in the final paragraph of the Recommendations section, it reads, "In addition, Energy Division and/or the IOUs should consider conducting the additional recommendation studies to further improve the reliability of both gross and net impact estimates for future energy efficient lighting programs." Can the report specifically state what types of studies are recommended?	We do not mean to recommend specific future studies in this report. We have changed the wording to avoid confusion. The entirety of the research leads to the recommendations, along with research findings presented in the WO013 report.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
4	PGE	NTG Weights and Precision	Overarch-ing	Question	On April 10, 2014, the joint electricity-providing Investor-Owned Utilities (electric IOUs), Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric Company (SDG&E), submitted comments (Attachment B) on the DNV GL Work Order 028 Briefing to IOUs on the Upstream Lighting Program NTG Methods and Results. In those comments, the electric IOUs recommended that DNV GL include discussions related to threats to validity, sources of bias, approaches used to reduce threats and bias, to increase reliability, and precision levels. We appreciate that the final report now includes many of these. However, we note that a discussion of the reliability of the final recommended NTGRs is missing. PG&E recognizes that, given the multiple sources of data and methods for estimating the NTGR, a formal calculation of the achieved confidence and precision is not possible. However, can the final report include a qualitative assessment of the uncertainty around the estimated net energy and demand impacts? In the above-referenced comments, the electricity IOUs requested the inclusion of a sensitivity analysis, considered best practice, in order to assess the stability of the final NTGR for each utility. We appreciate that the final report describes the rationale for assigning weights to the different inputs (e.g., retail manager survey, retail buyers, lamp choice model, etc.) to the NTGR. Could the final report include a sensitivity analysis?	We have added an additional appendix that looks at the uncertainty around the lamp choice model and the weighting in the NTG framework.
5	PGE				(cont.) Another concern was over half of the people approached in the store intercept surveys did not buy any lamps. We believe the choice set presented to non-purchasers in particular should have included an option of "none of these." Could the report include an explanation of whether non-purchasers were included in the Ranked Logit Model and more generally, how they were addressed in the model?	We have added an additional appendix that looks at the uncertainty around the lamp choice model and the weighting in the NTG framework. The none-of-these option is an alternative design option, but given that the respondent had just made a purchase that was included in their choice sets, we did not feel it was necessary.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
6	PGE	Ranked Logit Model	Overarch-ing	Question	In the April 10, 2014 comments, the joint electric IOUs expressed concerns about the design of the ranked logit model. One concern was that the choice set faced by a respondent did not include an option of "none of these." Without this option, the model will estimate the relative size of the coefficients, but their absolute magnitudes will be incorrect due to the possibility of prices moving people out of the market. Could the final report discuss more fully the limitations and potential biases of the use of a nested logit model for estimating the NTGRs? Could the final report include a qualitative assessment of the uncertainty around the estimated net energy and demand impacts?	We have added an additional appendix that looks at the uncertainty around the lamp choice model and the weighting in the NTG framework. The none-of-these option is an alternative design option, but given that the respondent had just made a purchase that was included in their choice sets, we did not feel it was necessary.
7	PGE	Supplier Self-Report Methodolog y	Overarch-ing	Question	PG&E recommends that the self-report approach to estimating NTGRs based on interviews with manufacturers, retail buyers, and retail store managers be strengthened by following more closely the principles outlined in the California Guidelines for estimating Net-To-Gross Ratios Using the Self-Report Approaches (SRA). While it was attempted in this evaluation to incorporate some of the SRA principles such as the use of consistency checks into the method, improvements can be made. Given the importance of interviews with mid- and upstream market actors in the estimation of NTGRs for upstream and mid-stream interventions, does Energy Division and DNV GL support the formation of a working group, comprised of the Energy Division and its consultants and IOU representatives, to address the difficult methodological challenges of assessing the influence of such programs so that improvements can be made to impact evaluations in the future?	We support the development of a working group to address these methodological challenges. The CA Lighting PCG would be a good place to start.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
8	PGE	Variability of Results	Overarch-ing	Question	We appreciate all of the results contained in this report. However, as we review values populated in some of the tables, we are challenged to understand the variability of values by IOU, channel and measure. Specifically, could the final report include an explanation of the variation of estimated hours of use observed between SCE and SDG&E given their similarity in latitude and the importance of this parameter in driving energy savings estimates (see Table 10 on page 3-5)? Also could the final report include an explanation of the large differences between IOUs for specific channels shown in Table 43 on page 4-34? This additional commentary will help the reader interpret the findings reported.	We attempt to address the differences in HOU by IOU in section 5.2.3.5. The differences found in Table 43 that shows LCM results has to do with the diversity and prices of products found on the shelves in the stores within the IOUs.
9	PGE	Survey instruments	N/A	Question	Can the report add the survey instruments used in this evaluation to the Appendix?	We could consider a Volume 2 of the report that included the survey instruments.
10	PGE	Uncertainty bands	Through-out	Question	Can the report include whenever possible uncertainty bands and when not possible, a qualitative discussion of the issues around the values presented?	We show statistical tests of difference for select gross parameters in Appendix B. We have added uncertainty analysis for the NTG calculations in Appendix I
11	PGE	Interactive effects	N/A	Question	Can the report include a section/table in the results chapter showing the interactive effects results? Please show the impacts of the interactive effects on the results at the HIM level, and aggregated for all programs evaluated in this study. Please provide: 1. the resulting therm "savings" (which will be negative), and 2. The MW and GWh savings with and without the interactive effects. By providing information at the HIM level, this will help the IOUs understand how the evaluators calculated each value. By providing the aggregated interactive effects, the IOUs can better understand the total impact of the interactive effects on these programs.	Interactive effects were outside the scope of this report. All ex-ante assumptions for interactive effects were passed through. Interactive effects have been called out for study as part of the 13-14 studies.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
12	PGE	Webinar presentation	N/A	Question	We appreciated that Energy Division and DNV GL hosted a webinar to present the high-level findings of this report. That being said, having the webinar prior to the release of a draft report limited the value of the webinar. Does Energy Division agree to strive to schedule the release of a review draft report at least one week prior to a webinar to discuss its findings?	Energy Division Response: Energy Division will strive to improve the review schedule for future reports.
