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2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation

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Final, Report Only

Prepared for California's Investor-Owned Utilities:

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Executive Summary

This document is the executive summary of the 2004/2005 California Statewide Residential Retrofit Single-Family Energy Efficiency Rebate (SFEER) Program Evaluation, Measurement and Verification (EM&V) Study. This evaluation effort was guided by the California Public Utilities Commission's Energy Division (CPUC), with the four California investor-owned utilities (IOUs) [Pacific Gas and Electric (PG&E), Southern California Edison (SCE), Southern California Gas (SCG) and San Diego Gas and Electric (SDG&E)] providing critical support and feedback. This evaluation was funded through the public goods charge (PGC) for energy efficiency and is available for download at www.calmac.org. This report summarizes the overall results of the evaluation effort.

1.1 Program Overview

In 2004, the Residential Lighting and Home Energy Efficiency Rebates (HEER) Programs were combined to form the Statewide Single-Family Energy Efficiency Rebate (SFEER) Program to streamline internal operations for the utilities. The SFEER Program includes a diverse array of energy efficiency measures including home improvement products, heating and cooling equipment, lighting, appliances, and pool equipment. The 2004/2005 Program targeted all residential customers paying a Public Goods Charge (PGC; i.e., IOU customers) and residing in dwellings of four units or less, including condominiums and mobile homes. Although the Program combined the previously distinct HEER and Residential Lighting Programs, the Programs appeared unchanged from the consumer perspective.

This evaluation of the 2004/2005 SFEER Program offers both retrospective examination and prospective guidance in shaping current rebate programs offered within the residential sector, and meets the objectives set forth by the California Public Utilities Commission (CPUC) in Decision R.01-08-028 for monitoring and evaluation (M&E) studies as well as those provided in the California Evaluation Framework (dated June 2004).

1.2 Evaluation Objectives and Approach

The principal objectives of this evaluation were to (1) conduct verification activities to validate statewide accomplishments as reported by the IOUs in their 2004/2005 SFEER Program claims; and (2) perform a customer behavior analysis and process evaluation that assesses the Program's effort to provide helpful information, services, and prescriptive rebates to help move the market to install energy efficient measures.

The evaluators conducted nearly 5,000 telephone surveys with Program participants and non-participants, 400 onsite surveys and an additional 130 in-depth interviews with Program staff and key supply-side market actors (retailers, manufacturers, and contractors) to support and inform this evaluation. This depth of this data allowed for a detailed assessment of both the lighting and non-lighting components (which included 14 distinct measures) of the SFEER Program. Table 1-1 summarizes the key elements of our EM&V approach.

Table 1-1: Summary of Data Collection Activities

Data Collection Activity	Respondant Type	# Completes	Time Frame	Survey Mode
Program Staff Interviews	IOU Program Staff	10	10/06 - 12/06	Indepth Interview
Customer Telephone Surveys	Program Participants	2,207	12/06 - 3/07	CATI Telephone
	General Population	2,511	12/06 - 3/07	CATI Telephone
Onsite Audits	Non-Lighting Participants	267	12/06 - 4/07	Onsite Visit
	Lighting Participants	100	12/06 - 4/07	Onsite Visit
Participating Supply Side Interviews	Lighting manufacturers	14	10/06 - 12/06	Indepth Interview
	Lighting retailers	23	10/06 - 12/06	Indepth Interview
	HVAC contractors	32	10/06 - 12/06	Indepth Interview
	Appliance Dealers	26	10/06 - 12/06	Indepth Interview
	Pool Contractors/Retailers	25	10/06 - 12/06	Indepth Interview

1.2.1 *Process Evaluation and Customer Behavior Analysis*

The objectives of the process evaluation were to evaluate the effectiveness and efficiency of the Program both in terms of satisfying participants (both consumers and suppliers) and achieving energy savings. In addition, the process evaluation assesses the effectiveness of Program marketing from the perspective of participating customers. Program influence was measured through self-report data on the degree to which the Program influenced customers' purchase decisions. This report also provides feedback on Program implementation strategies, assesses the levels of performance and success of the Program, and investigates whether there is a continuing need for the Program.

The objectives of the customer behavior analysis were to analyze participation trends; assesses awareness of energy efficiency in general and energy-efficient products; and of the Program and its delivery mechanisms.

In addition, this evaluation documents the effectiveness of customer information and education; marketing and outreach to trade allies (including energy-efficient equipment manufacturers, retailers, and installation contractors); and statewide coordination with other programs. Both the process and customer behavior analyses were investigated separately for the HEER and Upstream Lighting Program components[1].

1.2.2 *Impact Evaluation*

A key objective of the impact evaluation was to verify Program performance via a thorough tracking system review and both phone and onsite verifications of installed equipment (which included collection of key equipment characteristics, such as efficiency level and run-time settings) for all measures included in the SFEER Program. Program savings were analyzed by key HTR segments, measure, and IOU.

A second crucial objective of the impact evaluation was the estimation of ex post energy and demand savings and net-to-gross ratios. Because of the number of measures eligible under the 2004/2005 SFEER Program, conducting a complete savings analysis for each measure was not feasible. A prioritization of all SFEER measures was conducted (based upon both the reported 2004/2005 energy savings accomplishments and the future achievable energy savings potential of the measure) to determine where in-depth analysis efforts should be focused. Based upon this prioritization a series of net and gross impact approaches was implemented across the measures evaluated, with major differences in the methods used for analyses of non-lighting and lighting measures (Table 1-2).

Table 1-2: Impact Evaluation Methods by Measure

Measure Type	*Technology Type*	*Verification*	*Gross Savings Methods*		*Net Savings Methods*		
		Surveys, Onsite Audits	*Billing Analysis*	*Engineering Model*	*Participant Self-Report*	*Supplier Self-Report*	*Discrete Choice*
Clothes Washer	Clothes Washer	X		X	X		X
Dishwasher	Dishwasher	X			X		
HVAC	Central AC	X		X	X		X
	Evaporative Cooler	X			X		
	Gas Furnace	X			X		
	Heat Pump	X			X		
	Room AC	X			X		
	Whole House Fan	X			X		
Insulation	Insulation	X	X		X		X
Pool Pumps	Single and Two Speed	X	X	X	X		
Programmable Thermostat	Programmable Thermostat	X	X		X		X
Water Heater	Electric	X			X		
	Gas	X			X		
Windows	Windows	X	X		X		
Lighting	CFLs	X		X		X	
	Interior Lighting	X		X		X	
	Exterior Lighting	X		X		X	
	Torchiere	X		X		X	

[1] Note that we were limited in our ability to capture Program influence on consumer purchasing decisions for the Upstream Lighting component of the Program because of its upstream delivery strategy; however, we did examine influence of the Program incentive (in the form of a $2.00 discount per CFL). The results of these analyses are presented in Chapter 5.

1.3 Process Evaluation and Market Assessment Results

1.3.1 *Lighting*

Findings for lighting measures are presented for the four following topics:

- Market characteristics;
- Market barriers;
- Program design; and
- Program publicity.

Market Characteristics

CF product availability has expanded substantially over the last several years. As of the end of 2006, more than 1,800 ENERGY STAR® qualified CFL models were being produced by 117 manufacturers around the world. These products represent a wide array of styles, wattages, and features. Starting in 2003, approximately 300 new ENERGY STAR models have gone to market each year, and the total number of qualifying models more than doubled between 2004 and 2006. While the number of non-twister (or non-spiral) models has increased significantly over time, twister style bulbs continue to dominate the market. Sixty percent of the models produced in 2006 were twister style bulbs, and 70 percent were between 13 and 23 Watts.

CFL market share has increased steadily over the last decade. California's CFL market share in 2005 was more than double that in the U.S. as a whole (6.4% and 2.7%, respectively).[2]

CFLs are now widely available (at least during Program promotions), as the Program has expanded sales of CFLs into drug, grocery, and discount stores. These channels account for two-thirds of total Program sales. The vast majority of these sales are spiral or twister-style CFLs. Specialty CFLs, CF fixtures, and torchieres are still predominantly sold through home improvement stores.

Consumer awareness of CFLs and CF fixtures has increased substantially over the past several years, with 95 percent of the general population aware of CFLs (up from 82% in 2003) and nearly a third of the population aware of CF fixtures. The CFL purchase rate has increased to nearly two-thirds of the population (up from 56% in 2003), while at least 6 percent of the population has purchased CF fixtures. Thirty percent of the population is aware of CFLs but have not yet purchased any.

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[2] Based on retail point-of-sale data; see Itron's "California Residential Efficiency Market Share Tracking: Lamps 2005" report for more details.

The average CFL purchaser household in California has 7 CFLs installed of a total of approximately 41 sockets. Bedroom fixtures are the most likely to be filled with CFLs, where 61 percent of lamps are CFLs. Nearly three-quarters of CFLs installed in these households are spiral bulbs.

Nearly 60 percent of CFL purchasers are storing CFLs – 5 on average among those who store bulbs. Most keep them on hand to replace CFLs as they burn out. Many of these same households also have incandescent bulbs in storage and those who store have on average 13 incandescent bulbs in storage. Most of these households say that when an incandescent bulb burns out they will install a CFL. Their decisions depend most on the room in which the bulb will be installed and whether they have CFLs or incandescent bulbs in storage.

Publicity regarding mercury contamination from CFL disposal has recently increased as the products become more common in the marketplace. A number of manufacturers report that product recycling is a promising option, but most indicate that the direction for these efforts should come from state or local governments, non-profits, or individual customers rather than manufacturers. A couple of manufacturers thought that CFLs should be mandated to have lower levels of mercury (less than 5-6 milligrams per bulb). Other manufacturers thought that serious regulation is not needed because CFLs contribute less to mercury pollution than incandescent bulbs when power plant emissions are considered. Manufacturers also varied in their approaches to disseminating information about disposal options – with some putting information on their labels or websites.

Market Barriers

CFL product quality continues to be a concern for both suppliers and consumers. Problems with bulb performance hindered the adoption of earlier CFL models and may have created some long-standing customer prejudices against the technology. Consumer satisfaction with CFLs is moderately high, with an average rating of 7.7 on a scale of 1 to 10 where 1 means “not satisfied” and 10 means “very satisfied” among CFL purchasers. Regarding specific CFL attributes, consumer satisfaction is highest with length of CFL life (8.5) and lowest with the way they look in fixtures (6.6) followed by the color of light (7.4).

Consumers are more satisfied with CFLs that are installed in out-of-the-way locations such as halls, stairways and offices and less satisfied with CFLs in dining/living rooms and kitchens. This is likely because they are more likely to tolerate issues with brightness, light color and fit where aesthetics and light preference are not likely to be as important and/or in applications where they are used less frequently. Consumers are also more likely to be satisfied with spiral CFLs than specialty CFLs or CFLs controlled by timers or dimmers.

The evaluation results indicate that there are many remaining barriers to CFL purchase and installations, and no one barrier is dominant. Some consumers are still having issues with CFL brightness or price, others have CFLs in storage or are waiting for bulbs to burn out, and still others have incandescent bulbs on hand and will use those up (and perhaps buy more) before buying CFLs. These barriers sometimes vary based on which lamp the consumer is considering. Room type and application (e.g., requiring specialty or controls) impact consumers' satisfaction with current CFLs and willingness to install CFLs in the future. Some other notable findings with respect to barriers:

- Our results show that consumers who purchased CFLs at grocery stores were more price-sensitive than shoppers in other store types.
- Consumers were mostly unaware that specialty CFLs are produced that will replace almost any screw-based lamp, including 3-way, dimmable and small-base lamps.
- Manufacturers feel that price is a significant barrier to getting consumers to buy specialty CFLs.
- Many consumers who said they are unlikely to buy CFLs in the coming year were unaware that CFLs are often sold for $2 or less.
- CFL manufacturers are aware that consumers still have issues with CFL light color and fluorescent products in general, and they feel that a combination of further technological improvements and consumer education about the current state of the technology would help to improve consumer acceptance.

Program Design

The 2004/2005 Program tied its CF product incentives to lumens instead of watts. This change was consistent with changes made by the national ENERGY STAR program to recommend CFLs based on lumen equivalents that correspond to various incandescent bulb wattages. Most manufacturers still label their CFLs with incandescent wattage equivalents so that customers do not have to understand lumens to select the right product. While this Program change occurred behind the scenes, it likely impacted the marketplace by updating incandescent to CFL equivalents based on actual brightness levels.

Only 8 percent of the low-wattage CFL incentives offered through the 2004/2005 Program were point-of-sale (POS) incentives – all from a single retailer. (The remaining incentives were manufacturer buydown.) The low penetration of POS incentives in the Program has been mostly due to lighting manufacturer preference for the buydowns with some additional effects from retailer unawareness of the POS option. All of the manufacturers preferred the buydowns. They claimed that smaller retailers face barriers to wider use of POS incentives including financial carrying costs, point-of-sale marketing costs, Program tracking requirements, other Program administrative compliance costs, and logistical challenges such as programming cash registers. Some manufacturers also pointed out that "keystone pricing" practices – where retailers set prices that are about double their wholesale costs – mean that consumers get more value out of upstream incentives (i.e., manufacturer buydown) than downstream incentives (i.e., POS). Since the lighting manufacturers have been recruiting most of the small-to-medium-sized retailers into the Program, the manufacturer buydown incentive has remained predominant.

Program Publicity

The Program provides limited direct marketing support to participating lighting suppliers. Prior California IOU lighting programs dedicated a much larger portion of funding towards marketing and training. These activities were scaled down mostly in response to supplier feedback that they preferred more rebates and to do their own advertising, since the utilities' one-size-fits all approach was not appropriate for most retailers.

Manufacturers were satisfied with the Program's approach to marketing in 2004/2005. However, retailers – especially smaller retailers – were less satisfied. This is likely because smaller retailers in particular have fewer resources to devote to promotional activities. They would also be more receptive to utility-developed promotional materials since they would have fewer restrictions on making use of those materials than larger retailers.

In-store CFL promotions have an impact on CFL purchases, with one-third of consumers first learning about CFLs from in-store displays or other point-of-sale materials. The same proportion of 2004/2005 CFL purchasers noticed retailer CFL advertising and reported that they were somewhat or very influenced by it when they made their purchase.

1.3.2 *Non-Lighting*

Process and market findings related to the Program's non-lighting measures and the HEER component (i.e., non-lighting) of the Program are organized by the following five topics:

- Market characteristics;
- Equipment efficiency standards;
- Program influence and participant satisfaction;
- Program design; and
- Program publicity.

Market Characteristics

California consumers have generally rated themselves as fairly knowledgeable about conservation and energy efficiency. These ratings peaked during the energy crisis, as the state's residents were inundated with messages to conserve energy and install energy efficiency measures such as CFLs and programmable thermostats. Current ratings are slightly lower than during the energy crisis, but higher than levels prior to the crisis. The current media attention on global warming and heightened awareness of national security issues related to foreign oil dependence as a result of the ongoing Iraq war have likely contributed to keeping these energy-related issues in consumers' minds.

Awareness of the state's Flex Your Power campaign continues to be high – with a majority (52%) of the state's residents having heard of it and 38 percent of these reporting that the campaign influenced them to take actions to save energy. Likewise, more than half (64%) the state's residents are aware of the ENERGY STAR program.

Almost all households (94%) said they routinely take actions to conserve energy – most often turning off lights when they are not being used (70%) and turning down the heat or decreasing heat usage (49%). Media messages during and after the energy crisis focused on conservation measures such as these, so it is not surprising that these are the measures most often cited by households. The statewide Flex Your Power campaign focuses on conservation measures such as these as well as specific energy-efficiency measures such as lighting and appliances.

California consumers' attitudes towards energy conservation and efficiency have been fairly positive over time in terms of prioritizing energy efficiency. The current results showed that attitudes have stayed about the same over time or have slightly improved.

Equipment Efficiency Standards

The Program provides education on standards changes to its trade allies and Program rebates change in response to shifting federal and state standards and ENERGY STAR specifications. Standards for energy-equipment standards are constantly changing. This is especially true in California where changes in the state's own Title 20 Appliance Efficiency Standards are occurring at the same time as national changes in minimum efficiency standards for residential central air conditioners and ENERGY STAR equipment. These changing standards can have significant impacts on the dealers and installation contractors who sell energy-efficient equipment. Recently, federal and/or California standards have changed for clothes washers, central air conditioners and pool pumps.

California is undergoing changes in its pool pump requirements and the Program can provide support to pool trade allies to inform and prepare them for these upcoming changes. All new pool pump installations or replacements occurring after January 1, 2006 require a capacitor-start/capacitor-run or two-speed motor, and additional changes to motor, pump, and nameplate requirements will take effect in January, 2008. Only one in five pool contractors interviewed were aware of the changing requirements. Pool contractors have an array of concerns about the new standards, chief among them that the changes will lead to higher prices, consumer dissatisfaction, and other unspecified negative effects.

Program Influence and Participant Satisfaction

Among Program participants who purchased their measures from contractors, contractors had more influence on their decisions to purchase energy-efficient measures than other potential influences. Nearly 40 percent of participants felt their contractors were very influential on their purchase decisions, almost twice the proportion of participants who purchased from contractors and felt that the rebate, Program, advertising materials, or salesperson were very influential.

The vast majority of consumers and supply-side market actors (appliance dealers, HVAC contractors, and pool retailers/contractors) who participate in the Program are relatively satisfied with the Program as a whole. Among the three groups of market actors, pool contractors were most satisfied with the Program as a whole, followed by appliance dealers and HVAC contractors. A small proportion of HVAC contractors felt that Program staff could be more available, knowledgeable, and/or understanding of their needs. Pool contractors/retailers were more satisfied with their interactions with Program staff, but a far smaller proportion of pool retailers/contractors had any contact with Program staff than HVAC contractors or appliance dealers. A significantly greater proportion of HVAC contractors in PG&E and SDG&E service territories reported dissatisfaction with the SFEER Program than in the combined SCE and SCG territories.

Participating customers are most satisfied with the Program as a whole as well as with their equipment and contractor (among those who purchased from contractors), and least satisfied with rebate turnaround time and savings on their utility bills.

Appliance dealers and HVAC contractors both expressed the feeling that the Program needs to improve communications regarding changes. Using a scale of 1 to 5 where 5 equaled “very easy” and 1 equaled “very difficult,” the average HVAC contractor “easiness” rating was 3.4. Those HVAC contractors who had difficulty keeping up with Program changes cited general lack of communication from Program staff.

Program Design

The California IOUs have been promoting variable speed drives (VSDs) in residential central air conditioners and enhanced evaporative coolers. Less than a third of HVAC contractors who participated in the SFEER Program during 2004/2005 reported that they install VSDs on their residential central air conditioners. By far, the greatest barrier to these installations is the high initial cost. More than two-thirds of participating HVAC contractors felt that the California utilities have encouraged greater use of VSDs, but nearly half of these contractors felt that the effects were small or limited in scope.

Nearly sixty percent of participating HVAC contractors install advanced two-stage evaporative coolers (AECs) in residential applications, but more than half of these contractors install them only “rarely.” Contractors cited the energy-efficiency benefits of AECs and their low upfront costs compared with other cooling technologies, but on the downside felt that the technology is largely unable to remove humidity in extreme climates. Some also felt that installation of AECs was challenging, that they are aesthetically unpleasing, and that the profit margin is low for installers. Less than one-third felt that the California utilities have encouraged greater use of AECs.

Some HVAC contractors and pool retailers/contractors felt that the Program needs to increase (or restore) rebate levels. In 2006 SCE and SDG&E eliminated their central air conditioning rebates and many HVAC contractors pointed to this as a reason why they are not as involved in the program as they once had been. Pool contractors pointed to inadequate multi-speed pool pump rebates as a reason for not attending utility training classes promoting this technology. The low market penetration of multi-speed pumps among the participating pool contractors also indicates that rebate levels may be inadequate.

Throughout its evolution, the Program has relied increasingly upon the point-of-sale (POS) delivery channel for incentives – particularly for lighting measures, but also for programmable thermostats and pool pumps as well as other HEER measures (such as clothes washers and whole house fans) on a more limited basis. The POS channel requires less of a financial investment for the Program than mail-in rebates because incentive payment is streamlined (larger payments made to a small group of suppliers rather than smaller payments made to a large number of individual customers). However, the POS channel can create complications for some retailers – particularly smaller ones – because Program reporting requirements necessitate capture of line item detail (individual measure purchases) which may not be technologically feasible for some retailers. Additionally, the POS channel may lead to higher free-ridership rates since discounts are generally applied automatically, requiring no action (or even awareness) on the part of the consumer.

The Program attempted to collect data on point-of-sale purchases (where no customer data are collected) by using nominal incentives to assist in collecting customer data. In 2004/2005, SCE utilized this approach to obtain contact information for programmable thermostat and pool pump POS participants. Customers would provide their contact information to the utility, and in return would receive a gift card for a nominal amount at a prominent retailer such as Starbucks. The evaluators obtained this information and used it to conduct surveys with POS purchasers. The data were useful to ensure that participants via all program delivery mechanisms were included in the evaluation. However, because of the large volume of measures the evaluators were unable to dedicate large enough sample sizes to make meaningful comparisons across POS versus non-POS groups by measure type.

Despite the challenges posed by the POS channel, appliance dealers believe that Program staff needs to make a greater effort to enroll appliance dealers in the POS process. Approximately a third was unaware of its existence prior to the evaluation interviews.

Program Publicity

The Program has in recent years prioritized incentives over marketing expenditures. While it has continued to use direct mail, utility websites and leveraging of trade ally relationships, direct consumer mass advertising is more limited. Instead, other programs that are part of the state's portfolio of energy efficiency programs have dedicated budgets for marketing and outreach (such as Flex Your Power and the Statewide Education and Training Program.)

Nonetheless, the main channels through which 2004/2005 participants learned about the Program was through utility mass marketing (bill inserts, brochures, and other advertisements), retail salespeople or point-of-purchase materials, and contractors. Notably, consumers are increasingly made aware of the Program via the Internet – with 28 percent of participants obtaining applications on-line versus 21 percent in 2003 (a statistically significant change at the 90 percent level of confidence).

The main trade ally groups that the Program engages to promote the Program – HVAC contractors, retailers and pool contractors – have low satisfaction with Program marketing. In prior years, the Program emphasized regular visits to retailers to provide point-of-purchase materials, Program applications and updates on Program specification changes and timing of rebates. In recent years some utilities have done less of this. This may have contributed to low satisfaction levels for retailers. Contractors report seeing little or no Program marketing and would like to see an increase in direct consumer marketing.

HVAC contractors and pool retailers/contractors both felt that the Program needs to improve/increase its marketing such that consumers would be more aware that rebates are available when they need new equipment.

1.4 Impact Evaluation Results

1.4.1 *Program Goals and Claimed Savings*

Lighting

The statewide net savings goals for the residential lighting component of the SFEER Program were 487 GWh and 62 MW. As Table 1-3 below shows, the Program claimed to have exceeded both its consumption and demand goals in 2004/2005 by 46 and 44 percent, respectively. Ninety-two percent of these claimed savings resulted from the four CF bulb measures, seven percent came from interior or exterior lighting fixtures, and the remaining savings came from the ENERGY STAR® torchiere measures.

Table 1-3: Residential Lighting Goals and Reported Accomplishments[3]

Net Savings	CPUC Target	Reported	% Target Reached
Net Energy Savings, kWh	486,700,909	712,226,983	146%
Net Demand Reduction, kW	61,896	88,855	144%

Non-Lighting

The statewide net savings goals of the HEER component of the SFEER Program were 64.8 GWh, 59 MW and 11.7 million therms. Table 1-4 below shows that the Program claimed to have nearly met its electricity consumption and demand goals (99% and 96% respectively) and exceeded its gas consumption goal by 26 percent. Over half of the HEER claimed kWh savings resulted from two primary measures: programmable thermostats (34%) and pool pumps (17%). Clothes washers, insulation, windows and central air conditioning each also resulted in 8 to 9 percent of the overall claimed electric savings. ENERGY STAR clothes washers and programmable thermostats each made up roughly one-third of the overall claimed Therm savings, followed by insulation (12%) and ENERGY STAR dishwashers (8%).[4] In total these four measures made up nearly 90 percent of the claimed HEER Therm savings.

[3] This includes savings from Public Good Charge (PGC) funded lighting rebates only.

[4] Note: A major reason for the low realization rate was the use of average hours of operation and peak information from previous studies that proved to be high relative to recorded values. Adjustments have been made to the CFL energy savings values using the latest DEER data for the 2006 program year and beyond.

Table 1-4: HEER Component Goals and Reported Accomplishments

Net Savings	CPUC Target	Reported	% Target Reached
Net Energy Savings, kWh	64,787,547	63,885,137	99%
Net Demand Reduction, kW	59,471	57,001	96%
Net Therms Reduction	11,696,656	14,737,196	126%

1.4.2 *Evaluation Results*

Lighting

The statewide gross realization rate across all lighting measures was estimated at 64 percent for kWh savings and 30 percent for kW savings. The statewide NTG ratio across lighting measures was estimated at close to 60 percent. Final estimated Net realization rates were estimated at 47 percent for kWh savings and 23 percent for kW savings. These results are broken down by measure in Table 1-5 below.

Ninety-seven percent of lighting incentives were paid out for CF bulbs, with more than two-thirds specifically for bulbs between 1,100 and 2,599 lumens. Gross realization rates are below 100 percent for most of the CF bulb categories because:

1) Twenty-four percent of CF bulbs that had been purchased during 2004/2005 were reportedly not installed as of late 2006,
2) The Program assumed average operating hours of 3.5 per day versus the evaluation findings of 2.6, and
3) The Program assumed that 20 percent of CFLs were operating during peak hours while the evaluation estimated seven percent.

Table 1-5: Gross and Net Realization Rates and Net-to-Gross Ratios Across Lighting Measures[5]

Lighting Measures	Percent of			Gross Savings ex ante		Gross RR*		NTG Ratio				Net RR	
								ex ante		ex post			
	Rebate $	kWh Savings	kW Savings	MWh	MW	kWh	kW	kWh	kW	kWh	kW	kWh	kW
ENERGY STAR CFL 450 to 799 Lumens	3%	3%	3%	31,727	5	106%	50%	80%	80%	58%	58%	76%	36%
ENERGY STAR CFL 800 to 1,099 Lumens	16%	16%	17%	193,994	30	62%	30%	80%	80%	62%	62%	49%	23%
ENERGY STAR CFL 1,100 to 2,599 Lumens	68%	73%	78%	880,666	137	59%	28%	80%	80%	62%	62%	46%	22%
ENERGY STAR CFL 2,600 Lumens or Greater	0%	0%	1%	5,841	1	30%	14%	80%	80%	72%	72%	27%	13%
ENERGY STAR Interior/Exterior Fixture < 1,100 Lumens	0%	0%	0%	145	0	100%	100%	80%	80%	36%	36%	45%	45%
ENERGY STAR Interior/Exterior Fixture >= 1,100 Lumens	12%	7%	2%	89,082	3	100%	100%	80%	80%	36%	36%	45%	45%
ENERGY STAR Torchiere < 65 Watt	0%	0%	0%	389	0	100%	100%	80%	80%	63%	63%	79%	79%
ENERGY STAR Torchiere > 65 Watt	0%	0%	0%	2,005	0	100%	100%	80%	80%	63%	63%	79%	79%
Total	100%	100%	100%	1,203,849	176	64%	30%	80%	80%	59%	61%	47%	23%

* Gross RR = 100% are based solely on results from onsite verification activities. No billing analysis or engineering modeling was done for these measures.

[5] This table includes savings resulting from SCE Procurement funded lighting rebates.

The evaluators used participating lighting retailer and manufacturer self-report interviews to estimate free-ridership and spillover for the Upstream Lighting component of the Program. Typically, consumer self-report surveys would be used, but that method was not suitable for this Program evaluation for a number of reasons, including lack of participating customer data. The evaluators heavily leveraged the Program tracking database, which contained detailed records on types and quantities of lighting products sold by retailer and manufacturer for each utility. The evaluators also relied on expert Program staff as well to help inform the construct of our survey and analysis approach, where they identified the distinct groups of retail channels and product types. Program staff also supplied the contact information for decision-makers at each participating supplier, and in many cases helped convince reluctant suppliers to cooperate with the evaluators.

CFL purchaser free-ridership varies widely based on retail store channel. For low-wattage CFLs (under 30 Watts/2,600 lumens), which accounted for 97 percent of the lighting products discounted by the Program, the manufacturer and retailer-based data analysis estimates similarly high CFL sales volumes in absence of the program (high free-ridership rates of 66-75%) for big box and large home improvement stores, mid-level sales volume in absence of the program (free-ridership rates of 42-51%) for drug and small hardware stores, and low estimated sales volume in absence of the program (free-ridership rates of 3-16%) for grocery and discount stores. Reasons for these differences included:

- Differing price-sensitivity and shopping behavior at big box and home improvement versus grocery stores.
- Price caps at discount stores.
- Large chain internal pricing strategies that are not sensitive to Program discounts.

Non-Lighting

Onsite audits found 97 percent of non-lighting measures purchased through the HEER component of the SFEER program were installed and Program qualifying. Table 1-6 shows the measure-level adjustments made to the Program's gross energy savings claims based on the results of these onsite verifications. These adjustments do not incorporate the evaluations other gross savings analysis results (from the billing analysis or engineering modeling). Gas furnaces and insulation had the lowest levels of verification (92% and 91% respectively), which resulted from two of the gas furnaces inspected having AFUE values that were below Program minimum requirements (90% AFUE minimum). Three of the insulation sites inspected had installed new insulation that was less than R30 (the Program minimum requirement) or had upgraded a location that previously had greater than R11 installed (Program maximum allowable).

Table 1-6: HEER Program Gross Verified Savings

Measure Description	Verification Adjustment Factor
Air Conditioning	100%
Clothes Washer	100%
Dishwasher	100%
Whole House Evaporative Cooler	100%
Whole House Fan	100%
Gas Furnace	92%
Heat Pump	100%
Insulation	91%
Pool Pump	96%
Programmable Thermostat	97%
Room Ac	100%
Water Heater	100%
Windows	100%
Total Across All Measures	97%

The non-lighting measures achieved 52 percent of their net kWh goals, 49 percent of their net kW goals and 46 percent of their net Therm goals. Table 1-7 below provides the final estimated gross and net Program savings for the non-lighting measures based upon the evaluation analysis activities. These results incorporate all adjustments based on the findings of the billing analysis, engineering modeling, verification activities, self-report net-to-gross analysis and the discrete choice modeling.

Table 1-7: HEER Program Measured Savings

HEER Measures	Measured Savings	% of CPUC Goals	% of Reported Accomplishments
Gross kWh Savings	54,217,096	-	-
Gross kW Savings	46,945	-	-
Gross Therm Savings	8,311,733	-	-
Net kWh Savings	33,536,301	52%	52%
Net kW Savings	29,155	49%	51%
Net Therm Savings	5,381,840	46%	37%

The statewide gross realization rate across all non-lighting measures was estimated to be 71 percent for kWh savings, 68 percent for kW savings, and 46 percent for Therm savings. The statewide NTG ratio across non-lighting measures was estimated at 62 percent for kWh and 65 percent for Therms. Final estimated Net realization rates were estimated at 52 percent for kWh savings, 51 percent for kW savings, and 37 percent for Therm savings. These results are broken down by measure in Table 1-8 below.

Table 1-8: Gross and Net Realization Rates and Net-to-Gross Ratios Across Non-Lighting Measures

HEER Measure	Percent of Savings				Gross Savings			Gross RR*			NTG Ratios						Net RR		
					ex ante			ex post			ex ante			ex post			ex post		
	Rebate $	kWh	kW	Thm	MWh	MW	Thm (MM)	kWh	kW	Thm	kWh	kW	Thm	kWh	kW	Thm	kWh	kW	Thm
Air Conditioners	13%	8%	17%	0%	6,254	11	0	136%	110%	-	84%	84%	-	67%	67%	-	108%	88%	-
Heat Pumps	1%	1%	1%	0%	569	1	0	100%	100%	-	84%	84%	-	55%	55%	-	66%	66%	-
Room AC	1%	1%	1%	0%	482	1	0	100%	100%	-	85%	85%	-	69%	69%	-	81%	81%	-
Insulation	10%	9%	11%	12%	6,632	8	2,025	92%	102%	36%	87%	86%	86%	70%	70%	70%	74%	83%	30%
Clothes Washer	34%	9%	1%	33%	7,060	1	6,034	102%	175%	65%	80%	80%	80%	81%	81%	81%	103%	177%	66%
Dishwasher	10%	6%	1%	8%	4,859	1	1,495	100%	100%	100%	80%	80%	80%	41%	41%	41%	51%	51%	51%
Furnace - Gas	10%	0%	0%	5%	0	0	871	-	-	92%	-	-	82%	-	-	52%	-	-	58%
Pool Pumps	4%	17%	17%	0%	13,420	11	0	48%	33%	-	81%	83%	-	69%	69%	-	41%	28%	-
Programmable Thermostats	5%	34%	30%	36%	25,395	21	6,270	46%	46%	10%	85%	81%	85%	49%	49%	49%	27%	28%	6%
Water Heater	1%	0%	0%	1%	74	0	204	100%	100%	100%	82%	81%	84%	58%	58%	58%	71%	72%	70%
Whole House Evap. Cooler	1%	3%	3%	0%	2,483	2	0	100%	100%	-	88%	88%	-	66%	66%	-	75%	76%	-
Whole House Fan	1%	3%	5%	0%	2,284	3	0	100%	100%	-	87%	87%	-	71%	71%	-	81%	82%	-
Windows	11%	9%	14%	5%	7,044	10	986	51%	51%	53%	83%	82%	80%	47%	47%	47%	29%	29%	31%
TOTAL	100%	100%	100%	100%	76,556	69	17,884	71%	68%	46%	83%	83%	82%	62%	62%	65%	52%	51%	37%

* Gross RR = 100% are based solely on results from onsite verification activities. No billing analysis or engineering modeling was done for these measures.

These measure level realization rates are primarily being driven down by the following factors:

- **Insulation** made up 10 percent of the Program rebate dollars, 9 percent of net Program kWh savings and 12 percent of net Therm savings. Program savings were heavily weighted to SCG participants who statewide made up 78 percent of the kWh savings and 70 percent of the Therm savings for this measure. SCG claimed per unit kWh and Therm savings estimates that were 3.5 times and 2.5 times larger than those claimed by the other utilities, and as a result the billing analysis found only 55 percent of electric savings and 23 percent of gas savings for SCG Program participants.
- **Pool Pumps** made up only 4 percent of the Program rebate dollars, but 17 percent of net Program kWh and kW savings. Gross savings estimates were reduced based on the results of both the engineering analysis and the billing analysis. The engineering reductions resulted from changes to model assumptions regarding the Program mandated runtime and horsepower reduction. The largest discrepancy between ex ante and ex post savings was with peak demand reduction (33%); the ex ante peak reduction of 1.07 kW/unit is high compared to the average prior power collected onsite (1.11 kW). Even if all of the baseline pool pumps were running throughout the peak period, it would be difficult to achieve such a demand reduction given the size of the baseline pumps.
- **Programmable Thermostats** made up 5 percent of the Program rebate dollars, but 34 percent of net Program kWh savings and 36 percent of net Therm savings. The programmable thermostat measure had net and gross impacts that were lower than projected. The billing analysis found less than half of the projected electric savings and only 10 percent of projected Therm savings[6]. These findings are similar

[6] These models were unstable and had relatively low levels of significance.

directionally to those from the 2004/2005 Multi-family Rebate Evaluation[7] which found only 3 percent of gross electric demand and energy savings, and less than 1 percent of gross gas savings were realized. Both the discrete choice and self-report net-to-gross analysis estimated approximately 50 percent of Program participants to be free-riders. These analysis findings agree with findings from contractor interviews in which HVAC contractors indicated that they install ENERGY STAR programmable thermostats in nearly all their projects regardless of the rebate. Additionally customer surveys found only a small portion of participants who removed a manual thermostat actually used the new programmable thermostat as it is intended to be used. Additionally, most customers reported they would have bought at least a programmable thermostat, if not an ENERGY STAR programmable thermostat, in the absence of the Program. These findings lead to a belief that this market has been transformed and support the utilities' decision to drop this measure from the 2006/2008 rebate program.

- **Clothes Washers** made up 33 percent of net Program Therm savings and the engineering modeling found only 65 percent of the ex ante Therm savings which played a large role in reducing the statewide Therm net realization rates.
- **Heat pumps, dishwashers, gas furnaces, and water heaters** all had their net realization rates driven down a result of the self-report based net-to-gross analysis which found high levels of free-ridership (all greater than 42 %).