13	PGE	Typographical errors	Through-out	Question	The report contains several typographical errors, including: - Page 2-7, footnote 1: The text references CLASS. The footnote references RASS. Which one is it? - Page 2-29, end of first paragraph: The last sentence of the first paragraph should reference section 4.5 (instead of section 4). - Page 3-7, Table 12 footnote states, "See Appendix" - which one? This occurs in several places in the report. - Page 3-8: Sentence reads, "As explained in Section O" - this is a typo. - Page 3-18: In the paragraph under section 3.4.2 (Reflector CFL HOU), there is a mention of A-lamp CFLs. Should this actually be reflector CFLs? - Page 5-10: The first full sentence on this page has a few typos. - Page 5-18 and 5-23: There are several missing/invalid cross-references. - Can the Section 4.7 header be renamed to reflect that these are the Net Realization Rate results and not Net-To-Gross results?	These errors were addressed
14	PGE	Executive Summary, goal of evaluation	Page IX	Question	Can the executive summary clarify that the goal of the impact evaluation did not include estimation of spillover?	Spillover was not part of the scope of this evaluation

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
15	PGE	Executive Summary Tables	Pages IX - X	Question	In these tables, it is unclear what data is being displayed. Can the report state if it is only residential upstream lighting measures being displayed? Do these results include non-residential? Can the tables be updated to include accurately labeled table headers so it is clear what data is being reported? Upstream includes non-res so can the report indicate if and where those results are reported?	Updated.
16	PGE	Tables	Tables ES3 and ES4, page XIII and XIV	Question	For clarity, can the report include a row of results called, "All Other WO 28 Measures" after the HIMs so that it sums to the total shown?	Added to the tables
17	PGE	Tables	Tables ES3 and ES4, page XIII and XIV	Question	How was the overall realization rate estimated? Was it a weighted average? If so, of what?	Ex-post/ Ex-Ante
18	PGE	Recommendations	Page XV	Question	Can the report include lessons learned in this evaluation that can be applied to future evaluations? These lessons learned may pertain to data gathering, methods use, data analysis and, priority areas for future research.	We cannot add this section at this time.
19	PGE	Recommendations	Page XV	Question	The evaluation recommends programs continue to support spiral CFLs in hard-to-reach (HTR) channels, but the evaluation reports a low NTG for these channels, particularly spiral CFLs (with the exception of discount stores). Therefore, the recommendation seems inconsistent with the NTG findings. Please explain.	The NTGR for HTR stores is higher than Big Box channels.
20	PGE	Table Title	Page 1-3, Table 3	Question	For greater clarity, we recommend that the Table 3 title read as follows: "Quantity of Residential Upstream HIM Measures by IOU Program".	Title changed to reflect what is presented, this table included non-residential shipments.
21	PGE	Table Title	Page 1-3, Table 3	Question	Can the report indicate if non-residential results are included in Table 3?	Table 3 includes non-residential shipments
22	PGE	Table 3	Page 1-3	Question	Can the report explain why basic spirals are included in Table 3? Basic spirals are not rebated in the PG&E Residential Advanced Lighting program. See "44,283".	This was how the shipments were labeled in the tracking data

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
23	PGE	Add HIM Summary Tables	Page 2-9	Question	Can this report include a summary table for each HIM that compares IOU claim with evaluation findings? For example, Verification Rate, Gigawatt Hours, etc. This would be consistent with the '06 -'08 Upstream Residential Lighting Impact Evaluation.	Due to Ex-ante values that come from DEER, it is not easy to compare all of the parameters at the measure group level.
24	PGE	3.2.1, Base Spiral CFL Saturation Changes	Pages 3-3 to 3-4	Comment	The report indicates that the saturation of CFL lamps (spiral) in sockets has increased considerably in the three years since the previous evaluation was complete. This appears to contradict national trends. For example, based on data from NEMA, http://www.nema.org/news/Pages/What-a-Difference-a-Year-Makes-for-Incandescent-Lamps.aspx, CFL saturation increased through 2008, but has since then generally plateaued, if not declined slightly. This data also shows that incandescent use is also roughly the same nationally in 2010-2012 compared to 2008. Can the report explain if California is deviating from this trend, or when the higher CFL saturation values for 2007 and 2008 are averaged with the lower values in 2006, does California follow the national trend? If California is doing better than the national trends, can the report provide a rationale or possible explanations for why this deviation is occurring in California, and if IOU programs may be contributing to the different trends seen?	There is currently a study under way in Massachusetts to explore CFL stagnation, however recent data has shown that saturation is increasing there as well. This is an impact report, and comparing market trends with national markets is outside of the scope of this report.
25	PGE	HOU	Page 3-5	Question	Table 10 on p. 3-5 shows that the HOU for PG&E dropped from 1.8 in the 2006-08 evaluation to 1.6 in the 2010-12 evaluation. Our understanding is that this change is based entirely on the 2010-12 CFLs being installed in different rooms with lower hours of use than the 2006-08 CFLs. Can the report explain if these HOU differences between evaluations can be entirely explained by the differences in room installations?	This drop is due to the increased saturation of CFLs in households.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
26	PGE	Baseline wattage	Page 3-6	Question	The report notes that baseline wattage (i.e., the average wattage of comparable incandescent lamps) is declining. Can the report clarify if this is because CFLs are being installed in sockets where customers would traditionally install an incandescent with a lower wattage (e.g., in sockets where customers used to install 45W or 60W, instead of 60W or 100W incandescents)? Or, is this because the average wattage of incandescents is decreasing?	Incandescent baseline has been dropping for a number of factors. People have already replaced their higher wattage bulbs, higher wattage bulbs have been phased out with EISA and AB1109 legislation, etc.
27	PGE	Gross impact results	Pages 3-9, 3-15, etc.	Question	In the description of gross impact results for each measure, the report includes a brief description of why the ex post and ex ante results vary. These compare the ex post and ex ante HOU, Installation Rate and CF, and they are very helpful. Can the report also include a discussion of how delta watts differs between the ex ante and ex post assumptions? If there is little difference, perhaps don't include them as one of the bullets, but note after the bullets that there was little difference in the ex post and ex ante delta watts.	Average ex-ante delta watts does not differ substantially from ex post delta watts, however it is hard to present a side-by-side comparison because the ex-ante assumption is at a measure-by-measure level as opposed to the measure group level, and is not always explicit in the work paper. HOU, Peak CF and Installation rate are more readily comparable because the same ex ante assumption applies across the entire measure group.
28	PGE	Globe CFL gross impact	Page 3-27	Question	In the HOU section, it is stated that the SCE 2012 modeled lighting inventory result was 1.62 hours/day, and SDG&E result was 1.01 hours per day. Can the report explain why then the SCE realization rate is so much lower than SDG&E's?	Because SDGE ex-ante assumptions did not include any non-residential savings, so the non-res savings add to their ex-post values, raising their realization rate.
29	PGE	Hours of Use	Chapter 3 (3.1.1), page 3-1	Question	Can the report discuss how the study dealt with the increased number of lamps per home between 2009 and 2012? This increase in lamps may change the HOU from those found in the 2006-2008 ULP report as there may be more sockets in a particular room. Was a sensitivity analysis performed on peak CF (coincidence factor)? Would the consultant recommend conducting a new hours of use study given the change in lighting approaches and technologies in homes and businesses, and the increase in the use of controls?	The changes in HOU are driven entirely by the increased saturation of CFLs in homes. House size and the numbers of sockets per home are controlled for in the model. We would recommend a new HOU study within the next 5 years.
30	PGE	Include Data Source/ Reference	Chapter 3.1.4, page 3-2	Question	Can the report include the source (a reference) for, "ultimate install rate is 97%." Where did that come from?	added footnote

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
31	PGE	Include Data Sources in Figures and Tables	Page 3-3	Question	Can the report include the sources for all data tables and figures? For example, what data was used in Figure 1? What were the total sockets? What is the total number of residential sockets, not just MSBs? Or what percent of these are MSBs?	We are not able to address this comment at this time. Data sources are listed in the report, but we are not going to label the data sources for every table and figure.
32	PGE	Explain Variability of Results	Page 3-6	Question	Table 11 - Can the report explain the variability of results in Table 11 across IOUs?	We attempt to address this in section 5.2.3.5
33	PGE	Baseline Assumption	Page 3-6, section 3.2.4	Question	Can the report explain the baseline assumption to determine delta watts for each of the four HIM measure categories? (To clarify, the baseline assumption is the assumed lamp wattage that was replaced.)	The baseline assumption in installed incandescent lamps that fit a similar application as the rebated HIM. Basic Spiral and A-lamp CFLs both have the same baseline of A-lamp incandescents. Reflector CFLs base line is reflector incandescents. Globe CFL baseline is Globe incandescents.
34	PGE	Explain Yearly Results & Variability of Results	Page 3-8	Question	Can the report explain how this evaluation developed the yearly results in Table 13 and in other tables throughout the report? Also, can the report explain what is driving the variability of UES results across utilities?	The yearly results are based on the per-wattage UES multiplied by the average wattage of rebated measures in the HIM and an Program Year. The variability is based on the changes in the wattages of rebated measures.
35	PGE	Gross Realization Rate	Page 3-9	Question	Table 14 and Table 22 - GRR results do not seem to line up with the reduction in HOU (21%), IR (97%) nor the reduction in delta watts. Only possible explanation we can come up with is that the Res/Non-Res split has changed and is now 93:7. Can the report explain how the GRR~1 was developed for kWh? Also, can the report specify if the tables reflect Residential results or also Non-Residential ULP results?	Table 14 shows both Residential and Non-residential. Table 15 shows how the savings break down between Residential and Non-residential
36	PGE	Net to Gross	Page 4-28	Comment	We recommend tracking the changes in availability, accessibility, and affordability of the CFLs as an alternate approach to estimate net to gross. The reason is these are the intended consequences of the program.	We look at this with the shelf surveys, and report on some of the trends in the WO013 report. Additionally, those aspects play a role in the LCM.
37	PGE	NTGR	Chapter 4 NTG analysis (starting on page 4-28)	Question	Can the report provide more explanation and data to support the weighing scheme used for the entire NTGR?	Not at his time.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
38	PGE	Lamp Choice Model	Page 4-30	Question	Can the report include what questions were asked and to whom in the lamp choice model?	We could consider a Volume 2 of the report that included the survey instruments.
39	PGE	Table 41 - Spiral CFL NTG	Page 4-32	Question	PG&E made a conscious decision to focus our program in the HTR retail channels, including independent grocery stores. There are over 100 participating independent grocery stores in PY2010-12. Can the report explain why there was only 1 observation? If the calculated NTG is 1, can the report explain the 0.46 NTG recommendations? Can the report include a definition and a list of sample retailers in each category?	It is difficult to intercept a shopper purchasing a light bulb in a small independent grocery store; our field staff spent a minimum of 4 hours in each store. We are not including the list of stores we visited in the report, if PGE would like to look into this further that can be arranged.
40	PGE	NTG	Table 42, page 4-33	Question	Can the report show the number of observations here as it was displayed in Table 41? Can the report explain how a negative NTGR result happens and what implications that has on the validity of the method?	The substitution effect is explained on Page 4-32 and 4-33. It does not have implications on the validity of the method, but does show that discounting competing products can affect the demand in unintentional ways.
41	PGE	Substitution Effect	Page 4-33	Question	Can the report explain the logic of the substitution effect and how that can be overlaid with the recommended NTG?	The substitution effect is explained on Page 4-32 and 4-33.
42	PGE	NTG	Page 4-34	Question	Did this evaluation consider using customer SRA to examine how many go to membership clubs to purchase CFLs because they know they will find the variety and quantity of EE lamps there?	We did not specifically analyze the Consumer CATI data for this question.
43	PGE	NTG	Page 4-34	Question	Did this evaluation consider asking vendors how they priced and stocked EE lamps?	Our in-depth interviews touched on this subject.
44	PGE	NTG	Table 43, Page 4-34	Question	Can the report explain the order of magnitude differences between the Price Effects and the Availability and Price Effects model formulations?	The availability and price effects method removes program bulbs deemed to be program reliant from the choice sets, in cases where the program bulbs are the only CFL option this creates a NTG of 1, which raises the overall NTG.