Clothes washers and central air condition both had net kWh realization rates that were higher than 100 percent, which were primarily driven by the following factors:

- **Clothes Washers,** which made up more than a third of overall Program rebate dollars, accounted for 9 percent of net Program kWh savings. While the engineering modeling activities found only 65 percent of Therm savings (as mentioned above), they realized more than 100 percent of the ex ante kWh and kW savings estimates. The discrete choice analysis found relatively low levels of free-ridership which resulted in a NTG ratio of 81 percent.
- **Central Air Conditioners** made up 13 percent of the Program rebate dollars, but 8 percent of net Program kWh savings and 17 percent of net kW savings. ACs also had higher than expected gross savings as a result of the engineering analysis which found, on average, ACs rebated through the Program exceed their gross energy savings by between 10 and 36 percent.

[7] KEMA 2007, "Evaluation of the 2004-2005 Statewide Multifamily Rebate Program". Prepared for The California Public Utilities Commission, Pacific Gas and Electric Company, San Diego Gas and Electric Company, Southern California Edison, and Southern California Gas Company.

Overall SFEER Program Summary

The statewide NTG ratio across all SFEER measures was estimated at 59 percent for kWh, 61 percent for kW and 65 percent for Therms. Final estimated net realization rates were estimated at 48 percent for kWh savings, 31 percent for kW savings, and 37 percent for Therm savings. These overall gross and net savings estimates broken down by the lighting and non-lighting components of the Program are provided below in Table 1-9 and Table 1-10. The table below also shows that the ex post net savings estimate across all measures was 489,760 kWh, 62 MW and 5,382 million Therms. The lighting component of the program makes up 93 percent of these kWh savings and 53 percent of the kW savings. All Therm savings come from the non-lighting component of the program.

Table 1-9: Gross Savings Estimates Across All SFEER Measures[8]

Measure Type	Measure	Units	Gross Savings						Gross RR		
			ex ante			ex post					
			MWh	MW	MM Therms	MWh	MW	MM Therms	kWh	kW	Therms
Non-Lighting	Central Air Conditioners	15,724	6,254	11.2	0	8,506	12	0	136%	110%	-
	Central Heat Pumps	872	569	0.6	0	569	1	0	100%	100%	-
	Room AC	4,042	482	0.6	0	482	1	0	100%	100%	-
	Insulation (square feet)	25,909,882	6,632	7.5	2,025	6,101	8	737	92%	102%	36%
	Clothes Washer	152,541	7,060	0.9	6,034	7,201	2	3,922	102%	175%	65%
	Dishwasher	93,440	4,859	0.5	1,495	4,859	1	1,495	100%	100%	100%
	Furnace - Gas	20,118	0	0.0	871	0	0	804	-	-	92%
	Pool Pumps	10,428	13,420	11.3	0	6,384	4	0	48%	33%	-
	Programmable Thermostats	106,847	25,395	20.7	6,270	11,682	10	627	46%	46%	10%
	Water Heater	15,423	74	0.0	204	74	0	204	100%	100%	100%
	Whole House Evaporative Cooler	1,391	2,483	2.3	0	2,483	2	0	100%	100%	-
	Whole House Fan	4,794	2,284	3.1	0	2,284	3	0	100%	100%	-
	Windows - High Perf. Dual Pane (square feet)	5,394,792	7,044	9.8	986	3,592	5	523	51%	51%	53%
	NON-LIGHTING TOTAL	31,730,294	76,556	68.5	17,884	54,217	46.9	8,312			
Lighting	ENERGY STAR CFL 450 to 799 Lumens	996,402	31,727	5	-	33,633	2.5	-	106%	50%	-
	ENERGY STAR CFL 800 to 1,099 Lumens	3,274,900	193,994	30	-	121,170	8.9	-	62%	30%	-
	ENERGY STAR CFL 1,100 to 2,599 Lumens	10,579,198	880,666	137	-	522,665	38.6	-	59%	28%	-
	ENERGY STAR CFL 2,600 Lumens or Greater	42,336	5,841	1	-	1,774	0.1	-	30%	14%	-
	ENERGY STAR Interior/Exterior Fixture < 1,100 Lumens	2,295	145	0	-	145	0.0	-	100%	100%	-
	ENERGY STAR Interior/Exterior Fixture >= 1,100 Lumens	361,661	89,082	3	-	89,082	2.7	-	100%	100%	-
	ENERGY STAR Torchiere < 65 Watt	2,255	389	0	-	389	0.1	-	100%	100%	-
	ENERGY STAR Torchiere > 65 Watt	13,077	2,005	0	-	2,005	0.3	-	100%	100%	-
	LIGHTING TOTAL	15,272,124	1,203,849	176		770,862	53.2		64%	30%	
SFEER PROGRAM TOTAL		47,002,418	1,280,405	245	17,884	825,079	100	8,312			

[8] This table includes savings resulting from SCE Procurement funded lighting rebates.

Table 1-10: Net Savings Estimates Across All SFEER Measures[9]

Measure Type	Measure	Net Savings									NTG Ratio			Net RR		
		ex ante			ex post			% ex post savings			ex post					
		MWh	MW	Thms (MM)	MWh	MW	Thms (MM)	kWh	kW	Thm	kWh	kW	Thm	kWh	kW	Thm
Non-Lighting	Central Air Conditioners	5,254	9.4	0	5,699	8.3	0	1%	13%	0%	67%	67%	-	108%	88%	-
	Central Heat Pumps	476	0.5	0	316	0.3	0	0%	0%	0%	55%	55%	-	66%	66%	-
	Room AC	411	0.5	0	332	0.4	0	0%	1%	0%	69%	69%	-	81%	81%	-
	Insulation (square feet)	5,751	6.5	1,744	4,271	5.4	516	1%	9%	10%	70%	70%	70%	74%	83%	30%
	Clothes Washer	5,648	0.7	4,828	5,833	1.3	3,177	1%	2%	59%	81%	81%	81%	103%	177%	66%
	Dishwasher	3,887	0.4	1,196	1,968	0.2	606	0%	0%	11%	41%	41%	41%	51%	51%	51%
	Furnace - Gas	0	0.0	711	0	0.0	414	0%	0%	8%	-	-	52%	-	-	58%
	Pool Pumps	10,814	9.4	0	4,418	2.6	0	1%	4%	0%	69%	69%	-	41%	28%	-
	Programmable Thermostats	21,578	16.8	5,300	5,724	4.7	307	1%	8%	6%	49%	49%	49%	27%	28%	6%
	Water Heater	61	0.0	170	43	0.0	119	0%	0%	2%	58%	58%	58%	71%	72%	70%
	Whole House Evaporative Cooler	2,193	2.0	0	1,650	1.5	0	0%	2%	0%	66%	66%	-	75%	76%	-
	Whole House Fan	1,983	2.7	0	1,613	2.2	0	0%	4%	0%	71%	71%	-	81%	82%	-
	Windows - High Perf. Dual Pane (square feet)	5,829	8.1	789	1,671	2.3	243	0%	4%	5%	47%	47%	47%	29%	29%	31%
	NON-LIGHTING TOTAL	63,885	57	14,737	33,536	29	5,382	7%	47%	100%	62%	62%	65%	52%	51%	37%
Lighting	ENERGY STAR CFL 450 to 799 Lumens	25,382	3.9	-	19,416	1.4	-	4%	2%	-	58%	58%	-	76%	36%	-
	ENERGY STAR CFL 800 to 1,099 Lumens	155,195	24.2	-	75,614	5.6	-	15%	9%	-	62%	62%	-	49%	23%	-
	ENERGY STAR CFL 1,100 to 2,599 Lumens	704,533	109.7	-	325,997	24.0	-	67%	39%	-	62%	62%	-	46%	22%	-
	ENERGY STAR CFL 2,600 Lumens or Greater	4,673	0.7	-	1,277	0.1	-	0%	0%	-	72%	72%	-	27%	13%	-
	ENERGY STAR Interior/Exterior Fixture < 1,100 Lumens	116	0.0	-	52	0.0	-	0%	0%	-	36%	36%	-	45%	45%	-
	ENERGY STAR Interior/Exterior Fixture >= 1,100 Lumens	71,266	2.2	-	32,359	1.0	-	7%	2%	-	36%	36%	-	45%	45%	-
	ENERGY STAR Torchiere < 65 Watt	311	0.0	-	245	0.0	-	0%	0%	-	63%	63%	-	79%	79%	-
	ENERGY STAR Torchiere > 65 Watt	1,604	0.2	-	1,263	0.2	-	0%	0%	-	63%	63%	-	79%	79%	-
	LIGHTING TOTAL	963,079	141		456,224	32.4		93%	53%	0%	59%	61%	-	47%	23%	
SFEER PROGRAM TOTAL		1,026,964	198	14,737	489,760	62	5,382	100%	100%	100%	59%	61%	65%	48%	31%	37%

1.5 Conclusions and Recommendations

1.5.1 *Lighting*

1) **Certain lighting retailer channels that have participated in the Program for a number of years (such as big box and large home improvement stores) will sell a similar volume of CFLs whether the Program provides incentives or not**.

   CFL sales for new entrant retailer channels such as drug and discount stores are highly influenced by Program incentives.

   The inconsistent availability of CFL discounts for grocery, drug, and discount stores is a concern.

   a) Significantly reduce or eliminates incentives for low-wattage CFLs in big box or large home improvement stores. CFL discount programs in the Northwestern U.S. have already adopted such strategies.
   b) Increase incentive levels on low-wattage CFLs to grocery, drug and discount stores, where very low free-ridership exists and purchasers are very price-sensitive.
   c) Increase the allocation of incentive dollars for low-wattage CFLs sold in grocery, drug and discount stores so that they can be stocked year-round.
   d) Give preferential incentive allocations to grocery, drug, or discount stores that pledge to stock CFL products year-round.

[9] This table includes savings resulting from SCE Procurement funded lighting rebates.

2) **Awareness of CFLs in general as a technology is extremely high, however, consumer awareness and acceptance of specialty CFLs is very low.**
   a) Continue to make incentives available for specialty CFLs, ENERGY STAR torchieres and hard-wired fixtures in big box and large home improvement stores as well as other retail channels. While the evaluators advocate the significant reduction or elimination of rebates for low-wattage CFLs in big box and large home improvement stores, the evaluators recommend that rebates be retained for other CF products in these stores due to relatively low rates of consumer awareness and lingering acceptance barriers.
   b) Increase incentive levels for specialty CFLs. A number of lighting manufacturers cited specialty CFLs as a product category where rebate levels are inadequate.
   c) Increase consumer education and awareness efforts that focus on specialty CFLs.
   d) Support quality testing for specialty CFLs. As the saturation of low-Wattage CFLs increases over time, specialty applications will account for an increasing share of the remaining CFL potential. Yet specialty CFLs are newer technologies that have not been tested as thoroughly as standard low-wattage bulbs. Recent PEARL testing results have shown that covered CFLs, for example, due not perform as well as bare bulbs, likely due to problems with heat retention.

3) **Much potential remains for increasing CFL installations among CFL purchaser households**.
   a) Consider limiting the sale of promotional CFLs in multi-packs (since most households already have CFLs in storage) to keep the installation rate from declining and to capture energy savings impacts sooner. Evidence from a recent study in the Northwest shows that consumers who purchase multi-packs are storing CFLs at a higher rate than single-pack purchasers.
   b) Encourage year-round stocking of CFLs in grocery, drug, and discount store channels (per the above recommendation). This should help reduce the purchase of incandescent bulbs and increase CFL purchases (by reducing the price and availability barriers) – helping to increase CFL saturation.
   c) Consider encouraging consumers to replace working incandescent bulbs now rather than waiting for them to burn out.
   d) Increase Program focus (as described in the above recommendations) on specialty CFLs to address 3-way, controlled and other applications to help expand CFL installations.

4) **Many consumers are unaware that CFLs are sold in a wide variety of retail channels for $2 or less, and some consumers do not realize that CFL technology has improved.** These barriers impact the CFL purchase rate (those who are aware of CFLs but have not yet bought them) and the rate of CFL saturation (prior CFL purchasers are who not buying more).
   a) The Program and the other marketing campaigns with which it coordinates should focus educational messages on CF product technology improvements.
   b) The prior recommendation regarding encouraging participating retailer stock CFLs year-round at promotional prices should be considered in order to convert non-purchasers and keep purchasers buying CFLs.

5) **There are still some lingering issues regarding consumer perceptions of CFL quality and performance**.
   a) Consider conducting consumer education regarding recent improvements in CFL technology.
   b) Ensure that specialty CFLs perform well so that those products are well accepted by early adopters of that technology; this is key to making sure specialty CFLs are accepted more widely by the general population.
   c) A continued Program focus on lumen equivalence will help ensure that consumers select the appropriate CFL to incandescent wattage.

6) **The 2004/2005 Program was dominated by manufacturer buydown incentives, with few retailers offering POS rebates**. Prior years' Programs included more POS incentives. This shift is likely due to retailers preferring the buydown option because it means less paperwork for them and newer retailer entrants who are unable to comply with the POS Program requirements. Since consumers are likely to get more value from manufacturer buydown this trend may be positive for the Program and the market.
   a) The manufacturer buydown option should be emphasized over the POS option since both consumers and the Program is likely to get more value per dollar spent.
   b) The POS option should be offered for strategic reasons, e.g., to recruit any retailers who would not be likely to participate via the manufacturer buydown.

7) **The supplier self-report free-ridership and spillover approach was ultimately successful in generating defensible net-to-gross ratio estimates by retail channel and product type and was preferable to attempting to estimate free-ridership and spillover from customer interviews based on the data that was available**.

   Good detailed tracking data are essential to generating evaluation results, as is cooperation from expert IOU Program staff.

   High response rate, at least among the major participating suppliers, is also essential to robust evaluation results.

   a) This method should be used instead of (or at least in conjunction with) consumer self-report methods for future evaluations. If, in future evaluations, there is interest in comparing the results from the supplier-based NTG method with those from a consumer self-report method – despite the challenges posed by the latter method (most notably, that many CFL purchasers may not realize that the product they purchased was discounted by the program) – the utilities should consider collecting contact information from customers who purchase CFLs discounted by the program to ensure that evaluators have the contact information necessary for a consumer self-report analysis. The utilities may wish to consider providing CFL purchasers with a nominal incentive in exchange for their contact information (similar to the process through which contact information was obtained from 2004/2005 POS measure participants).

b) For planning purposes, the utilities should use the net-to-gross ratio estimates provided in Tables 5-1 through 5-4 (which are by product and store type) combined with appropriate weights based on the number of products they expect to rebate by product and store type to develop net-to-gross ratio estimates for current and future Upstream Lighting programs. There is a general belief that self-reported NTG estimates are biased low[10], however since it was not possible to conduct additional NTG analysis for the lighting measures in this Program we were unable to determine if this hypothesis holds true for supplier self-report estimates.
c) The Program should continue to collect and make available to evaluators complete and detailed tracking data. And Program staff should be invited to provide input into the construct of the free-ridership and spillover survey and analysis approach.
d) Program staff should encourage participating suppliers to respond to evaluator requests for surveys and should continue to collect and provide current contact information in order to ensure high response rate.
e) Program staff should consider trying to collect end-user data via bounce-back cards included in Lighting packaging materials or POS mail-in cards (that would offer an incentive to fill out such as a Starbuck gift card). This would allow for the identification of a portion of the CFL purchasers and thus it would be possible to conduct a self-report NTG analysis with end-user groups and compare the results of this analysis with those from the supplier NTG analysis to cross-validate these results.

8) **Larger retailers are able to promote Program CFLs and are satisfied with how the Program deals with marketing. However, smaller retailers could use more marketing support.**
   a) Consider offering marketing support to smaller retailers, and/or encouraging the manufacturers who serve them to provide promotional materials.

9) **The Program realized low electricity and demand savings for lighting measures. The evaluation estimated that the Program saved 64 percent of gross electricity and 30 percent of claimed gross demand savings for lighting measures. Gross realization rates are below 100 percent for most of the CF bulb categories due to lower evaluation-estimated change in wattage, operating hours and installation rate as compared to Program assumptions.**
   a) The Program should update its per unit savings parameters to reflect that installation rates are 76 percent, operating hours are 2.6 hours per day and peak usage is seven percent.

10) **The Program cannot claim savings for CFLs that are not installed. Seventy-six percent of the CFLs purchased during the 2004/2005 Program period are installed, but approximately 24 percent are in storage. The CFL storage rate is negatively impacting Program savings.**

[10] A comparison of the non-lighting NTG results from this study found self-report NTG estimates were lower than those resulting from the discrete choice. This finding was supported by a 2001 XENERGY meta-analysis that was completed as part of the Standard Performance Contracting Program.

a) One can assume that some proportion of the CFLs currently in storage will be installed at a later date, but at present, there exists no data to suggest how long "stored" CFLs generally spend in storage or the rate at which they replace CFLs versus other lamp types when they are eventually installed. Consider conducting additional research to clarify these issues; results from this research could be used to adjust future year Program savings to account for presently-stored CFLs that are installed in the future. In the absence of additional data to determine the fate of these stored bulbs, we have addressed this issue in this report by adjusting the EULs used in the lifetimes savings estimates included in Chapter 10 of this report. For this study we assumed the 24 percent of bulbs that were in storage would be installed at burnout (year 8) and thus 52 percent of the bulbs were estimated to have an EUL of 8 years and 24 percent were assumed to have an EUL of 16 years. See Chapter 10 for further details and results.

b) As mentioned above, consider limiting the sale of promotional CFLs in multi-packs to keep the storage rate from increasing (and the installation rate from declining) and to capture energy savings impacts sooner. Evidence from a recent study in the Northwest shows that consumers who purchase multi-packs are storing CFLs at a higher rate than single-pack purchasers.

11) **Although publicity regarding mercury contamination from CFL disposal has recently increased and national CFL recycling rates are less than 25 percent, lighting manufacturers are in disagreement about what should be done about this problem or even whether anything should be done.**

a) the IOUs participating in the SFEER Program, along with other California utilities, should engage lighting manufacturers in a collaborative working group process to try to find agreement on:

i) Uniform ways to provide CFL purchasers with disposal information;

ii) Uniform ways to described mercury risk on product labeling; and

iii) Strategies for increasing CFL recycling rates.