45	PGE	Table 44 different NTG between IOUs?	Page 4-35	Question	Home Improvement stores make national stocking decisions most of the time. Can the report explain why SCE's NTG for Home Improvement is significantly higher than the other 2 IOUs?	While some large home improvement stores do make national stocking decisions, there is still store-to-store variance and program activity is one of the drivers of that variance. The differences in NTG from the LCM depend upon the diversity of products and prices on the shelves the choice sets are drawn from.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
46	PGE	NTG	Page 4-36	Question	Given the large variation in results shown before that put to question the LCM results, can the report explain why it believes that using the "Price Effects Only" for CFL reflectors and globes is appropriate simply because the other model did "not perform well"? What were the criteria that led you to believe the other model did not perform well?	We used the "Price effects only" scenario for Reflectors and globes so that we could use the Manufacturer self-report data without double counting their responses.
47	PGE	NTG	Page 4-36	Question	Can the report provide more explanation as to what it means by "...for CFL reflectors and CFL globes, LCM results were generally not as robust...we recommend ... NTG results of 0.09 for CFL reflectors and 0.17 for CFL globes..."? Can the report explain how the robustness was established?	The robustness was determined based on the sample sizes of the respondent data and the statistical significance of the results. The reflector and globe models did not produce results that the evaluators felt could be disaggregated to the IOU and Channel level, so an overall result was applied.
48	PGE	NTG survey questions	Section 4.3.1, page 4-37	Question	Can the report show the questions used to develop the NTGR scores for each SRA?	This could possibly be included in a Volume 2 with Survey instruments
49	PGE	NTG survey questions	Section 4.3, page 4-37 to 4-40	Question	Did the evaluation surveys ask participating and non-participating manufacturers and vendors how important the upstream lighting program was at stimulating demand for these EE measures and affecting their stocking, pricing, and sales practices? If so, can the report show the questions used? Can the report also clearly state the number of interviews that were completed versus attempted and an estimate of the percent of total EE measure sales these respondents represented? This is provided in some cases, but not consistently for all.	We did not ask the question as stated in this comment. It is possible for survey instruments to be included in a volume 2 of the report. See table 73 to see what percent of rebated measures the interviews represented.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
50	PGE	Rationale for NTG Methods Weights	Section 4.5, starting on page 4-41	Question	Can the report explain more clearly, why the final weights assigned were 90% to the LCM results (as seen above highly variable across IOUs, channels and EEMs) and only 10% for the supplier self-report results? What data does the report rely upon to discount the supplier data more than that of customers who have been shown in numerous SRA studies to be unreliable? The variability of the weights used to develop a SRA or LCM score and then the weights used to combine these scores would benefit from much more in-depth explanations that offer data to support the weighting schemes used. Alternatively, could the report at least conduct a sensitivity analysis of the final NTGR values with different scoring weights?	The weights in the LCM model were developed with the expert judgment of the evaluators, and CPUC consultants. A sensitivity analysis of the weights has been added to an Appendix I.
51	PGE	Final NTG Ratios	Section 4.6, page 4-43	Question	Can the report explain why the ex-post NTGR vary across IOUs? Was this due mostly to the different claims by channel?	The variance was due to different volume of shipments by channel as well as the availability of products on the shelves in stores.
52	PGE	Final NTG Ratios	Section 4.6, page 4-43	Question	Can the report provide NTGR results by channel and EE measure and not just by IOU? Can the report discuss some of the methodological challenges and caveats in these values, at least qualitatively? Can the report provide lessons learned that could help improve the methodology and data gathering and analysis for future NTG efforts?	See sections 4.2 and 4.3 Table 43 through table 48 for results by Channel and HIM.
53	PGE	4.7 final NTG savings results	Page 4-44	Question	Can the report explain how one should interpret the results between this section and the remainder of the report? The Ex Post % of Ex Ante is around 90%, but all of the NTG recommendations throughout the report are around or below 50%.	The NTG recommendations are in relation to gross savings. The differences between ex-post and ex ante have to do with how ex ante assumptions differ from ex post results. Table 51 shows ex post NTG differs from ex ante NTG assumptions.
54	PGE	Residential and nonresidential split	Page 5-4	Question	"Residential estimates are based on a weighted total of CFLs found installed in the CLASS lighting inventory." Can the report explain how they were weighted?	The Weights described in section 5.2.3.3.1 were applied to the CLASS lighting inventory.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
55	PGE	Saturation changes equation	Page 5-7	Question	In the equation for the CFL saturation, can the report explain what the term "w_h" means? We assumed it is a weighting per household, but can it be explained how the weight was developed (e.g., based on total CFLs? Total MSBs? Something else?) Also, in this equation, the term w_h appears in both the numerator and the denominator. Doesn't it then cancel out?	Yes, "w_h" means the household weight. The Weights described in section 5.2.3.3.1 were applied to the CLASS lighting inventory.
56	PGE	Saturation changes	Page 5-7	Comment	The report presents the method used for estimating CFL saturation, and then presents another method - the "ratio estimator" of CFL saturation. Can the report provide an explanation as to why the evaluators chose to use the method they did, instead of the ratio estimator?	Because we model the HOU at the household level, and then aggregate to the IOU level, Household saturation is what is relevant to this report. We explain why this is different from ratio estimation so the saturation data does not get misinterpreted. We attempted to clarify in the report.
57	PGE	Installation rate	Page 5-7	Question	On pages 5-8 through 5-10, the report presents a trajectory analysis of CFL installations and storage rates. However when introducing this analysis on page 5-7, the report states, "The following is an explanation of the analysis used to estimate an installation rate under the previous definition. The results of the trajectory analysis were not used for the final impact evaluation savings estimates." If it was not used, can the report explain why then present it? Is it because this analysis was used to support the decision to assume that all CFLs would be installed?	Yes, this is how installation rate was planned on being calculated from the research plan, and it was through doing this analysis that the decision to switch to the new definition was arrived upon.