1.5.2 *Non-Lighting*

1) **The general population continues to be concerned about the environment and energy efficiency, and the call to action generated from the energy crisis has not decreased dramatically, with most households regularly taking actions to conserve energy.**

2) **The trade ally groups that the Program engages – retailers and contractors – believe the Program could do more to raise awareness among consumers about the Program and its energy efficiency products and rebates.**

a) The Program may consider ramping back up its retailer support efforts, particularly for retail channels that sell products where it is difficult to meet goals. For retailers that primarily sell products where Program goals are met quickly, it is probably not necessary to increase support.

b) The Program's bill inserts and online applications are effective at least for the products where goals are met. It may not make sense from a cost-effectiveness perspective for the Program to conduct mass consumer advertising to increase consumer awareness of the Program since many of its non-lighting measures are replace on burnout measures.
c) Flex Your Power could be leveraged more effectively by tying it more directly to the Program. Flex Your Power should, if possible, conduct advertising on products for which the Program has trouble meeting goals, and attempt to return to a promotional schedule in which they time these promotions to correspond with IOU and national Program promotions. FYP currently times the majority of its advertising to the summer months to decrease advertising costs associated with "Flex Alerts" that urge Californians to immediately reduce electricity use during critical periods.

3) **Recent changes in Federal and state standards for energy efficiency equipment have, in general, not caused problems for equipment vendors, although changing pool pump standards may be a concern in the coming year.** In order to support pool contractors in adjusting to the upcoming changes we recommend:
   a) Working with California pool contractor trade associations on the development of an educational campaign so that pool contractors in the state will be ready for the new standards.
   b) Increasing awareness of utility education and training opportunities for pool pump contractors.
   c) Increasing rebate levels for multi-speed pool pumps.

4) **Some contractors (HVAC in particular) felt that the Program could do more to keep them informed about the Program and generally be more available and knowledgeable.**
   a) The Program should continue its outreach efforts to trade allies and consider increasing interactions with HVAC contractors and appliance dealers.

5) **Significant cost and acceptance barriers remain for the greater use of variable speed drives (VSDs) and advanced evaporative coolers among HVAC contractors.** We recommend:
   a) Offering increasing incentive levels for VSDs to overcome lingering cost barriers.
   b) Continuing to offer financial incentives for advanced evaporative coolers.

6) **The collection of point-of-sale customer data using incentives combined with mail-back cards was useful in expanding the sample of participants included in the evaluation.**
   a) The IOUs should continue attempting to collect POS data using mail-back cards.
   b) The CPUC should determine during the next evaluation planning phase if it is desirable to compare POS versus non-POS participants, and if so, devote resources to oversampling on POS measures.

7) **DEER Updates should utilize evaluation results to improve ex ante gross impact estimates.**
   a) To the extent feasible and appropriate, the current DEER Update should utilize the results in this evaluation Study, in conjunction with other updated sources, to further improve savings estimates and increase the consistency and transparency of user applications of DEER data.

8) **Ex ante net-to-gross ratios also appear to be high given current CPUC NTG definition rules.**
   a) We recommend including NTG ratio updates as a key component in future SFEER evaluations. In addition, we recommend future evaluations also investigate the longer term market effects of these programs.
   b) We found NTG results from the discrete choice analysis were higher than those resulting from the self-report NTG methods leading us to believe that the self-report NTG method is generally biased low[11]. For the four measures where both types of NTG analysis were completed we used the results from the discrete choice analysis since we felt they were more robust. We recommend performing discrete choice NTG analysis in future studies for a greater number of measures (for which it is feasible). We also recommend that future resource dollars be dedicated to better understanding the relationship between self-report and discrete choice analysis and devising a method in which discrete choice analysis can be used to inform the scoring algorithms used within the self-report method.

9) **Increase measure-level data readily accessible for future impact evaluations.**
   a) Retain Qualified Products Lists for all measures which allows for the accurate determination of whether or not a particular measure model is program qualifying in the event that the model has been discontinued.
   b) Increase level of detail regarding assumptions used for ex ante savings estimates included in Program workpapers.
   c) Capture additional application data that is most relevant to impact evaluations in tracking database. This includes data such as:
      i) The ARI number of air conditioning systems to aid in determining the efficiency and capacity of the newly installed system,
      ii) Information on the equipment which was replaced (prior efficiency levels of units, presence of insulation, etc.), and
      iii) Various home characteristics (such as floor area or vintage of home) that would improve the accuracy of impact and savings estimates.

[11] This finding was supported by a 2001 XENERGY meta-analysis that was completed as part of the Standard Performance Contracting Program.

10) **Relationship between Delivery Channel and Program impacts should be explored for rebated refrigerators**
    a) A large percentage of the SCE refrigerator program is delivered through POS rebates.
    b) Continue capturing POS customer data so that these customers can be identified.
    c) We recommend future evaluations include analysis into the effect the delivery channel has on net program impacts to determine if the POS rebates are resulting in higher levels of free-ridership and thus lowering the overall NTG ratio.

2

Introduction

2.1 Background

The 2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate (SFEER) Program was a statewide energy efficiency program administered by the four California investor-owned utilities (IOUs): Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas Company (SCG), and San Diego Gas and Electric Company (SDG&E). The SFEER Program was comprised of two components: Home Energy Efficiency Rebates (HEER) and Upstream Lighting. These components – previously distinct programs – provided rebates and upstream incentives for energy-efficient measures for existing residential homes including single-family dwellings up to four units, condominiums and mobile homes. Eligible measure categories included ENERGY STAR® appliances; ENERGY STAR lighting; home improvement measures; heating, ventilation and air conditioning (HVAC) equipment; and pool pumps and motors.

This evaluation of the 2004/2005 SFEER Program offers both retrospective examination and prospective guidance in shaping current rebate programs offered within the residential sector, and meets the objectives set forth by the California Public Utilities Commission (CPUC) in Decision R.01-08-028 for monitoring and evaluation (M&E) studies as well as those provided in the California Evaluation Framework (dated June 2004). The two principal objectives of the evaluation are to: (1) conduct verification activities to validate statewide accomplishments as reported by the IOUs in their 2004-2005 program claims; and (2) assess the Program's abilities to provide helpful information, services, and prescriptive rebates to move the market toward energy-efficient measures.

Because of the number of measures eligible under the 2004/2005 SFEER Program, conducting a complete savings analysis for each measure was not feasible. Therefore, in addition to meeting the overall evaluation objectives of verifying the Program's accomplishments and conducting a process assessment for all measures, we prioritized evaluation of the eligible measures based primarily on the reported 2004/2005 energy savings accomplishments by measure, but also considering the future achievable energy savings potential for each measure.

As lighting was responsible for roughly 90 percent of the Program's savings, lighting is clearly the highest priority. The other high priority measures on which evaluation efforts were focused include those that contributed at least 10 percent each to the Program's non-lighting kWh, kW or Therm savings, which consist of the following measures: clothes washers, central AC, insulation, single speed pool pumps, programmable thermostats and windows. In addition, two speed pool pumps were included as a high priority measure because of changes that are occurring in the standards for this measure which will move future program efforts toward two-speed pumps instead of single-speed pumps.

This Study, prepared by an independent third party evaluation team consisting of Itron (formerly Quantum Consulting) and KEMA, Inc., provides information about existing equipment for the residential population, evaluation findings, and Program guidance.

2.2 Evaluation Objectives and Approach

As mentioned above, the principal objectives of this evaluation are to:

- Conduct verification activities to validate statewide accomplishments as reported by the IOUs in their 2004/2005 Program claims, including hard-to-reach (HTR) accomplishments, including update estimates of gross and net energy and peak demand savings where appropriate.
- Perform a customer behavior analysis and process evaluation that assesses the Program's effort to provide helpful information, services, and prescriptive rebates to help move the market to install energy efficient measures, specifically assessing the effectiveness of:
  - Current incentives and customer information and education programs;
  - Marketing and outreach programs to Trade Allies; and
  - Statewide coordination with other energy efficiency programs.

Per the evaluation, measurement and verification (EM&V) requirements identified in the California Public Utilities Commission's 2003 Energy Efficiency Policy Manual, this evaluation accomplishes following objectives:

- Measures the level of energy and peak demand savings achieved by the Program;
- Measures the Program's cost-effectiveness;
- Provides feedback on Program implementation strategies;
- Measures indicators of Program effectiveness, including tests of the assumptions that underlie the Program theory and approach;
- Assesses the overall levels of performance and success of the Program; and
- Helps to assess whether there is a continuing need for the Program.

The evaluation also documents the effectiveness of customer information and education; marketing and outreach to trade allies (including energy-efficient equipment manufacturers, retailers, and installation contractors); and statewide coordination with other programs.

2.2.1 *Approach*

To meet each of the objectives outlined above, this evaluation is comprised of five overarching components:

1. **Verification of Program performance** involved a Program tracking system review, phone and onsite verification of the equipment installed, and onsite verification of key characteristics (e.g., efficiency) of the equipment installed. Program savings are presented in the body of the evaluation report by key HTR segments, measure, and IOU. Energy and demand savings using current ex post savings estimates were also verified.
2. **Estimation of ex post energy and demand savings and net-to-gross ratios** is another crucial objective of the Study. Varied approaches were used dependant upon various characteristics of the measure being evaluated, with major differences in the methods used for gross and net savings analyses of non-lighting and lighting measures.
   - Non-lighting Measure Gross Savings Analysis. The methods used to estimate gross energy savings for the highest priority measures included billing analyses and/or engineering analysis based upon tracking DEER and telephone survey data. The latter of these two approaches was also be used to estimate gross demand savings.
   - Non-lighting Measure Net Savings Analysis. Net savings are typically calculated as gross savings multiplied by a net-to-gross (NTG) ratio. Various methods can be used to calculate NTG ratios, the majority of which focus on the estimation of free-ridership (participants who would have installed the measure in the absence of the Program) and spillover (where the Program is credited for adoption of the measure by non-participants) rates. Participant and non-participant spillover rates were estimated as part of this evaluation, however final NTG ratios are based on free-ridership alone. The methods used within this Study include self-report analysis (based on participant and non-participant survey data) and discrete choice analysis (in which statistical regression techniques are used to create a model that predicts behavior based on relevant customer characteristics and can thus be used to simulate behavior in an environment without the Program).
   - Lighting Measure Gross Savings Analysis. The gross savings analyses for lighting measures focused on improving the key parameter estimates used to calculate gross savings for CFLs and fixtures based on information gathered during telephone and onsite surveys. The key parameters include delta watts (the difference between the pre-installation bulb wattage and the wattage of the

replacement CFL), hours of operation, and installation rate. We leveraged the 2004 California CFL Metering Study to obtain hours of operation look-up values.

- Lighting Measure Net Savings Analysis. Calculating net savings for the Upstream Lighting component of the Program was complicated as a result of the difficulty estimating of free-ridership and spillover, the two key components of NTG ratios, for programs that are delivered upstream, as the customers who are purchasing discount products may or may not be aware of the Program. The Study asked participating lighting manufacturers and retailers to estimate what percentage of the rebated CFL lighting products that they did sell would have been sold if the program rebates had not been available. Different percentage estimates were obtained for different CFL product categories and different categories of retailers. These estimates were then weighted by the sales volume of the manufacturer or retailer to calculate separate NTG ratios for each retailer category and for each CFL product type.

3. The **Customer Behavior Analysis** analyzes participation trends (including how well the Program served HTR customers); assesses awareness of energy efficiency in general and energy-efficient products; and the Program and its delivery mechanisms. We investigated these issues for the HEER and Upstream Lighting Program components, and results are presented in the market characterization chapters (4 and 7).

4. The **Process Evaluation** evaluates the effectiveness and efficiency of the Program both in terms of satisfying customers (both consumers and suppliers) and achieving energy savings. In addition, the process evaluation assesses the effectiveness of Program marketing from the perspective of participating customers. Program influence was measured through self-report data on the degree to which the Program influenced customers' purchase decisions. We investigated these issues for the HEER and Upstream Lighting Program components[12], and results are presented in the Program component assessment chapters (5 and 8).

5. **Recommendations for Program Enhancements** are based upon a synthesis of the results of the process evaluation, the customer behavior analyses, and the ex post savings study. These recommendations are in the form of tangible actions to improve the performance of the current Program. They are focused on identifying cost-effective marketing strategies and Program delivery approaches, considerations for changes in incentives, potential energy efficiency measures to consider, and changes

[12] Note that we were limited in our ability to capture Program influence on consumer purchasing decisions for the Upstream Lighting component of the Program because of its upstream delivery strategy; however, we did examine influence of the Program incentive (in the form of a $2.00 discount per CFL). The results of these analyses are presented in Chapter 5.

in Program delivery that may result in higher customer satisfaction and increased effectiveness of the Program.

2.3 Data Collection Activities

There were four areas of primary data collection completed in support the Study. These areas included:

- **Participant Verification Telephone Surveys and Onsite Audits** to support the verification of Program performance, estimation of ex post energy and demand savings, and net-to-gross analysis tasks.
- **Customer Behavior Survey** to support the customer behavior analysis and process evaluation.
- **Supply-Side Interviews** to support the customer behavior analysis and process evaluation.
- **Program Staff Interviews** to support the process evaluation.

There were two customer telephone surveys, two onsite surveys, and a thorough review of Program applications and invoices, conducted to support the first two of these primary data evaluation objectives (Participant Verification and Customer Behavior). Overall close to 5,000 customers were surveyed statewide. The comprehensive sample design memo that was approved by the evaluation committee is included in Appendix B.

2.3.1 *Telephone Surveys*

The telephone surveys were conducted with Single Family Rebate participants, as well as a sample of the general population of customers across all four of the IOUs. The surveys were made up of a series of question modules designed to collect data to meet all of the evaluation's analysis requirements. Table 2-1 below shows the various survey modules and the population of customers with whom they were conducted.

Table 2-1: Telephone Survey Modules

Module #	Survey Module	Participant Survey		General Population	
		Base	Supp	Base	Supp
1	Non-Lighting Verification	✓	✓		
2	P-Stat POS Screener	✓	✓	✓	✓
3	Market Assessment	✓		✓	
4	Process Evaluation	✓			
5	Indepth CFL Lighting Module			✓	
6	Discrete Choice/Billing	✓	✓	✓	✓
7	Customer Demographics	✓	✓	✓	✓
8	On-Site Recruiting	✓	✓	✓	✓
Survey Completes		2,207		2,511	
		796	1,411	1,000	1,511

Participant Survey

As the exhibit above indicates, a total of 2,207 participants – PG&E, SDG&E, SCE and SCG customers who received a mail-in rebate or a Point-Of-Sale rebate for a Program-qualifying energy efficiency measure – were surveyed. In addition to their verification function, these surveys were also used to assess customer satisfaction and sources of Program awareness for the Customer Behavior Analysis and Process Evaluation components of the Study. They were also used for developing self-reported estimate of free-ridership.

Of the total 2,207 participants surveyed, 796 were asked questions from all but the In-depth Lighting survey module. This component of the survey was referred to as the Participant Base component. The sample for this component of the participant survey was selected randomly from the utility tracking databases to verify the rebated equipment installed matches the Program tracking system. We aimed at completing a minimum of 50 surveys with customers in 15 different equipment bins who received rebates which allows us to present meaningful results for each of these technologies.

The remaining 1,411 participants were asked a shortened survey that focused on batteries of questions necessary to support the discrete choice and billing analysis activities which are planned for a subset of the overall Program measures. Referred to as the Participant Supplemental component, this data collection activity allows for the calculation of net and gross Program impacts; the questions included in these modules are thus aimed at determining the influence of the rebate programs on the purchases of these measures. The participants selected for this component of the participant survey came from one of six technologies: central air conditioning, clothes washers, insulation, pool pumps, programmable thermostats or windows. These measures were selected since they are the focus of the discrete choice and/or billing analyses. Table 2-2 below shows the distribution of participating measure technology, stratified by IOU, for the participant survey.

Table 2-2: Distribution of Participant Survey Completes

Technology	PG&E	SCE	SDG&E	SCG	Total
Air Conditioner	100	102	51		253
Clothes Washer	100		51	103	254
Dishwasher	22		10	20	52
Whole House Evaporative Cooler	11	40			51
Whole House Fan	22	21	10		53
Gas Furnace	20		10	20	50
Heat Pump	24	21	10		55
Insulation	100		52	101	253
Pool Pump	152	202	50		404
Programmable Thermostat	153	96	51	75	375
Room AC	20	20	10		50
Water Heater	22		10	21	53
Windows	127	50	77		254
Refrigerator			50		50
Total	**873**	**552**	**442**	**340**	**2,207**

General Population Survey

Within the General Population survey, a total of 2,511 customers in PG&E, SDG&E, SCE and SCG service territory were surveyed to evaluate awareness of and participation in energy-efficiency programs, as well as energy efficiency behaviors, such as installation of energy efficient lighting, appliances, and equipment and conservation measures. The focus of 1,000 of these customer surveys was on a series of in-depth lighting questions to assess their awareness, purchase and installation history and satisfaction with CFL bulbs. This component was referred to as the base Lighting component. The questions in this survey module allowed us to identify CFL purchasers and non- purchasers.

Because the lighting component of the Program is delivered upstream and thus the utilities do not collect customer specific data, we were unable to obtain a list of 2004/2005 Program Participants from which to draw our sample. Instead, we conducted random-digit dialing within utility service territories and relied on customer self-reports of CFL purchase activity to identify whether customers purchased CFLs during 2004 or 2005. While these purchasers may not have bought CFLs specifically rebated by the Program, it is possible that some proportion CFL purchases in 2004 and 2005 were either directly or indirectly influenced by the Program because of its powerful influence on the market. Through these methods we identified 573 respondents who purchased CFLs during 2004 and/or 2005.

Identifying the CFL purchasers and non-purchasers allowed us to gather CFL participant data to aid in the assessment of gross impacts and explore awareness of CFLs, attitudes towards energy efficiency and barriers to CFL purchases among the non-purchaser population. The remaining 1,511 customers were asked a shortened survey, similar to the participant supplemental survey, again focused on question batteries necessary to support the discrete choice and billing analysis evaluation tasks. This survey component is referred to as the General Population Supplemental component. Table 2-3 below shows the breakdown by IOU for the two components of the General Population survey.

Table 2-3: Distribution of General Population Survey Completes

General Population Survey	PGE	SCE	SDGE	SCG	Total
Lighting Survey	400	200	200	200	1,000
Supplemental Survey	502	409	200	400	1,511
Total	**902**	**609**	**400**	**600**	**2,511**

Completes across both of the telephone surveys were stratified IOU service territory. The samples for each of the surveys were allocated across the four IOUs roughly proportional to participation or customer population. Although the sample of SCE customers may seem under represented, this is not the case since a large portion SCG customers are also SCE customers. Results of the participant surveys were weighted to represent the number of participants by IOU and measure. Results of the general population survey were weighted to represent each IOUs entire customer population.