58	PGE	Installation trajectory tables	Page 5-8 to 5-9	Comment	Some of the row labels in table 59 are unclear. For example, how does the first row (Program discounted bulbs) differ from the 4th row (total program CFLs)? Also, it's not clear which of these rows refer to cumulative numbers (e.g., "total CFLs installed at start of year" appears to be cumulative), vs. which refer only to what happened that year. It's also not clear which "program bulbs" are stored 2006-08 program bulbs, vs. which are 2010-2012 program bulbs. Can the report add clarifications to this table to help guide the reader? Can the table include numbering the rows and adding explanatory equations (e.g., a + b - d) as one level of refinement? Can the report also provide units?	This table was meant as an illustrative example of how installation rates would have been calculated under the previous definition. For a more in-depth explanation of the analysis please reference the 06-08 Upstream Lighting Impact report where this methodology was used.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
59	PGE	Average Daily HOU and Peak CF	Section 5.2.3, starting on page 5-10	Question	Did this evaluation consider the impact of latitude? Can the report explain if the analysis distinguished how the length of sunlight affected a high usage (e.g., porch light) versus a low usage (e.g., closet) lamp? A high usage lamp may be used 8 hours per night in Summer and 14 hours per night in Winter, yet the closet lamp would likely still only be used less than 1 hour regardless of the hours of daylight during the year. The variation of the length of daylight would also vary by latitude and thus we can expect more of a variation the farther we are from the Equator. Can the report explain how these physical phenomena and where the lamp is used was taken into account in the model shown?	Please refer to the 06-08 Upstream lighting report for a more in-depth explanation of how the HOU and Peak CF models were estimated.
60	PGE	Variables Used in HOU and CF ANCOVA	Table 61, pages 5-14 and 5-15	Question	Can the report explain why the analysis did not consider retirees or people who work at home as part of the "Household Composition" variable?	Please refer to the 06-08 Upstream lighting report for a more in-depth explanation of how the HOU and Peak CF models were estimated.
61	PGE	HOU ANCOVA Model Parameter Estimates	Table 63, page 5-16	Question	The coefficients for IOUs differ markedly for the HOU Ancova results. Can the report provide an explanation for these differences?	We try to address this in section 5.2.3.5
62	PGE	Peak CF	Page 5-18	Question	In the second paragraph of this page, should the last sentence read, "That is, 16 CF's were calculated for each logger..."	Updated in report
63	PGE	CLASS sampling strata and premise weights	Page 5-21	Question	In Table 66, for daily kWh, the first row shows <= 20.9, the second row <=33, and the third row >33. Should the second row be ">20.9 and <=33"? Similarly for the other "middle" values in this table.	Yes, that is how the categories work. The displayed values are truncated so the table fits on the page.
64	PGE	Premise Weights Ranking	Sect 5.2.3.3.2 page 5-22	Question	Did this evaluation test the assumption that "...HOU is likely correlated with education, own/rent status...." and that would lead to a beneficial effect on the estimates from raking weight adjustment?	We do not look at the effects of adjustments as "beneficial" or "harmful", but rather the raking of the weights was an attempt to make the sample as representative of the true population as possible

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
65	PGE	2012 CLASS Variables Imputed for Ranking	Table 67, page 5-23	Question	Can this report explain the level of confidence in the accuracy of the reported income values? Can the report indicate if these results were checked against other indicators such as size of home and neighborhood?	DNV GL feels confident in the self-reported values.
66	PGE	2009 RASS Weighted Distributions Before and After Ranking	Table 68, page 5-23	Question	Can the report explain if the analysis checked to see how large of an impact raking had on final results? If the intent is to enable comparisons across various instances of time, is it not ignoring important effects such as the economic downturn of 2008-2010 that, for example, might be the explanation for the increase in rental versus owned property in Table 68?	That intent was to remove as much sampling bias from the inventories as possible and to model the effects of the changing saturations of CFLs on CFL HOU.
67	PGE	5.2.3.3.2 Premise Weights Raking	Page 5-23	Question	The report indicates that the missing demographic information in the surveys was artificially input by regression analysis prior to ranking. However, if this information that is being used to provide this regression is also included in this same dataset, then the effect of the regression appears to be producing more 'consistent' data in the set, which produces a greater sense of validity, but does not actually represent new, unique information. Can the report provide information on how this is not effectively double counting the data by making the partial results fit the expected results as predicted through the regression?	These demographic variables were imputed for a small portion of the population in order to adjust the weights to better fit the population. While it would be ideal to have perfect information, this is not an effective double counting.
68	PGE	Sampling weights	Page 5-24	Question	In table 68 comparing the 2012 CLASS with the 2006-08 metering study samples, can the report add a column for how the actual population aligns with these demographic segments (based on census data)?	Census data was not used for the WO028 report. See CLASS report for Census comparisons.
69	PGE	Application of 2006-2008 ANCOVA Models to 2012 CLASS Inventory	Section 5.2.3.4, page 5-24	Question	Can the report explain if and how the analysis addressed the increase in lamps in homes that could have different HOU, delta watts and/or CFs than the 2006-08 values used for the 2010-12 analysis? For example, homes that used to have one central lamp in the kitchen or dining room may have seen these replaced with 6 to 10 ceiling cans and/or under the counter LED/T-lamps with different HOU, delta watts (baseline was zero as no bulbs existed!)?	The HOU model does not take into account changes within an individual home from changes in lamp distribution. Both home inventories are "snap shots in time" and we do not attempt to model how they might have been different before or after the in-home inventory was conducted.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
70	PGE	Differences in HOU and CF by IOU	Section 5.2.3.5, pages 5-24 and 5-25	Question	Can the report explain how it was taken into account that HOU are a function of both latitude and to a lesser degree weather? For example, San Diego has more hours of daylight in Winter and people spend more time outdoors, reducing the average HOUs of high use sockets than people living in northern California. In Summer, there is less of an impact of latitude and longitude as everyone comes home from work while there still is light out.	We try to address this in section 5.2.3.5
71	PGE	Delta watts	Page 5-26	Question	Under Installed CFL wattage, the report states, "These wattages were weighted and used as a reference against CFL wattages rebated by the program". Can the evaluators explain what they mean as a reference, and how it was used?	This is in reference to Installed CFL wattages, the rebated wattages were used in the delta watts calculation. We have removed the Installed CFL wattage bullet point to avoid confusion.
72	PGE	Delta Watts	Section 5.2.4, page 5-26 and 5-27	Question	Can the report explain why this evaluation did not research CFL for CFL replacement or LED for CFL replacement? Do the authors recommend that be included in a future study?	This was studied, but was not an impact parameter. Some findings are presented in the WO013 report.
73	PGE	Delta Watts	Section 5.2.4, page 5-26 and 5-27	Question	Could the report clarify how the Delta Watts were determined? Perhaps with a make believe room with two types of sockets (table lamp and central candelabra?) and show how the calculation is done? As written, it is hard to understand what was done.	Delta watts is not determined on a lamp-by-lamp basis, so a make believe room would not help explain it. Delta watts was the difference between the average rebated wattage of HIMs by IOU in a given program year, compared to the IOU wide average wattage of comparable inefficient lamps installed in residential homes.
74	PGE	Net Impacts Sampling	Section 5.3, pages 5-27 through 5-60	Question	Can the report provide more details on the sample frames and actual responses? How many people (and who) were interviewed? How many completes and refusals?	This could possibly be included in a Volume 2 with Survey instruments
75	PGE	Lamp Choice Model	Section 5.3.1, pages 5-27 through 5-52	Question	Can the report explain if the lamp choice model method included the program spend impacts across the entire market (spillover) that results in increased awareness, availability, accessibility, competition for sales which leads to more affordability of the EE measures? These non-price variables can affect customer choice in ways that customers are not aware of.	No, spillover was outside the scope of this evaluation.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
76	PGE	Multinomial Logic Model	Section 5.3.1.2.1 eq 2 page 5-29	Question	Can the report explain how price (P) and household income (H) are related? Given the small impact of the purchase of CFLs on most household's disposable income, can the report explain if these economic-focused utility functions provide reliable estimates of customer actions? Are there better variables to use as motivators of consumer choice? For example, absent the ULP, markets would likely have less availability and accessibility of EEMs. If customers can't find a CFL at the store, how many would drive to a different store for 2 CFLs? Can the report explain if the analysis considered other models for consumer choice that were not so price dependent?	The ULP promotes CFLs by discounting the price of CFLs. We designed the model to capture the role price plays in the decision process of consumers. One possible outcome going into the model estimation process was that the coefficient on price would not be a significant explanatory variable. That was not the case. We did not consider a model without price. We did explore including promotional activity in the store as an explanatory variable. However, the coefficient was positive (as expected, indicating that promotional activity moves consumer choice toward CFLs), but not significant. We also recognize that there are other motivators besides price and promotional activity. The final model specifications reflect the best use of the available data.
77	PGE	Promotional Activity	Section 5.3.1.4.4, page 5-31	Question	Can the report explain if this evaluation explored the effects of where the EEMs were placed on the shelf, what % of the total lighting area was taken up by EEMs, how varied the product offerings were, their prices compared to those of similar products, how often were there special sales/promotions of the EEMs, or other typical marketing aspects that significantly affect sales?	See above comment regarding promotional activity.
78	PGE	5.3.1.4.6 Preference Ranking	Page 5-33	Question	It appears that the information provided for the consumer to choose among lamps for preference is a lamp type and cost. Since many consumers will further wish to know what the life expectancy and overall cost of operation are before choosing a lamp, can the report explain how this information is presented? If it is not presented, can the report explain how the implicit mental estimations (based on their current understanding of the light source technology) are being made by the consumer being taken into account?	The final model specification stratifies the price coefficient into two household income groups: high income ($100,000 per year and over) and low income. Our expectation going into modeling estimation is that high income consumers are less price sensitive than other consumers. The model estimation results support this hypothesis.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
79	PGE	Brand impacts	Section 5.3.1.5.1, pages 5-33 through 5-35	Question	Can the report provide evidence for the assertion that studying branding impact on consumer choice would not provide benefit to program implementers? It is important to know if customers prefer a particular brand or shy away from another to ensure programs are not promoting brands customers do not like.	As with promotional activity, we attempted to include national brand as a parameter in the LCM and choice set creation. We agree that it is important for Pas to know if certain brands are preferable to others when choosing where rebates should be given, however with the current data we were not able to model those effects.
80	PGE	Illogical relationships in model	Section 5.3.1.5.1, pages 5-33 through 5-35	Question	Can the report provide more details on the "statistically significant variables that formed illogical relationships." that were not included in the model? Which variables were these? What was it about them that formed illogical relationships?	We designed the scenario analysis to handle the concern of products not being available in some channels without the program. As described in the report, we ran a two scenarios with the LCM. The first looked at how market shares would change in the absence of the program price discounts. The second scenario considered how changes to price and product availability effect market shares.
81	PGE	A-lamp and twister defined	Section 5.3.1.7, page 5-37 through 5-44	Question	Can the report clarify what the A-lamp and twister 1020 observations consisted of? What does "1020 observations" mean? How many respondents made up the 1020 observations?	Add explanatory phrase to text.
82	PGE	Add footnote	Section 5.3.1.7, Table 70, pages 5-38 through 5-40	Question	Can the report add a footnote to the table explaining what "Type" column entries mean (Alternative, Choice, and/or Individual)?	The paragraph prior to Table 70 gives examples of parameter types.
83	PGE	Nesting coefficient	Section 5.3.1.7, page 5-41	Question	Can the report explain where the 0.84 nesting coefficient came from? It appears in the equation, but it is unclear how it was derived in Table 70. Can the report provide more explanation?	See Figure 10 and nearby text for a depiction and explanation of the nesting structure.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
84	PGE	Key relationship s	Section 5.3.1.7, page 5-42, and 5-43	Question	Can the report provide more data to support some of the assumptions in the key relationships that were expected? For example, low-income customers care about reducing their energy bills to have more disposable income. But they have a cap on how much they can spend to do so--thus are more willing and able to purchase low price CFLs (especially at 99c stores), than LEDs. Can the report explain why this is not reflected in the price sensitivity comments presented? Similarly on page 5-43, the EUL becomes more important if the price of LEDs ~ price CFLS ~ P incandescents. If price LEDs >> the other lamps, then EUL will play a smaller role in customer choice.	How consumers trade-off purchase costs with lower operating costs and longer useful life is a relationship that we built into the LCM through separate price coefficients for each technology. Ideally, we would have built the EUL and operating costs directly into the model. We some attempts at this--including watts as an explanatory variable and dividing the price by the EUL. However, each approach to model the EUL and operating cost directly ran into the same problem: all incandescents have higher EUL and greater watts than CFLs and CFLs have higher EUL and operating costs compared to LEDs. Thus, the alternative specific constant absorbs these attributes. We would very much like to better explore how EUL and operating costs interact with income but the data will not allow us to do that. We include technology-specific price terms and interact high-income with price as our best approximation.