Data Collection for Point of Sale Program Participants

In 2004 and 2005, the SFEER Program offered instant rebates for do-it-yourself customers who bought measures such as programmable thermostats, room air conditioners (RAC) and pool pumps at retailers, such as Home Depot, Lowes or Leslie’s Pool Supply, thereby eliminating the application process for these purchasers. Because of the downstream nature of these rebates, referred to as Point-Of-Sale (POS) rebates, there exists limited customer tracking data. As shown in Table 2-4 below, SCE was able to collect customer contact data on approximately 700 programmable thermostat purchasers and 760 pool pumps[13]. From these leads we completed surveys with 71 POS participants (50 pool pumps and 21 programmable thermostats). We also identified a total of 86 self-report POS programmable thermostat participants (40 in the Participant survey and 46 in the General Population survey). We did not target any POS RAC points because, despite the fact that statewide POS

[13] SCE was able to capture customer data for some POS rebate participants through a Starbucks giftcard incentive, for Programmable Thermostat and Room ACs, and through records kept by a key retailer for Pool Pumps.

rebates make up 38 percent of PGC funded RAC rebates, customer data existed for only 19 of the RAC POS participants.

Table 2-4: Point-Of-Sale Rebate Participants and Availability of Customer Data for POS measures

Point of Sale Measures	PG&E			SCE				SCG			SDG&E			Statewide POS
	Total Units	POS Units	% POS	Total Units	POS Units	% POS	w/ Cust Data	Total Units	POS Units	% POS	Total Units	POS Units	% POS	
Clothes Washer	85,474	1	0%	0	0	-	**0**	49,640	0	0%	13,319	0	0%	0%
Dishwasher	51,063	2	0%	0	0	-	**0**	30,312	0	0%	9,994	0	0%	0%
Pool Pump	4,094	0	0%	5,558	809	15%	**760**	0	0	-	480	0	0%	8%
Prog Thermostat	44,500	20,617	46%	25,363	7,053	28%	**678**	30,965	24,538	79%	4,355	3,313	76%	53%
Room AC	983	0	0%	2,431	1,519	62%	**19**	0	0	-	597	0	0%	38%

2.3.2 *Onsite Surveys*

The onsite surveys were conducted at a sample of the homes of Lighting and Non-Lighting measure Single Family Rebate participants that had participated in one of the phone surveys described above. Table 2-5 below shows the distribution across measures and IOU of onsites completed.

Table 2-5: Distribution of Onsite Surveys Across SFEER Measures and IOU

Measure	Utility				Completed Onsite Surveys
	PG&E	SCE	SCG	SDG&E	
Central Air Conditioner	10	10	-	5	25
Clothes Washer	12	-	10	5	27
Dishwasher	4	-	5	3	12
Evaporative Cooler	2	8	-	-	10
Gas Furnace	7	4	-	2	13
Insulation	12	-	15	7	34
Pool Pump	19	20	-	9	48
Programmable Thermostat	12	14	-	6	32
Refrigerator	-	26	-	-	26
Whole House Fan	4	5	-	2	11
Windows	14	6	-	9	29
Total Non-Lighting	**96**	**93**	**30**	**48**	**267**
Total Lighting	**40**	**40**	**-**	**20**	**100**
Total Onsite Surveys	**136**	**133**	**30**	**68**	**367**

Non-Lighting Measure Onsites

From the population of 2,207 surveyed SFEER Program participants described above, 215 were selected for onsite surveys to verify the installed non-lighting equipment matched the Program tracking system and were indeed Program-qualifying. The onsites focused primarily on the high priority measures that were large contributors to the Program's overall energy savings accomplishments. The Programmable Thermostat onsites were only selected from the mail-in rebate applications and the POS rebates with customer data (excluding self-reports). They were also slightly under-represented in the overall onsite sample because they are relatively easy to verify over the phone.

Lighting Onsites

From the population of 573 CFL purchasers identified as having purchased CFLs during 2004 or 2005 from the General Population survey, 100 were selected for onsite surveys to collect data to support the ex post impact analysis for this measure (such as installation location, pre and post wattage and installation and storage rates). These onsites also support the customer behavior analyses, exploring potential for and barriers to future CFL installations and consumer lighting preferences.

2.3.3 *Supply-Side Market Actor Interviews*

The purposes of the market actor interviews are to update key market measurements such as stocking, pricing and promotional patterns; to understand how the Program is influencing suppliers and consumers in 2004 and 2005; and to inform future program design by exploring how rebates are used by market actors to promote and sell their products. These supply-side interviews were comprised of interviews with participating retailers, manufacturers, and contractors. Table 2-6 shows the distribution of completed supply-side market actor interviews.

Table 2-6: Distribution of Supply-Side Interviews

Supply-Side Market Actor Category	Number of Completed Interviews
Participating lighting manufacturers	14
Participating large lighting retailers	7
Participating small lighting retailers	16
Participating HVAC contractors	32
Participating appliance dealers	26
Participating pool contractors/retailers	25
Total Completed Interviews	**120**

Retailer and Manufacturer Interviews

Suppliers were surveyed with regard to their experience with the Program, in order to evaluate the effectiveness of Program delivery, marketing and coordination with other complementary programs and for soliciting recommendations for Program improvements. Big box retailers, who sell a range of products that are rebated by the Program, were asked about how the Program influences their behavior as well as their customers'. They were also asked about the effectiveness of Program marketing and educational messages that were disseminated to consumers. For point-of-sale measures (lighting products and p-stats), retailers were further queried about their satisfaction with the POS process, including satisfaction with: rebate levels by product type, POS data requirements, and payment turn-around.

Contractor Surveys

Contractors who actively promoted the Program to their customers were surveyed similarly, regarding the influence of the Program on their promotion and stocking behavior, as well as their customers' selection of energy efficiency products. Likewise, contractors were asked about their satisfaction with the rebate process and how it impacts their sales.

2.3.4 *Program Staff Interviews*

Ten in-depth interviews were conducted with members of the IOU Program staff. These interviews initiated the process evaluation and provided an opportunity to update our understanding of the Program and the pertinent research issues that we need to address within the Study.

2.4 Organization of Report

This report consists of eleven chapters and 10 appendices:

Chapter 1 (Executive Summary) summarizes the high level findings of the Study and provides recommendations for future analysis.

Chapter 2 (Introduction) provides a brief description of the SFEER Program, states the Study objectives, and summarizes the research activities and data collection efforts of this evaluation.

Chapter 3 (Program Activity) summarizes the Program background and evolution, highlights the IOU marketing activities, and provides the 2004/2005 Program goals and accomplishments.

Chapter 4 (Lighting Market Characterization) provides an overview of the market for CFLs and CF fixtures using data from secondary sources as well as our interviews with lighting suppliers. The chapter also includes a consumer summary which provides an overview of consumer awareness and purchase rates for CFLs and CF fixtures as well as CFL disposition, satisfaction, barriers, and future CFL purchase intentions.

Chapter 5 (Assessment of Upstream Lighting Program Component) presents results related to the Upstream Lighting Component of the 2004/2005 SFEER Program including supplier satisfaction with the Program and its marketing as well as a discussion of the Program net-to-gross ratio. This section also presents results on Program influence (both direct and indirect) from the consumer perspective.

Chapter 6 (Lighting Impacts) presents realization rates and per-unit ex post gross savings estimates for lighting measures.

Chapter 7 (Non-Lighting Market Characterization) provides an overview of the market for energy-efficient non-lighting measures using secondary data sources and our interviews with market actors. This section also assesses consumer awareness of energy-efficiency programs, general awareness and knowledge about energy efficiency, and consumer behaviors as they relate to energy efficiency and energy conservation.

Chapter 8 (Assessment of HEER Program Component) presents results related to the HEER Component of the 2004/2005 SFEER Program including supplier satisfaction with the Program and its marketing. On the consumer side, the section covers sources Program awareness, the in-store purchase experience, Program-related experiences with contractors, Participant satisfaction, and Program influence.

Chapter 9 (Non-Lighting Impacts) presents verification and realization rates as well as per-unit ex post gross savings estimates for non-lighting measures.

Chapter 10 (Program-Level Impacts) presents the results of the ex post gross savings analysis; verification efforts; effective useful life (EUL) and net-to-gross (NTG) analyses; and the cost-effectiveness assessment for all lighting and non-lighting measures.

Chapter 11 (Conclusions and Recommendations) summarizes findings from the Study, presents our conclusions based on research results, and provides suggestions for Program enhancements.

Appendix A (Bibliography) provides a detailed source to all referenced documents included in report.

Appendix B (Sample Design Memo) includes a copy of the comprehensive sample design memo that was approved by the evaluation committee.

Appendix C (Survey Instruments) contains the survey instruments for the participant and non-participant surveys.

Appendix D (Survey Dispositions) summarized the overall disposition of all attempted telephone surveys (including refusals, disconnected/wrong numbers, language barrier and non-participants).

Appendix E (Interim Results Memos) includes a copy of the interim results memos provided to the evaluation committee.

Appendix F (Lighting Methodology) summarized that analysis methods used to calculate the lighting gross and net impacts.

Appendix G (Non-Lighting Methodology and Complete Results) summarized that analysis methods used to calculate the non-lighting gross and net impacts and provides detailed analysis results.

Appendix H (Survey Tables) includes banner tables for all questions included in CATI phone surveys.

Appendix I (Refrigerator Analysis) includes the results of a separate analysis that was completed for rebated refrigerators. This add-on component to this evaluation focused on refrigerators that were rebated through the procurement funded rebate program. It is focused on SCE refrigerators; however data collected on a small number of SDG&E rebated refrigerators is also included in this appendix.

3

Program Description

3.1 Program Overview

3.1.1 *History*

In 1997, the California Public Utilities Commission (CPUC) declared that the purpose of energy-efficiency programs should be to transform the market so that individual customers and suppliers in the future competitive market would make better choices about appliances, home improvement measures, and HVAC equipment. Pacific Gas & Electric (PG&E), Southern California Edison (SCE), Southern California Gas Company (SCG), and San Diego Gas & Electric (SDG&E) developed designs for the 1999 portfolio of energy-efficiency programs, with the major programs serving the entire state. One of these statewide market transformation programs was the California Residential Lighting and Appliance Program (CRLAP), which was designed to improve the availability, promotion, and sales of energy-efficient residential lighting and appliances by inducing sustained changes in the behavior of market participants. This Program continued through December 2001.

Another program introduced during the market transformation era was the Residential Contractor Program (RCP), whereby the investor-owned utilities (IOUs) offered rebates directly to contractors. In 2001, the IOUs migrated from contractor to consumer rebates and while the amount of interaction with contractors declined somewhat, the utilities still relied on this important trade ally group to market the Program to consumers and to provide assistance with measure eligibility and the rebate application process.

In 2001, the state's energy efficiency program emphasis shifted from its longer-term market transformation -oriented goals toward achieving more immediate energy and peak demand savings. This shift in policy was instigated by the California energy crisis which intensified in the summer of 2001 with anticipated and real shortages of energy supply occurring during peak hours.[14] Incentives were provided through mail-in rebates to consumers (for non-lighting measures) as well as through manufacturer buydowns and point-of-sale (POS) retailer discounts (for lighting measures). In addition to providing thousands of rebates for non-lighting measures, the utilities ultimately provided incentives for over 7 million compact fluorescent lamps (CFLs) in 2001 in response to the state's energy policy shift.

[14] The statewide Flex Your Power marketing campaign also began in 2001 (see below for details).

In 2002, the CRLAP split into two distinct Programs:

1. **Statewide Crosscutting Residential Lighting Program**. The 2002 Lighting Program was designed to achieve energy savings by increasing the availability of ENERGY STAR® qualified lighting products in the marketplace and expanding CFL saturation within California households. The Program built upon the successes of CRLAP by leveraging the existing retailer and manufacturer partnerships and continuing to increase the supply of ENERGY STAR lighting products into the marketplace through the use of discounts. The Program relied on retailers and manufacturers to advertise the discount using their own point-of-purchase promotions and did not include an emphasis on supplier support functions such as co-operative advertising and salesperson training. The 2002 Program was ultimately responsible for reducing the price of over 3 million CFL products statewide.
2. **Statewide Residential Retrofit Single-Family Home Energy Efficiency Rebate (HEER) Program.** The 2002 HEER Program continued strategies from the 2001 Program, providing rebates to residential customers for appliances, HVAC measures, and other home improvement measures to help offset the incremental cost for high efficiency equipment. In addition to the Program's evolution from a contractor-driven strategy (prior to 2001) to a consumer rebate strategy, the utilities also began to rely less on implementation contractors, partners upon whom they had relied in the past to perform field support functions. This trend toward in-house utility Program operations reflected a decrease in the intensity of field support being provided by the Program and an effort by the utilities to reduce implementation costs and maximize incentive budgets.

The 2003 Residential Lighting and HEER Programs continued their strategies from the 2002 Programs. The 2003 HEER Program added POS rebates for programmable thermostats, enabling customers to bypass a mail-in rebate in favor of an instant rebate at the cash register in participating stores. Programmable thermostat volume increased in 2003 and led all non-lighting measures in terms of energy savings contributions.

3.1.2 *2004/2005 Program*

In 2004, the Residential Lighting and HEER Programs were combined to form the Statewide Single-Family Energy Efficiency Rebate (SFEER) Program to streamline internal operations for the utilities. The SFEER Program included a diverse array of energy efficiency measures including home improvement products, heating and cooling equipment, lighting, appliances, and pool equipment. The 2004/2005 Program targeted all residential customers paying a Public Goods Charge (PGC; i.e., IOU customers) and residing in dwellings of 4 units or less, including condominiums and mobile homes. Although the Program combined the previously distinct HEER and Residential Lighting Programs, the Programs appeared unchanged from the consumer perspective.

The 2004/2005 SFEER Program was designed to overcome three major barriers to energy efficiency measure adoption in the residential sector:

- Higher incremental costs for high efficiency measures relative to standard efficiency measures;
- Lack of consumer information about energy-efficient equipment and its benefits; and
- Lack of availability of high efficiency products in the market place.

The Program included consumer incentives (in the forms of mail-in rebates and POS incentives) to address the higher incremental costs of energy-efficient equipment. To address the lack of consumer information, the Program conducted advertising through multiple channels (including bill inserts, the Flex Your Power campaign, and IOU websites) and provided measure-specific information sheets/brochures at retail outlets. To increase availability of high efficiency products, the Program conducted outreach and training to trade allies (including retailers, manufacturers, and distributors) to convince them to carry Program-qualifying products, and also provided upstream wholesale cost buydown for some measures to encourage manufacturers to ship discounted Program-qualifying products to retailers.

In 2004/2005, the SFEER Program expanded its use of the point-of-sale product delivery method. The Program continued to offer POS rebates for programmable thermostats and lighting and, in 2004, POS incentives expanded beyond programmable thermostats and lighting in some service territories to dishwashers, clothes washers, water heaters, whole house fans, swimming pool pumps, and room air conditioners.

The 2004/2005 SFEER Program coordinated with other statewide programs including the Multifamily Energy Efficiency Rebate Program, the Home Energy Efficiency Survey Program, the Education and Training Program, and the statewide Appliance Recycling Program to ensure that residential customers served by the four IOUs would all have the opportunity to benefit from the Program's services. The Flex Your Power advertising campaign also continued to market the Program statewide (see the end of this section for additional detail on Flex Your Power).

2004/2005 Hard-to-Reach Definition

For the 2004/02005 HEER component of the SFEER Program the California Public Utilities Commission (CPUC) defined residential hard-to-reach (HTR) customers as those "who do not have easy access to Program information or generally do not participate in energy efficiency programs" because of one of five barriers[15]:

[15] CPUC Energy Division, 2003. Energy Efficiency Policy Manual, Version 2. August, 2003.

- Language: primary language spoken in the home is other than English.
- Income: annual income level less than 400 percent of federal poverty guidelines. For 2004, these annual income levels are as follows: $37,240 for one person; $49,960 for two; $62,680 for 3; $75,400 for 4; $88,120 for 5; and $100,840 for a 6-person household.[16]
- Housing Type: multi-family and mobile home tenants;
- Geographic: residents of areas other than the San Francisco Bay Area, San Diego area, Los Angeles Basin, or Sacramento; and/or
- Homeownership (split incentives): renters.

The utilities targeted these hard-to-reach customer segments through efforts in languages other than English and through community-based organizations.

HTR criteria were defined somewhat differently for the Upstream Lighting component of the SFEER Program. Because the Program is delivered upstream, HTR criteria were defined based on the retail locations offering discounted lighting product. The two criteria were:

- Geographic: retailers located in areas other than the San Francisco Bay Area, San Diego area, Los Angeles Basin, or Sacramento; and/or
- Store type: retail channels including drug and grocery stores.

No HTR goals were set for the 2006/2008 programs, however interviews with SFEER Program staff indicated they believe they will continue to reach similar levels of HTR customers since they do not plan to change their marketing efforts to these customers.

3.2 Overview of Measures and Specifications

3.2.1 *Non-Lighting Measures*

Table 3-1 provides an overview of the non-lighting measures for which mail-in rebates were available through the HEER component of the 2004/2005 SFEER Program as well as the available rebate amounts by Program year. As shown in the table, incentive levels for several measures decreased between 2004 and 2005 – including windows, water heaters, dishwashers, clothes washers, heat pumps, central air conditioners, and programmable thermostats – and remained the same for other Program measures.

[16] Department of Health and Human Services, 2004. Notice: Annual Update of the HHS Poverty Guidelines. Federal Register: February 13, 2004 (Volume 69, Number 30); Page 7335-7338. Online at http://aspe.hhs.gov/poverty/04fedreg.htm.