85	PGE	SR analyses	Sect 5.3.2, pages 5-52 through 5-59	Question	For all the SR analyses, can the report explain how the analyses addressed different scores to develop a unique score did? How were the weights determined and based on what data? Was any sensitivity analysis done and if so, can the report provide the results and offer at least a qualitative discussion of the uncertainty in the results?	SR responses were weighted based on how many shipments were associated with each response.
86	PGE	Table 73: interviews w/ manuf and retail buyers	Page 5-56	Comment	The retail buyers change over the course of a program cycle. Were the retails buyer interviews spread out over the 2010-12 cycle? Retail buyers' participants faced changing market conditions. The mix of rural to urban can also change. We suggest that these interviews be conducted yearly on a representative sample.	Two rounds of interviews were conducted. We agree that ideally interviews should happen early and yearly.
87	PGE	Statistical procedures	Page 5-59	Question	Can the report provide more details on the "robust statistical procedures used to estimate the standard errors of the ratio." or the "reported confidence intervals"?	"The reported confidence intervals were calculated via Taylor series, but replication methods were also tested and did not yield distinguishable results."

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
88	PGE	Multi-state model	Page 5-60	Question	Can the report add a couple of sentences to explain that the multi-state model was deemed unreliable and that Appendix F has more details? Can the recommendations be updated to include a discussion of whether future efforts should try doing a multi-state model?	Added to the report
89	PGE	In-store intercepts	Appendix C-3 to C-4	Question	While the sample design for the shelf survey was sound, there is no recognition of the limitations of this approach highlighted by Butler (2008). Also, while the selection of the day of the week and time of day might have relatively little effect on the results of the shelf-survey, it could potentially make a large difference with respect to the results of the in-store intercepts. Different types of customers might choose to shop on different days of the week and at different times of day. Being constrained to conduct in-store intercepts on the days when shelf surveys are conducted might have introduced some degree of biased in unknown directions. While the IOUs do not in principal object to the use of in-store intercepts to collect the data necessary to evaluate upstream programs, they do agree that a frank discussion of the limitations of such approach should be presented.	Thank you for your comment, this will be taken into consideration for future intercept data collection.
90	PGE	Refusals to Participate in In-Store Surveys	Appendix C-10	Question	The report does not include the refusal rate. Can the in-store survey cooperation rate be reported in the final report and some discussion of the possibility of non-response bias as well?	We do not have good records of the numbers of refusals.
91	PGE	Tables 75 and 76	Appendix B	Question	Can the report clarify how Table 75 differs from Table 76? It appears to be repetitious.	The same data is presented in both tables. Table 75 is referencing table 9 from the Basic spiral CFL section, and table 76 is referencing table 17 from the A-lamp CFL section.
92	PGE	Interview completion s	Appendix C.1	Question	How many participant, non-participant and past-participant stores interviewed? How did the analyses weigh their results to get the final numbers? How deal with spillover where non-participants carry EEMs to compete with participant stores?	See tables 91-93. Spillover was outside the scope of this report.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
93	PGE	Non-purchasers	Table 97, Appendix C	Question	Can the report explain if the 598 non-purchasers responses were used in the development of the NTGRs? If so, can it be explain how their responses were combined with purchasers?	The non-purchaser responses were not used in developing the LCM results.
94	PGE	Refusal	Table C-4 Appendix C.2.1	Question	How did the refusal to respond by a major chain affect the results for this channel? Are there any lessons learned that could be used to improve data gathering in future efforts?	While it would always be preferable to have responses from more retail buyers, we cannot estimate how much the refusal of one respondent would affect the results from a given channel. In future efforts, more cooperation from program staff in securing interviews with key program participants is always welcomed.
95	PGE	Self-Selection in Other Surveys	Appendix C, Page C-10	Question	The description of how field staff were trained to conduct shelf surveys was quite thorough and helpful. However, a similar description of how these same field staff were trained to approach shoppers and elicit their cooperation in the survey was not presented. Can the report address and respond to the issues described above and how they impact the validity and reliability of the results?	Field staff training materials could be included in a future volume 2 of the report. At this time, we are not including a discussion of how field staff training impacts the validity of the results.
96	PGE	CDD used as a parameter for CZ	Appendix D	Question	Can the report explain why CDD was used as a parameter for CZ? Wouldn't HDD be more important and affect hours of use more, given that daylight is shorter in the cold Winter months and customers come home from work in the dark?	Please refer to the 06-08 Upstream lighting report for a more in-depth explanation of how the HOU and Peak CF models were estimated.
97	PGE	MSM	Appendix F.5	Question	The MSM was deemed unreliable, showing results that ranged from 1.60 for the first half of 2010 to 0.44 over an 18-month period starting in 2009. Can the report explain if this is due to the large volume of CFLs incented in 2008, plus the economic recession and the concurrent reduction in IOU support for CFLs in 2009 per CPUC directive that significantly reduced CFL sales in 2009? Sales recovered somewhat in 2010 as previous CFLs burned out. Can the report explain if the analysis considered these factors and is it possible to take these into account and see whether the MSM can provide credible results after all?	We believe the wide range in results for the MSM was more a result of it not being a good fit for California in 2012 than the hypothesis stated in this comment.

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
98	PGE	Precision and Confidence Intervals	Appendix G	Question	Can the report include in the Executive Summary and Chapter 4 the results shown at the end of this appendix on precision and confidence intervals?	We were not able to include this at this time.
99	SCE		Page 1-2	question	Do you mean the measures are unlikely to remain in the program? (Rather than likely?)	Yes, we have changed the wording in the report.