Table 3-1: Non-Lighting Measures and Mail-In Rebate Levels by Program Year

Measure Type / Measure	Program Year		Offered By
	2004	2005	
Home Improvement Measures			
Attic insulation (<R11 to R19)	$0.15/sq ft	$0.15/sq ft	All IOUs
Wall insulation (R0 to >R13)	$0.15/sq ft	$0.15/sq ft	All IOUs
High performance dual-pane windows	$1.00/sq ft	$0.50/sq ft	SCE, PG&E, SDG&E
Natural gas storage water heater (EF >0.62)	$40/unit	$30/unit	PG&E, SDG&E, SCG
Electric storage water heater (EF >0.93)	$40/unit	$30/unit	SCE, PG&E, SDG&E
ENERGY STAR programmable thermostat	$20/unit	$10/unit	All IOUs
Pool Pumps			
Pool pump & motor: Single speed	$125/unit	$125/unit	SCE, PG&E, SDG&E
Pool pump & motor: Two speed	$300/unit	$300/unit	SCE, PG&E, SDG&E
Appliances			
ENERGY STAR dishwasher	$50/unit	$30/unit	PG&E, SDG&E, SCG
High efficiency clothes washer	$25, $75, $125/unit	$35-$75/unit	PG&E, SDG&E, SCG
Heating, Ventilation, and Cooling (HVAC) Equipment			
ENERGY STAR room air conditioner	$50/unit	$50/unit	SCE, PG&E, SDG&E
Energy-efficient central heat pump	$200-$700/unit	$200-$625/unit	SCE, PG&E, SDG&E
Energy-efficient central air conditioner	$200-$700/unit	$200-$625/unit	SCE, PG&E, SDG&E
Whole house fan	$100/unit	$100/unit	SCE, PG&E, SDG&E
Energy-efficient duct evaporative cooling	$300-$600/unit	$300-$600/unit	SCE, PG&E, SDG&E
ENERGY STAR central natural gas furnace	$200/unit	$200/unit	PG&E, SDG&E, SCG
Variable speed motor air handler system	$100/unit	$100/unit	All IOUs

Key changes in measure offerings between the 2003 and 2004/2005 Programs include the following:

- A two-tiered incentive was developed for clothes washers to distinguish the most efficient clothes washers.
- A new set of incentives for advanced whole house evaporative coolers including an incentive for the more efficient two-stage evaporative cooler.
- An increased incentive for High Performance Windows from $0.50 per square foot to $1.00 per square foot for 2004. The incentive was increased to stimulate customer participation and achieve equity for the Single and Multifamily markets. The incentive returned to $0.50 per square foot for 2005.
- A change in tiered incentive levels for HVAC to simplify Program requirements for customers.

Mail-in rebates for programmable thermostats were eliminated between 2004 and 2005 with the notable exception being for programmable thermostats purchased at the same time as a heating or cooling system.

SFEER Program incentives were not available year-round for all measures; the Program stopped offering incentives for some measures (i.e., "closed" some measures) partway through the Program implementation period. Program managers thus monitor energy savings accomplishments and incentive payments by measure and may occasionally close some measures early to enable them to meet their respective savings goals for electricity, demand, and natural gas without overspending their incentive budgets. Some measures closed and then "re-opened" as additional funds became available. This varied by utility and Program year. In 2004, for example, PG&E closed out 9 Program measures in April. In July of that year, funds for all measures were depleted and all measures were closed, and then were re-opened again in September.[17] In each of these cases, notices were mailed to home appliance and home improvement retailers as well as HVAC, windows, insulation, and plumbing contractors, and Program information was updated on PG&E's website.

3.2.2 *Lighting Measures*

For lighting measures, the IOUs offered incentives to manufacturers for CFLs, interior and exterior compact fluorescent (CF) fixtures, and CF torchieres based on a tiered incentive structure.[18] The 2004/2005 Program shifted its tier focus for lighting incentives from wattage ranges to lumen ranges, with higher incentives for bulbs with higher lumen output (and for fixtures that accommodate higher-lumen bulbs) to address the issue that CFLs with the same wattage as incandescent bulbs will not necessarily emit the same light levels (where as lumens are a more accurate reflection of brightness). The Program's lumen standards were based on recommendations from ENERGY STAR as to equivalent incandescent light output as shown in Table 3-2. The tiers generally follow the same wattage ranges as in prior Program years but better reflect equivalent incandescent light levels. The change in tiers was made behind the scenes in agreements between the IOUs and manufacturers and was not apparent to consumers.

[17] Personal communication from S. Boughen, PG&E Marketing Manager for 2004/2005 SFEER Program. August 25, 2006.

[18] A manufacturer buydown is a subsidy paid to a manufacturer to offset manufacturing costs such that the subsequent price the manufacturers offer to retailers (and, ultimately, to consumers) is lower.

Table 3-2: Incandescent/Lumen Equivalency

Incandescent Bulb Wattage*	Typical Light Output
40 Watts	> 450 lumens
60 Watts	> 800 lumens
75 Watts	> 1,100 lumens
100 Watts	> 1,600 lumens
150 Watts	> 2,600 lumens

Source: www.energystar.gov, 2006.
* Wattage shown for a-lamp style incandescent bulbs.

Incentive levels for lighting products ranged from $1.00 to $2.50 per bulb, $5.00 to $10.00 per fixture, and were $10.00 per torchiere. Incentive levels were unchanged between 2004 and 2005 (see Table 3-3). Note that the 2004/2005 SFEER Program included no incentives for ceiling fans because a 2002 study showed that energy savings were much lower than previously claimed and were not cost-effective.[19]

[19] RLW Analytics, 2002. Statewide Investor Owner Utility Ceiling Fan Study: Final Report. Prepared for San Diego Gas and Electric Company.

Table 3-3: Lighting Measures and Manufacturer Buydown Levels, 2003 Through 2005 [20]

Measure Type / Measure	2003	2004	2005
Interior CFL (bulb)			
450 to 799 lumens	$0.00	$1.00	$1.00
800 to 1,099 lumens	$1.00	$1.50	$1.50
1,100 to 2,599 lumens	$2.00	$2.00	$2.00
2,600 lumens and higher	$2.00	$2.50	$2.50
Interior CF Fixture			
Less than 1,100 lumens	$5.00	$5.00	$5.00
1,100 lumens and higher	$10.00	$10.00	$10.00
Exterior CF Fixture			
Less than 1,100 lumens	$5.00	$5.00	$5.00
1,100 lumens and higher	$10.00	$10.00	$10.00
CF Torchiere*			
Less than 65 Watts	$5.00	$10.00	$10.00
Greater than 65 Watts	$10.00	$10.00	$10.00

* Note that the 2003 Program distinguished between wattage levels for CF torchieres while the 2004/2005 Program did not distinguish wattage or lumen levels.

Data sources: 2003 incentive levels as cited in KEMA, 2005. 2004/2005 incentive levels as cited in IOU Manufacturer Incentive Level worksheets for 2004 and 2005.

Among the 2004/2005 incentives provided for CFLs, the majority were for higher wattage CFLs (over 1,100 lumens). However, prior years' programs were more focused on lower wattage bulbs. Nearly a third of the CFLs for which 2004/2005 Program incentives were provided were less than 1,100 lumens (18 Watts), a decrease from more than 40 percent of incentives for CFLs less than 18 Watts in 2003 and more than 60 percent in 2002. The Program provided incentives for nearly 15 million low-Wattage CFLs (less than 30 Watts) but only approximately 104,000 specialty CFLs. Specialty CFLs thus only accounted for 1 percent of total CFLs (units) for which the Program provided incentives (and 1% of the total incentive dollars provided).

Manufacturer Buydown

The buydown mechanism comprised the vast majority of the Program's lighting incentives, which were paid directly to lighting manufacturers.[21] (The remainder of lighting incentives was paid to retailers in the form of POS rebates.) Lighting manufacturers could participate in the Program by recruiting eligible retailers. Retailers were eligible if they sold ENERGY

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[20] 2003 data source: KEMA, 2005. "CFL Metering Study: Final Report." Prepared for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison. February 25, 2005.

[21] For PG&E the manufacturer buydown incentives accounted for 88 percent of the rebated lighting products and the percentage was even higher for the other participating utilities.

STAR CFL products (bulbs, fixtures, torchieres) to residential customers, were located in the PG&E, SCE, or SDG&E service territories, had a valid California retailer license, and were not also participating in the POS rebate component of the Program.

Table 3-4 shows a breakdown of Program spending for lighting manufacturer buydown incentives through the Upstream Lighting component of the 2004/2005 SFEER Program. PG&E, SCE, and SDG&E all provided manufacturer buydown incentives for lighting measures in 2004/2005. PG&E accounted for more than half of the Program manufacturer buydown incentives, followed by SCE (38%) and SDG&E (11%). Grocery stores were responsible for more than 40 percent of total manufacturer buydown dollars for lighting.

Table 3-4: Program Incentives for Lighting Manufacturer Buydown by Utility, 2004/2005

	IOU			All IOUs	
Store Type	**PG&E**	**SCE**	**SDG&E**	**Total Buydown Dollars**	**% of Total Buydown Dollars**
General merchandise/big box	$ 2,260,266	$ 2,657,984	$ 201,328	$ 5,119,578	**18%**
Large home improvement	$ 1,870,410	$ 1,217,836	$ 48,372	$ 3,136,618	**11%**
Grocery stores	$ 5,131,780	$ 4,771,196	$ 2,122,702	$ 12,025,678	**42%**
Drug stores	$ 3,475,265	$ 395,398	$ 255,588	$ 4,126,251	**15%**
Discount stores	$ 318,560	$ 1,437,776	$ 374,792	$ 2,131,128	**8%**
Small hardware stores	$ 804,383	$ 205,813	$ 163,522	$ 1,173,718	**4%**
Other store types	523,957	$ 99,122	$ 33,520	$ 656,599	**2%**
Program Buydown Total Dollars	**$ 14,384,621**	**$ 10,785,125**	**$ 3,199,824**	**$ 28,369,570**	
% of Total Dollars	51%	38%	11%		**100%**

The participating lighting manufacturers reserved incentive funds by submitting a Reservation Request Form along with supporting documentation (retailer purchase orders, information on the timing of the promotions, etc.) for each retailer/chain that had ordered eligible products. If all the paperwork was in order, the utilities would send the manufacturer a Notification of Allocation Form that specified the reserved quantity of lighting products and incentive funds. The utilities could grant reservations for lighting product quantities and incentive amounts that were less or more than what the manufacturer had requested.

The utilities required retail sales data from certain retailers before paying the incentives to the manufacturers. In these cases, the sales data would have to correspond to the shipping data of the invoice before the utility could reimburse the manufacturer. Payment of the financial incentives was contingent on timely product shipment (per the time period listed on the Notification of Allocation Form) and proper documentation of product promotion as discussed in the next section. Other prerequisites for incentive payment included a signed

Notification of Allocation form, invoices in a utility-specified format, lists of pre-incentive and post-incentive retail prices, copies of proof of delivery (freight documentation, signed affidavits of shipments), disbursement lists for retailers with central distribution facilities, and proof of performance documents (such as photos of product displays).

Lighting Point-of-Sale

Point-of-sale (POS) incentives only accounted for a small percentage of 2004/2005 Program incentives. Only 8 percent of the low-wattage CFLs incentives were POS incentives and all of these were from a single retailer. While POS incentives represented approximately half of the Program incentives for specialty CFL incentives, POS incentives represented about 20 percent of the CF fixtures and torchiere incentives. Table 3-5 shows a breakdown of spending for POS incentives through the Upstream Lighting component of the 2004/2005 SFEER Program. PG&E and SCE both provided POS incentives for lighting measures in 2004/2005. PG&E accounted for more than 90 percent of POS incentives, and the vast majority of POS incentives moved through general merchandise/big box stores. Large home improvement stores, local hardware stores, and other store types also offered POS incentives for lighting during the 2004/2005 period.

Table 3-5: Program POS Incentives for Lighting by Utility, 2004/2005

Store Type	IOU		All IOUs	
	PG&E	SCE	Total POS Dollars	% of Total POS Dollars
General merchandise/big box	$ 2,525,620	$ 172,330	**$ 2,697,950**	**96%**
Large home improvement	$ 105,100	$ 14,565	**$ 119,665**	**4%**
Grocery stores	-	-	**-**	**0%**
Drug stores	-	-	**-**	**0%**
Discount stores	-	-	**-**	**0%**
Local hardware stores	$ 300	-	**300**	**<1%**
Other store types	$ 2,016	-	**2,016**	**<1%**
Program POS Total Dollars	**$ 2,633,036**	**$ 186,895**	**$ 2,819,931**	
% of Total Dollars	93%	7%		**100%**

3.3 Overview of 2004/2005 Marketing Activities

3.3.1 *Utility Marketing Efforts*

The IOUs provided information about the 2004/2005 SFEER Program to consumers using a number of methods including bill inserts, direct mail, newspaper and radio advertising, email blasts, community events, and information from their web sites and phone centers. The IOUs also coordinated with market actors including manufacturers, distributors, retailers, contractors, and others to further their outreach efforts. These marketing and outreach efforts varied somewhat by utility and included the following:

- Coordination with manufacturers through wholesale cost buy-downs to increase supply of lower cost energy-efficient products in the marketplace (e.g., for energy-efficient lighting products as described above).
- Coordinated efforts with retailers to expand the POS incentive mechanism for a number of measures including appliances as well as pool pumps and motors. Many of the point of sale agreements between the IOUs and retailers included marketing materials to assist the retailers in advertising promotional products.
- Coordination with water agencies to co-promote rebates available from the IOUs and water agencies for energy- and water-efficient clothes washers. Marketing efforts included links to and from respective web sites, co-branded bill inserts, and co-branded point of purchase materials.
- A toll-free 1-800 phone line for retailers for retailers to request applications, point-of-purchase materials or any other Program support collateral.
- Measure-specific marketing materials targeted to particular customer segments (e.g., pool pump rebate information to swimming pool owners).

3.3.2 *Supplier Marketing Efforts*

The Program also mandated certain promotional efforts by suppliers. For example, the manufacturers receiving buydown incentives through the Upstream Lighting component of the SFEER Program were each required to conduct at least promotional activity annually. Allowable activities included print/radio/TV advertising, retail circulars, promotional display space, additional signage, and Point of Purchase (POP) material with other activities approved on a case-by-case basis. All promotional materials had to prominently feature both the ENERGY STAR logo and the logos of the applicable participating utility. Stickers provided by the utilities also had to be placed on all products and all signage had to be program-compliant. The promotional activity had to emphasize that the utilities had provided a specific dollar amount discount and that the discount is included in the customer's final purchase price. The manufacturers were responsible for all promotional costs except the costs of the stickers.

Marketing was not as big a focus of the 2004/2005 SFEER Program as it had been in past years (as a result of the continued focus on spending Program funds on incentives versus other expenses). For example, PG&E had a program marketing budget of $1.472 million but only spent 25 percent of this by the end of 2004. In 2005, PG&E shifted $500,000 of its unspent marketing funds to instead pay rebates or to cover direct implementation costs. By the end of 2005 PG&E had only spent 41 percent of its original marketing budget.

One consequence of these cuts in the marketing budget was less utility oversight of retailer marketing efforts. For example, in 2003 PG&E conducted 620 retailer site visits to check Program awareness, participation, signage, and product stocking. However, PG&E marketing staff indicated that in 2004/2005, there was no budget for such extensive site visits.

Despite the shift in focus for Program budget, some of the utilities did engage in limited inspection activities. For example, SCE hired an inspector who visited the retailers three times a year to ensure that the stores were being adequately stocked with Program rebate forms and marketing materials and to replenish any Program materials that were running low. As part of these visits, the inspectors might ask the store managers whether they were promoting the Program and what the Program could do to make their participation easier.

SDG&E, which has a much smaller service territory than the other California IOUs, used its own internal staff to do retailer visits. They made efforts to visit each retailer at least quarterly to deliver application forms and point-of-purchase signs and to talk to the associates on the sales floor.

3.3.3 *Statewide Marketing Efforts*

The Flex Your Power (FYP) advertising campaign continued to market the SFEER Program statewide during the 2004/2005 period. Initiated in 2001, FYP is the statewide energy efficiency marketing and outreach campaign. The campaign is a partnership of California's utilities, residents, businesses, institutions, government agencies, and nonprofit organizations designed to educate Californians on the energy, financial, and environmental benefits of energy efficiency and to support the energy-efficiency programs of the IOUs, third-party program providers, and other organizations. The campaign does so through a full range of marketing and outreach strategies including general-market television, radio (English and Spanish language), and newspaper ads (general market and ethnic advertisements). The campaign also ran advertising in trade journals and magazines, and produced printed educational materials, a website, an electronic newsletter, and cooperative marketing and outreach efforts with businesses, government, and nonprofit organizations.[22, 23] Advertising messages emphasized the benefits of energy efficiency and energy-efficient purchase options, and reinforced attitudes toward future purchases of energy-efficient products and services.[24]

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22 Efficiency Partnership, 2007. "About Flex Your Power" from http://www.fypower.org/about/.

23 2006-2008 Energy-Efficiency Program Description: "SCE2554 Statewide Marketing & Outreach - Flex Your Power." Online at http://www.californiaenergyefficiency.com/sce/2554.pdf.

24 McGuire, W. (Flex Your Power), 2007. Personal Communication. June 26, 2007.

Specific FYP marketing efforts during 2004/2005 include the following:

- **Television ads**. FYP produced five television spots during 2004/2005. Each spot was designed to increase awareness of the benefits of using energy-efficient appliances. The advertisements contained energy efficiency messages and, when appropriate, water efficiency and demand response messages. For instance, in 2004 Flex Your Power incorporated a water efficiency message during Water Awareness Month and around Earth Day (April-May) to leverage the outreach and marketing efforts of water agencies and to highlight the fact that saving water also saves energy. Television advertisements ran in the top five California markets (Los Angeles, Sacramento, San Diego, San Francisco, and Fresno) where more than 90 percent of the California population resides.
- **Radio ads**, consisting of:
  - **General market.** FYP produced nine radio spots during the 2004/2005 period. Most spots were designed to increase awareness of the benefits of using energy-efficient appliances and were utilized to reach all markets in California.
  - **Hispanic radio**. FYP produced five Hispanic radio spots during 2004/2005.
  - **Traffic report sponsorships.** FYP produced a natural gas message that ran in late 2005 via radio traffic report sponsorship. The spot informed Californians of the benefits of purchasing an energy-efficient furnace and was run in conjunction with a newspaper ad.
- **Print advertising**, consisting of:
  - **General market.** Print advertising, primarily newspaper ads, was utilized to reach both the top five markets described above as well as remaining markets. Numerous ads were produced in 2004/2005 and five included multiple regional versions.
    - In 2004, FYP ran print ads that supported energy-efficient appliance sales through home improvement retailers. FYP recruited retailers statewide that sell energy-efficient appliances, products, and lighting, and asked for commitments to train sales staff and distribute FYP materials. In exchange, FYP listed the names of participating retailers in newspaper ads highlighting the benefits of energy-efficient equipment.
    - Separately, in the fall of 2005, a print ad focused on controlling natural gas bills was also developed in response to higher-than-usual winter gas prices.
- **Ethnic markets.** FYP worked with New California Media (NCM) to identify publications that represented California's diverse ethnic population to plan for both 2004/2005 marketing. In partnership with NCM, FYP hosted ethnic publication gatherings throughout the state to solicit ideas from ethnic publishers about ways to reach their communities with energy efficiency messages. Numerous ads were translated into 12 languages (including Arabic, Armenian, Khmer, Chinese, Farsi, Japanese, Korean, Spanish, Portuguese, Russian, Thai and Vietnamese), targeting 16 ethnicities and ran in 86 papers.

- **Ads in trade publications.** FYP ran several ads in publications to specifically target certain audiences (e.g., home builders).
- **Events.** During 2004/2005 FYP held numerous events promoting energy-efficient products including Earth Day events, energy-efficient appliance promotions, appliance recycling days, and other events.
- **Internet.** FYP reports that the campaign collected, inputted, and continually updated all 2004/2005 programs (rebates, incentives, technical assistance, etc.) offered by IOU, third parties, municipal utilities, and water agencies in the searchable "Rebates, Grants and Loans" and "Audits, Classes and Services" sections of the FYP website. FYP staff report that they contacted energy-efficiency program providers regularly to keep program information up-to-date.

Flex Your Power added demand response messaging during the two hot summers of 2004 and 2005 as requested by the Administration, IOUs and CPUC. The Flex Your Power Now! campaign educates residents, businesses, and local governments about the key peak load-shifting and peak conservation measures to take to prevent Stage 1 Electrical Emergencies by issuing Flex Alerts notifying Californians to immediately reduce electricity use during critical periods. Using media, websites, and email notifications, FYP issued eight Flex Alerts in 2004 and 10 more were issued in 2005.[25]

Prior to 2004, the Flex Your Power campaign timed its appliance and lighting advertisements to correspond with seasonal spring appliance promotions, and timed lighting promotions in the fall to be compatible with national promotions (e.g., ENERGY STAR Cool Change for ACs, Change a Light for CFLs) and with in-state promotions for energy efficiency measures. With the creation of the Flex Action Network in 2004, Flex Your Power shifted the timing of its promotional efforts. In the past, the campaign could purchase separate blocks of advertising time in the spring and fall. Issuance of Flex Alerts involves little lead time, and short-notice advertising during the summer months is prohibitively expensive. For this reason, the campaign purchased a block of summer advertising time during which it normally runs messages regarding lighting, appliances, and cooling equipment, but these messages can be easily and inexpensively swapped with Flex Alert messaging if required. Instead of running spring and fall advertisements, the majority of Flex Your Power advertising is conducted during the summer months. Flex Your Power staff report that while the campaign timing has changed, the messaging has not.[26]

In 2006, the FYP campaign incorporated the former *Reach for the Stars* marketing campaign – which targets rural IOU customers – into the Flex Your Power Rural Program. The *Reach*

[25] Efficiency Partnership, 2007. "Historic Flex Alert Records" from http://www.flexyourpower.org/now/now_events.html.

[26] McGuire, W. (Flex Your Power), 2007.

for the Stars campaign kicked off in 2003 increase awareness of energy-efficient products and the IOUs' energy-efficiency programs among English and Spanish speakers, forming relationships with community-based organizations (CBOs) and local media outlets and leveraging these relationships to reach its target audience.

The *Reach for the Stars* campaign's 2004 accomplishments include the following:

- Outreach to more than 100 CBOs and state organizations in recruitment of 15 grassroots organizations as partners.
- Generation of more than 85 million advertising impressions via radio.
- Outreach through ads in newspapers that had a total readership of almost 52 million.
- Outreach to more than 1.5 million Hispanic rural California residents throughout the state through media relations activities and radio and print partnerships.
- Dissemination of more than 111,000 pieces of collateral, including informational brochures and branding items at conferences, fairs, and community events in rural areas statewide.[27]

The 2006 FYP Rural Program has an overall statewide budget of approximately $7,500,000. The Program will continue to focus its implementation strategy on reaching out to rural customers through partnerships with CBOs, other organizations, and local governments.

3.4 Program Goals and Accomplishments

3.4.1 *Energy Savings*

For the 2004/2005 Program years, the Single Family Energy Efficiency Rebate (SFEER) Program set performance targets for the Program in terms of net energy and demand savings. As shown in Table 3-6, statewide, the Program claimed to have met 99 percent of its net kWh target, 96 percent of its net kW target, and 126 percent of its net Therm target for non-lighting measures through the Home Energy Efficiency Rebate (HEER) component of the Program.

The Upstream Lighting component of the Program also claimed to have surpassed their goals for net kWh and kW savings (146% and 144%, respectively), as shown in Table 3-7.

[27] 2006-2008 Energy-Efficiency Program Description: "SCE2556 Statewide Marketing & Outreach - Flex Your Power Rural Program." Online at http://www.californiaenergyefficiency.com/sce/2556.pdf.

Table 3-6: Summary of Non-Lighting Targets and Reported Accomplishments[28]

Utility	CPUC Target	Reported	% Target Reached
PG&E			
Energy Savings, kWh	29,247,331	27,517,928	94%
Demand Reduction, kW	39,601	35,408	89%
Therms Reduction	6,241,916	7,988,191	128%
SCE			
Energy Savings, kWh	18,542,292	18,797,016	101%
Demand Reduction, kW	13,605	14,479	106%
Therms Reduction	-	-	-
SDG&E			
Energy Savings, kWh	6,231,347	5,446,196	87%
Demand Reduction, kW	2,016	2,748	136%
Therms Reduction	718,664	885,496	123%
SCG			
Energy Savings, kWh	10,766,576	12,123,998	113%
Demand Reduction, kW	4,250	4,365	103%
Therms Reduction	4,736,076	5,863,508	124%
Statewide			
Energy Savings, kWh	64,787,547	63,885,137	99%
Demand Reduction, kW	59,471	57,001	96%
Therms Reduction	11,696,656	14,737,196	126%

Table 3-7: Summary of Lighting Targets and Reported Accomplishments[29][30]

Utility	CPUC Target	Reported	% Target Reached
PG&E			
Energy Savings, kWh	374,130,548	530,996,021	142%
Demand Reduction, kW	44,877	61,951	138%
SCE			
Energy Savings, kWh	56,276,399	87,304,537	155%
Demand Reduction, kW	8,388	12,305	147%
SDG&E			
Energy Savings, kWh	56,293,962	93,926,426	167%
Demand Reduction, kW	8,631	14,598	169%
Statewide			
Energy Savings, kWh	486,700,909	712,226,983	146%
Demand Reduction, kW	61,896	88,855	144%

[28] PG&E *Residential Summary Database*, SCE *Annual Energy Efficiency Reports* (May 2005/May 2006), SDG&E and SCG *December 2005 Statewide Residential Single Family Rebate Workbooks*.

[29] This includes savings from Public Good Charge (PGC) funded lighting rebates only.

[30] PG&E, SDG&E, SCG and SCE, *December 2005 Narrative Reports for the 2004-2005 Statewide Residential Single Family Rebates Program*.

3.4.2 *Program Budget*

The investor-owned utilities (IOUs) reported expending all of their Program funds in 2004/2005, as shown in Table 3-8.

Table 3-8: Program Budgets and Expenditures[31]

Utility	Program Budget	Program Expenditures	% of Budget Spent
PG&E	$47,840,000	$47,681,000	100%
SCE	$7,256,874	$8,646,268	119%
SDG&E	$5,223,957	$7,361,820	141%
SCG	$8,368,900	$8,349,885	100%
Statewide	$68,689,730	$72,038,973	105%

3.4.3 *HTR Goals*

For non-lighting measures in the HEER component of the Program, each IOU had targets to reach with regard to the proportion of total Program participants who are considered hard-to-reach (HTR). For the HEER component of the SFEER Program, hard-to-reach customers were defined as those who meet the HTR criteria described above in Section 3.1 of this chapter. As shown in Table 3-9, three of the four utilities reported exceeding their HTR targets for the non-lighting measures. Only SDG&E, with the most challenging HTR goal (60 percent of Program participants were expected to be HTR), reported meeting its target exactly.

All of the utilities reported greatly exceeding the target set for the lighting measures, as shown in Table 3-10.

Table 3-9: Non-Lighting Hard-to-Reach Goals and Reported Accomplishments[32]

Utility	HTR Target	Reported
PG&E	35%	36%
SCE	34%	41%
SDG&E	60%	60%
SCG	23%	28%

[31] PG&E, SDG&E, SCG and SCE, *December 2005 Narrative Reports for the 2004-2005 Statewide Residential Single Family Rebates Program.*

[32] PG&E, SDG&E, SCG and SCE, *December 2005 Narrative Reports for the 2004-2005 Statewide Residential Single Family Rebates Program.*

Table 3-10: Lighting Hard-to-Reach Goals and Reported Accomplishments[33]

Utility	HTR Target	Reported
PG&E		
HTR Areas	15%	24%
Food and drug	10%	56%
SCE		
HTR Areas	15%	48%
Food and drug	10%	36%
SDG&E		
HTR Areas	15%	16%
Food and drug	10%	107%

3.4.4 *Reported Accomplishments by Technology*

Table 3-11 below shows Program reported participation by technology in terms of number of units, rebate dollars, and energy savings. Three measures – pool pumps, programmable thermostats, and dual pane windows – make up 60 percent of kWh savings statewide. Programmable thermostats were the leading measure in terms of kWh (34%) and Therm (36%) savings, but accounted for less than five percent of rebate dollars. On the gas side, programmable thermostats and clothes washers made up almost 70 percent of all Therm savings statewide.

PG&E led the IOUs in total kWh and Therm savings with 43 percent of statewide kWh and 54 percent of Therm savings. Programmable thermostats accounted for the majority of kWh savings in PG&E territory. As in previous years, clothes washers and programmable thermostats helped PG&E lead the Program in Therm savings.

[33] PG&E, SDG&E, SCG and SCE, *December 2005 Narrative Reports for the 2004-2005 Statewide Residential Single Family Rebates Program*.

Table 3-11: Reported Non-lighting Participation by Technology[34]

Utility	Technology	Rebated Units	Rebate Dollars	Rebate Pct of Program
PG&E	Central Air Conditioners	9,631	$3,313,625	8.23%
	Central Heat Pumps	499	$147,225	0.37%
	Room AC	995	$49,750	0.12%
	Insulation (square feet)	12,923,370	$1,933,039	4.80%
	Clothes Washer - Energy Star	89,582	$8,259,103	20.50%
	Dishwasher - Energy Star	53,134	$2,256,145	5.60%
	Furnace - Gas	15,186	$3,036,000	7.54%
	Pool Pumps	4,372	$657,393	1.63%
	Programmable Thermostats	46,066	$804,173	2.00%
	Water Heater	9,016	$246,856	0.61%
	Whole House Evaporative Cooler	153	$49,235	0.12%
	Whole House Fan	1,188	$118,665	0.29%
	Windows - High Perf. Dual Pane (square feet)	3,805,603	$2,796,716	6.94%
	TOTAL		$23,667,925	58.75%
SCE	Central Air Conditioners	5,161	$1,653,275	4.10%
	Central Heat Pumps	281	$82,250	0.20%
	Room AC	2,450	$122,500	0.30%
	Insulation (square feet)	8,692	$1,304	0.00%
	Pool Pumps	5,576	$741,275	1.84%
	Programmable Thermostats	25,461	$387,680	0.96%
	Water Heater	75	$2,670	0.01%
	Whole House Evaporative Cooler	1,230	$389,600	0.97%
	Whole House Fan	2,226	$222,600	0.55%
	Windows - High Perf. Dual Pane (square feet)	408,938	$408,938	1.02%
	TOTAL		$4,012,092	9.96%
SCG	Insulation (square feet)	12,109,812	$1,816,472	4.51%
	Clothes Washer - Energy Star	49,640	$4,111,840	10.21%
	Dishwasher - Energy Star	30,312	$1,234,040	3.06%
	Furnace - Gas	4,417	$883,400	2.19%
	Programmable Thermostats	30,965	$537,360	1.33%
	Water Heater	6,024	$214,270	0.53%
	TOTAL		$8,797,382	21.84%
SDG&E	Central Air Conditioners	932	$248,050	0.62%
	Central Heat Pumps	92	$31,575	0.08%
	Room AC	597	$29,850	0.07%
	Insulation (square feet)	868,008	$130,201	0.32%
	Clothes Washer - Energy Star	13,319	$1,474,615	3.66%
	Dishwasher - Energy Star	9,994	$367,400	0.91%
	Furnace - Gas	515	$103,000	0.26%
	Pool Pumps	480	$62,975	0.16%
	Programmable Thermostats	4,355	$87,100	0.22%
	Water Heater	308	$12,320	0.03%
	Whole House Evaporative Cooler	8	$2,400	0.01%
	Whole House Fan	1,380	$138,000	0.34%
	Windows - High Perf. Dual Pane (square feet)	1,180,251	$1,118,176	2.78%
	TOTAL		$3,805,662	9.45%
STATEWIDE	Central Air Conditioners	15,724	$5,214,950	12.95%
	Central Heat Pumps	872	$261,050	0.65%
	Room AC	4,042	$202,100	0.50%
	Insulation (square feet)	25,909,882	$3,881,016	9.63%
	Clothes Washer - Energy Star	152,541	$13,845,558	34.37%
	Dishwasher - Energy Star	93,440	$3,857,585	9.58%
	Furnace - Gas	20,118	$4,022,400	9.99%
	Pool Pumps	10,428	$1,461,643	3.63%
	Programmable Thermostats	106,847	$1,816,313	4.51%
	Water Heater	15,423	$476,116	1.18%
	Whole House Evaporative Cooler	1,391	$441,235	1.10%
	Whole House Fan	4,794	$479,265	1.19%
	Windows - High Perf. Dual Pane (square feet)	5,394,792	$4,323,830	10.73%
	TOTAL		$40,283,061	100.00%

[34] PG&E *Residential Summary Database*, SCE *Annual Energy Efficiency Reports* (May 2005/May 2006), SDG&E and SCG *December 2005 Statewide Residential Single Family Rebate Workbooks*.

Table 3-11: (continued) Reported Non-lighting Energy Savings by Technology

		Net Energy Savings		Net Energy Savings	
Utility	Technology	kWh	Pct of Program	Therms	Pct of Program
PG&E	Air Conditioners	2,773,599	4.34%	-	0.00%
	Heat Pumps	275,096	0.43%	-	0.00%
	Room AC	101,092	0.16%	-	0.00%
	Insulation (square feet)	1,344,030	2.10%	516,935	3.51%
	Clothes Washer - Energy Star	3,321,050	5.20%	2,843,865	19.30%
	Dishwasher - Energy Star	2,210,374	3.46%	680,115	4.61%
	Furnace - Gas	-	0.00%	572,573	3.89%
	Pool Pumps	3,848,482	6.02%	-	0.00%
	Programmable Thermostats	9,095,922	14.24%	2,488,835	16.89%
	Water Heater	46,092	0.07%	97,115	0.66%
	Whole House Evaporative Cooler	154,790	0.24%	-	0.00%
	Whole House Fan	438,281	0.69%	-	0.00%
	Windows - High Perf. Dual Pane (square feet)	3,909,120	6.12%	788,754	5.35%
	TOTAL	27,517,928	43.07%	7,988,191	54.20%
SCE	Air Conditioners	2,180,077	3.41%		
	Heat Pumps	151,013	0.24%		
	Room AC	248,920	0.39%		
	Insulation (square feet)	250	0.00%		
	Pool Pumps	6,193,037	9.69%		
	Programmable Thermostats	6,501,464	10.18%		
	Water Heater	11,414	0.02%		
	Whole House Evaporative Cooler	2,034,669	3.18%		
	Whole House Fan	1,024,249	1.60%		
	Windows - High Perf. Dual Pane (square feet)	451,923	0.71%		
	TOTAL	18,797,016	29.42%	-	0.00%
SCG	Insulation (square feet)	4,379,655	6.86%	1,176,233	7.98%
	Clothes Washer - Energy Star	1,831,430	2.87%	1,558,125	10.57%
	Dishwasher - Energy Star	1,260,979	1.97%	387,994	2.63%
	Furnace - Gas	-	0.00%	127,777	0.87%
	Programmable Thermostats	4,651,934	7.28%	2,543,682	17.26%
	Water Heater	-	0.00%	69,698	0.47%
	TOTAL	12,123,998	18.98%	5,863,508	39.79%
SDG&E	Air Conditioners	300,682	0.47%	-	0.00%
	Heat Pumps	49,487	0.08%	-	0.00%
	Room AC	60,655	0.09%	-	0.00%
	Insulation (square feet)	27,495	0.04%	50,530	0.34%
	Clothes Washer - Energy Star	495,142	0.78%	425,559	2.89%
	Dishwasher - Energy Star	415,750	0.65%	127,923	0.87%
	Furnace - Gas	-	0.00%	10,542	0.07%
	Pool Pumps	772,743	1.21%	-	0.00%
	Programmable Thermostats	1,328,676	2.08%	267,441	1.81%
	Water Heater	3,028	0.00%	3,501	0.02%
	Whole House Evaporative Cooler	3,348	0.01%	-	0.00%
	Whole House Fan	520,757	0.82%	-	0.00%
	Windows - High Perf. Dual Pane (square feet)	1,468,433	2.30%	-	0.00%
	TOTAL	5,446,196	8.52%	885,496	6.01%
STATEWIDE	Air Conditioners	5,254,358	8.22%	-	0.00%
	Heat Pumps	475,595	0.74%	-	0.00%
	Room AC	410,667	0.64%	-	0.00%
	Insulation (square feet)	5,751,430	9.00%	1,743,698	11.83%
	Clothes Washer - Energy Star	5,647,622	8.84%	4,827,549	32.76%
	Dishwasher - Energy Star	3,887,104	6.08%	1,196,032	8.12%
	Furnace - Gas	-	0.00%	710,892	4.82%
	Pool Pumps	10,814,262	16.93%	-	0.00%
	Programmable Thermostats	21,577,995	33.78%	5,299,957	35.96%
	Water Heater - Gas	60,534	0.09%	170,314	1.16%
	Whole House Evaporative Cooler	2,192,806	3.43%	-	0.00%
	Whole House Fan	1,983,287	3.10%	-	0.00%
	Windows - High Perf. Dual Pane (square feet)	5,829,475	9.12%	788,754	5.35%
	TOTAL	63,885,137	100.00%	14,737,196	100.00%

Table 3-12 shows the Program reported participation by technology in terms of number of units, rebate dollars and energy savings for the Upstream Lighting component of the Program. PG&E led the IOUs in total kWh savings with 75 percent of statewide savings.