100	SCE		Page 3-6		"Over time" not "overtime"	Changed
101	SCE		Page 4-30		There are a few places where the document refers to "Section 0" (presumably a placeholder) for more info.	References updated
102	SCE		Page 4-36		Why did poor performance of the LCM model due to small sample sizes lead you to prefer the "Price Effects Only" over the "Availability and Price Effects"? Is it because observations at availability-relevant locations are dropped from the modeling in the LCM and set to 1 in the NTG calculation? If so, given the better validity of the "Availability and Price Effects" model, it may be better to include all the observations in the modeling (assuming that the decision-making process depends on characteristics of lamps and people and differences between individual categories of purchases are driven by those differences) and then use the full model results for only those cases where availability was not affected. If the poor performance of the "Availability and Price Effects" scenarios suffered for some other reason, what is the reason?	We preferred the "price effects only" scenario for reflectors and globes, in order to use the manufacturer self-report numbers in the NTG framework. We felt that the model performed less well for reflectors and globes under both scenarios, and since the "availability and price effects" scenario includes inputs from the manufacturer interviews that scenario was not used for reflectors and globes.

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103	SCE		Page 5-16		It's still unclear what Table 62 shows: is it the p-value for a test of the join hypothesis that all variables in a grouping are zero?(It doesn't appear to be as the continuous variables have different p-values between Tables 62 and 63.) In any case, the text should explain what is in the tables	Table 62 corresponds to sequential tests (Type I Sum of Squares tests) for model coefficients, that is, the F-test for the model as each new variable is added to the model without removing the previous ones. For example, the p-value for saturation indicates whether saturation is statistically significant given that the intercept is also included in the model. These sequential tests are different from the ones in Table 63, which indicate whether each variable is statistically significant given that all others are also included in the model. The latter set of tests is known as tests for individual coefficients. Attempt to clarify added to the report.
104	SCE		Page 5-18, 5-23		"Error! Reference source not found."	References updated
105	SCE		Page 5-25,5-26		A reasonable attempt is made here to explain why SDG&E's HOU results are different. The fact remains that the model, as specified, indicates this. The only possible reasons are that the model is incorrect in a way that artificially creates this (all models are wrong, the question here is how wrong), or there is a true difference based on IOU. The first case seems most likely. While DNV GL indicates population density may be a determinative factor that is not controlled in the model, it may also be that variables collected in the study can be used in a way that describes reality better, although it matches the sample less well than the current model. Unfortunately, there's no way to know if this is the case with certainty	DNV GL agrees that with additional metering as well as additional data modeling could produce a model that "describes reality better" but without additional funding for a new metering study, the logger data from 06-08 was the best available.
106	SCE		Page 5-26,5-27		There is no discussion of why the remaining incandescents are used as the base wattage, rather than the calculated wattage of incandescents removed between time periods	There is not a reliable data source of wattage for removed incandescents.
107	SCE		Page 5-28		It's probably worth explicitly stating that in this section "utility" refers to the economic construct, not the firms that operate the programs being evaluated	Added to Footnote

Comment Number	Comment-er	Subject:	Page:	Question or Comment	Question or Comment:	Response:
108	SCE		Page 5-29		Equation (2) has F for the second variable, the text refers to A	Corrected text
109	SCE		Page 5-29		This is a bit nit-picking, but technically, equations (2) and (3) should reflect indices over both respondents and choices, such as i and j, rather than just one index, in order to reflect that the utility is conditional on the choice.	Yes, there is one utility for each choice in the choice set. However, the equations, as written, are consistent with the text. The text describes an example utility for one of the choices in the set of all choices. We only show an example as our intention is to guide interested readers through the theory and structure of logit models. We trust that motivated readers will look elsewhere to develop a rigorous understanding of logit models.
110	SCE		Page 5-32		"The survey instrument populates shows respondents lamps that are were found in the retail channel during previous shelf surveys."	Corrected text
111	SCE		Page 5-34		Earlier comments about not including a "none-of-the-above" option are no longer relevant for purchasers now that it is clear that the lamp chosen by the respondent is included in the choice set. (This was not clear from the presentation in the spring.)For non-purchasers, was "none-of-the-above" included for the lamp chosen by the respondent, as would be consistent with the design for purchasers? If not, how was this lamp chosen for the survey? Given that it appears 60% of the observations were non-purchasers, this remains a significant issue.	The A-Lamp/Twister and reflector models only uses purchaser observations. The globe model does use non-purchaser observations. We do not report the results of the globe model as rigorously as the A-Lamp model as we do not heavily on globe model in the NTG estimation.
112	SCE		Page 5-47		The text in the first paragraph seems to be from the reflector model, rather than the globe model.	Corrected text
113	SCE		NTG section		The reported parameter values from Tables 70-72 appear to be the model coefficients, rather than the marginal effects at the mean. The latter would be more meaningful to report (although the example would then not be useable).	The coefficients in Tables 70 - 72 are estimated coefficient values, not marginal effects at the mean. We appreciate the suggestion of reporting the marginal effects and will look to report marginal effects in future work.
114	SCE		NTG section		Was the nested logit model for the twister/A-lamps estimated as limited information or full information maximum likelihood models?	Full information.

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115	SCE		NTG section		Was the ranked structure of the survey data used in evaluating the LCM? If so, how? Specifically, how did the nesting structure in the twister/A-lamp model deal with the ranking of options. The text does not address the ranking structure of the survey data.	We did make full use of the ranked data. See the description of rank-ordered logit given at http://cran.r-project.org/web/packages/mlogit/vignettes/mlogit.pdf, page 28.
116	SCE		NTG section		For each of the LCM final models, how many of the observations were purchasers and how many non-purchasers?	We only included purchaser records in the final estimation data for each of the models. The text lists the number of observations.
117	SCE		Appendix C		The pagination restarts at C-1 several times	Fixed in report
118	SCE		C-2/p.168 of document		How were the non-purchasers included in the modeling? From the sum of the number of respondents and the number of observations in each model, they appear to be included, but the report does not explicitly address this. If included, did they receive equal weight as purchasers?	We limited the modeling to only purchaser respondents.
119	SCE		C-10/p.176		How many refusals were received in each of the channels?	We do not have good records of the numbers of refusals.

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