Table 3-12: Reported Lighting Participation and Energy Savings by Technology[35] [36]

Utility	Technology	Rebated Units	Rebate		Net Energy Savings	
			Dollars	Pct of Program	kWh	Pct of Program
PG&E	ENERGY STAR® (ES) CFL 450 to 799 Lumens	425,678	$425,678	1.84%	10,758,793	1.51%
	ES CFL 800 to 1,099 Lumens	2,079,976	$3,122,388	13.53%	98,357,494	13.82%
	ES CFL 1,100 to 2,599 Lumens	5,690,158	$11,380,316	49.32%	379,838,483	53.36%
	ES CFL 2,600 Lumens or Greater	13,824	$34,560	0.15%	1,525,838	0.21%
	ES Int./ or Ext. Fixture Less Than 1,100 Lumens	1,902	$10,110	0.04%	108,852	0.02%
	ES Int./ or Ext. Fixture 1,100 Lumens or Greater	197,255 #	$1,947,850	8.44% #	38,474,488	5.41%
	ES Torchiere < 65 Watt	1,640 #	$16,400	0.07% #	226,268	0.03%
	ES Torchiere > 65 Watt	12,777	$127,770	0.55%	1,566,971	0.22%
	TOTAL	8,423,210	$17,065,072	73.95%	530,857,187	74.58%
SCE	ENERGY STAR® (ES) CFL 450 to 799 Lumens	26,507	$26,507	0.11%	731,720	0.10%
	ES CFL 800 to 1,099 Lumens	410,334	$615,501	2.67%	19,498,569	2.74%
	ES CFL 1,100 to 2,599 Lumens	792,890	$1,585,780	6.87%	55,636,344	7.82%
	ES CFL 2,600 Lumens or Greater	-	-	0.00%	-	0.00%
	ES Int./ or Ext. Fixture Less Than 1,100 Lumens	1,089	$5,445	0.02%	41,196	0.01%
	ES Int./ or Ext. Fixture 1,100 Lumens or Greater	57,468	$574,680	2.49%	11,073,068	1.56%
	ES Torchiere < 65 Watt	300	$3,000	0.01%	41,407	0.01%
	ES Torchiere > 65 Watt	-	-	0.00%	-	0.00%
	TOTAL	1,288,588	$2,810,913	12.18%	87,022,304	12.23%
SDG&E	ENERGY STAR® (ES) CFL 450 to 799 Lumens	14,330	$14,330	0.06%	234,416	0.03%
	ES CFL 800 to 1,099 Lumens	285,980	$428,970	1.86%	13,386,279	1.88%
	ES CFL 1,100 to 2,599 Lumens	1,359,422	$2,718,844	11.78%	79,656,615	11.19%
	ES CFL 2,600 Lumens or Greater	-	-	0.00%	-	0.00%
	ES Int./ or Ext. Fixture Less Than 1,100 Lumens	-	-	0.00%	-	0.00%
	ES Int./ or Ext. Fixture 1,100 Lumens or Greater	3,768	$37,680	0.16%	649,115	0.09%
	ES Torchiere < 65 Watt	-	-	0.00%	-	0.00%
	ES Torchiere > 65 Watt	-	-	0.00%	-	0.00%
	TOTAL	1,663,500	$3,199,824	13.87%	93,926,426	13.20%
STATEWIDE	ENERGY STAR® (ES) CFL 450 to 799 Lumens	466,515	$466,515	2.02%	11,724,929	1.65%
	ES CFL 800 to 1,099 Lumens	2,776,290	$4,166,859	18.06%	131,242,342	18.44%
	ES CFL 1,100 to 2,599 Lumens	7,842,470	$15,684,940	67.97%	515,131,442	72.37%
	ES CFL 2,600 Lumens or Greater	13,824	$34,560	0.15%	1,525,838	0.21%
	ES Int./ or Ext. Fixture Less Than 1,100 Lumens	2,991	$15,555	0.07%	150,048	0.02%
	ES Int./ or Ext. Fixture 1,100 Lumens or Greater	258,491	$2,560,210	11.09%	50,196,671	7.05%
	ES Torchiere < 65 Watt	1,940	$19,400	0.08%	267,675	0.04%
	ES Torchiere > 65 Watt	12,777	$127,770	0.55%	1,566,971	0.22%
	TOTAL	11,375,298	$23,075,809	100.00%	711,805,916	100.00%

[35] This includes savings from Public Good Charge (PGC) funded lighting rebates only.

[36] PG&E *Residential Summary Database*, SCE *Annual Energy Efficiency Reports* (May 2005/May 2006), SDG&E and SCG *December 2005 Statewide Residential Single Family Rebate Workbooks*.

4

Lighting Market Characterization

This chapter of the report provides extensive background on compact fluorescent lamp (CFL) and fixture products and market structure, a summary of participating supplier perspectives on the market, and an overview of consumer familiarity with and use of CFL products. The evaluators obtained information for this chapter from a combination of primary and secondary data sources. The key primary data sources include the General Population Telephone Survey (n = 1,000) and Lighting Onsite Survey (n=100). Secondary sources include the ENERGY STAR® website,[37] other websites devoted to energy-efficient lighting,[38] and the California Residential Market Share Tracking: Lamps 2005 Report (Itron 2006).

Lighting market characterization information is organized as follows:

1. The **Product and Market Background** section provides detailed, technical information about the wide range of compact fluorescent products currently available, including bulbs, hard-wired indoor fixtures, and hard-wired exterior fixtures. Next, a description of CFL product market structure is provided, including distribution and retail sales of CFL products, and CFL market share information is presented. This section closes with a summary of recent efforts to improve CFL product quality.
2. The **Participating Supplier Summary** presents the findings from interviews of lighting manufacturers and retailers participating in the Single-Family Rebate (SFEER) Program as they relate to the structure, dynamics, trends, and standard practices of the California CFL products market.[39]
3. The **Consumer Summary** provides an overview of consumer awareness and purchase rates for CFLs and compact fluorescent (CF) fixtures as well as CFL disposition, satisfaction, barriers, and future CFL purchase intentions.

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[37] www.energystar.gov

[38] Namely, the National Lighting Product Information Program website (www.lrc.rpi.edu) and the U.S. Department of Energy's Energy Efficiency and Renewable Energy website (www.eere.energy.gov).

[39] "Participating suppliers" are defined as those who sold or installed equipment for which incentives were provided through the 2004/2005 SFEER Program.

4.1 Product and Market Background

4.1.1 *ENERGY STAR Qualification*

Energy-efficiency criteria for CFLs are based on input wattage, lamp efficacy (lumens per watt), lumen maintenance, and average rated lifetime. To qualify for ENERGY STAR, CFLs must have a minimum rated lifetime of 6,000 hours or greater; the current average rated lifetime for ENERGY STAR CFLs is 8,000 hours. ENERGY STAR CFLs use, on average, 66 percent less energy than a standard incandescent bulb and can last up to 10 years longer (based on using a 10,000 hour rated product a minimum of 3 hours/day). ENERGY STAR CFLs must also comply with specific power and operating requirements and meet federal safety guidelines.[40]

4.1.2 *Detailed CFL Product Information*

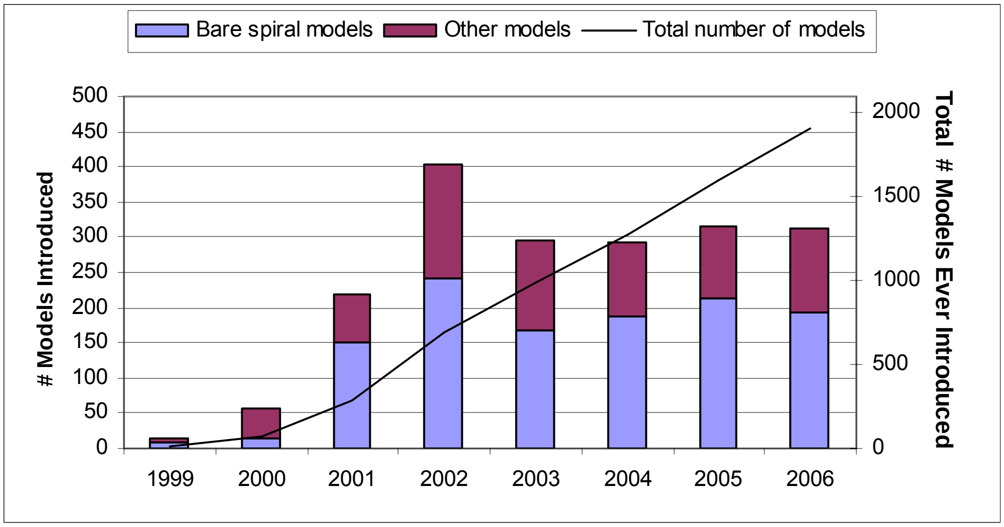
The following information regarding ENERGY STAR CFL products reflects ENERGY STAR products that qualified by the end of 2006.

Compact Fluorescent Light Bulbs

The Upstream Lighting component of the SFEER Program promotes ENERGY STAR labeled CFLs. As of the end of 2006, the ENERGY STAR website listed a total of 1,818 ENERGY STAR qualified CFL models produced by 117 manufacturers around the world. Figure 4-1 illustrates the number of ENERGY STAR qualified CFL models on the market since 1999 by model type. While bare spiral (also known as twister) type bulbs are the most common models of bulbs produced (including mini-spiral bulbs), the number of other model types produced has increased significantly.

[40] http://www.energystar.gov/index.cfm?c=cfls.pr_crit_cfls

Figure 4-1: ENERGY STAR CFLs by Model Type, 1999-2006



Source: www.energystar.gov
Note: Models retired from company product lines are included in this figure but not in any other figures or tables in this section of the report.

Table 4-1 shows the ten companies that produce the largest number of ENERGY STAR qualified CFL models. Combined, these companies produce 41 percent of models available. Less than 15 percent of the CFLs made in 2006 were produced by the three largest multi-product lighting manufacturers (Osram Sylvania, GE, and Philips). Several of the top CFL producers are active only (or primarily) in the energy-efficient lighting market.

Table 4-1: Top 10 ENERGY STAR CFL Model Producers, 2006

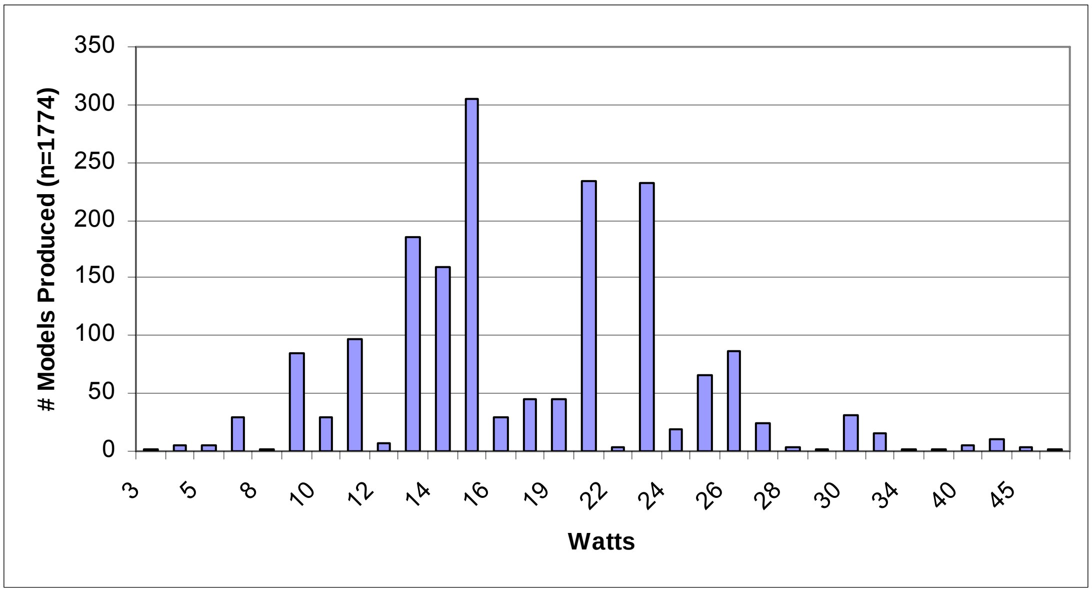
Company	# Models Produced	% Models Produced
Technical Consumer Products, Inc.	104	6%
Osram Sylvania Inc.	102	6%
Feit Electric	87	5%
Xiamen Topstar Lighting Co., Ltd.	77	4%
The Home Depot	74	4%
GE Consumer & Industrial	73	4%
Fujian Joinluck Electronic Enterprise Co., Ltd.	63	3%
Westinghouse Lighting Corporation	53	3%
Greenlite Lighting Corporation	52	3%
Philips Lighting Company	52	3%
Total	**737**	**41%**

Source: www.energystar.gov

CFL Size Information

ENERGY STAR CFL wattages range from 3 to 52 Watts. Figure 4-2 details the number of CFL models currently being manufactured by CFL wattage category. Seventy percent of the qualified models are between 13 and 23 Watts.

Figure 4-2: ENERGY STAR CFL Models by Bulb Wattage, 2006



Source: www.energystar.gov

Only a few CFL models have more than one brightness level; 27 manufacturers produce 16 models of qualified three-way bulbs. The 11/20/26, 12/19/28 and 13/20/25 wattage categories are the most popular three-way bulb types respectively, comprising 49 percent of qualified three-way models produced.

CFL Styles

As shown above in Table 4-1, bare spiral and mini-spiral (also known as twister and mini-twister) CFL models are the most common styles of ENERGY STAR qualified CFLs, representing more than 60 percent of the total models produced in 2006. However, today there is a wide variety of qualified CFL models on the market. Table 4-2 lists the styles of qualified CFL models available in order from most to least commonly produced.

Table 4-2: ENERGY STAR CFL Model Styles, 2006

CFL Model Style	# Models Produced	% Models Produced
Bare-spiral (twister)	655	36%
Bare-Mini-Spiral (mini-twister)	476	26%
Covered reflector	236	13%
Covered A-line	135	7%
Covered globe	114	6%
Bare-Triple Tube	96	5%
Other*	106	6%
Total	**1,818**	**100%**

* "Other" model types include covered bullet, bare-quadruple tube, bare-twin tube, covered-candle, bare-circuline, and covered-post, each of which represents less than 5 percent of ENERGY STAR CFL models produced in 2006.

Source: www.energystar.gov

CFLs come in many sizes and shapes to fit different fixture types. The size, color, and surface area of the tube(s) determine the amount of light produced. CFLs can have either a plug-in base or a screw-in base. The following CFL types are currently available:

- **Plug-In Base:** There are 2-pin and 4-pin ballasts available. One to three twin tubes can be connected to the ballasts. Most CFLs with plug-in bases are sold either within ENERGY STAR CF fixtures or as replacement bulbs for such fixtures.
- **Screw-In Base:** The CFL market consists of mostly screw-based bulbs. Most of the screw-in bulbs fit into medium bases. CFLs are connected to magnetic or electronic ballasts for starting and circuit protection. Integral CFLs have the tubes and ballast permanently connected. Modular CFL designs have separate tubes and ballasts; this allows replacement of tubes without changing the ballast. Screw-in CFLs come in six common shapes plus a myriad of covered shapes.
  - *Twin-tube* CFLs have two small parallel tubes. They are designed to fit into lamps, task lights, recessed ceiling lights and wall lights.
  - *Quad-tube* bulbs are only half the length of twin-tube CFLs but give nearly as much light. They may fit better in smaller lamps and similar applications.
  - *F-lamps* have two twin tubes like a quad tube but instead of being aligned top to bottom, they are aligned from side to side. They are used for task lights and low-profile recessed fixtures.
  - *Triple-tube* CFLs generate even more light in shorter bulbs. They pack high light output into a very small space and can be used in fixtures designed for incandescent bulbs, such as table lamps.
  - *Circular Lamps, also called "Circlines,"* are mainly designed as reading lamps. Some brands give the cool white light of a typical fluorescent while others have electronic ballasts and give warm light.

  - *Coiled/spiral tubes* are the most common CFL type. Spirals have a continuous tube in a spiral shape that has similar outside shape and light-casting qualities to a standard incandescent bulb.
  - *Square* CFLs are pretzel-shaped tubes that resemble two back-to-back Ds. The flat profile fits well into wall-mounted fixtures, sleek floor fixtures, and recessed downlights.
  - *Envelope or covered shapes* are encapsulated in glass tubes that look similar to conventional incandescent light bulbs, such as A-line, globe, candle, or reflector.
- **Sub-CFLs:** Sub-CFLs belong to a new generation of screw-in CFLs. They are smaller (as short as 4.5 inches), more compact, and even more energy-efficient than regular screw-in CFLs. They can fit most fixtures designed for incandescent lamps. These bulbs are also known as mini-CFLs.
- **Cold Cathode Fluorescent Lights (CCFLs):** Although there are now various linear lighting applications for CCFLs, miniature CCFLs have been used for years as backlights for computer LCD screens. CCFLs operate at a much higher voltage and lower current and have more than twice the life expectancy of conventional CFLs (partly because they operate at very low temperatures). They also do not suffer accelerated degradation with variations in supply voltage. Screw-in base CCFLs are easily dimmable, but are currently only available in very low wattages.

Hard-Wired Fixtures

Indoor Fixtures

The Upstream Lighting component of the SFEER Program is designed to promote a variety of ENERGY STAR-labeled residential lighting technologies, including hard-wired indoor lighting fixtures. As shown in Table 4-3, wall- and ceiling-mounted fixtures comprise about three-quarters of the qualified indoor fixture models produced.

Table 4-3: ENERGY STAR Qualified Hard-Wired Interior Fixture Models, 2006

Fixture Type	Frequency	% Models Produced
Wall-Mounted Lighting Fixture	3,072	37%
Ceiling-Mounted Lighting Fixture	3,039	36%
Suspended Lighting Fixture	1,271	15%
Portable Lighting Fixtures	252	3%
IC-Rated & Air-Tight Recessed Canister	235	3%
Recessed Canister	143	2%
Furniture/Cabinet Integrated	96	1%
Recessed Lighting Fixture	52	1%
Post Top Lighting Fixture	50	1%
Other*	119	1%
Total	**8,329**	**100%**

* "Other" styles include torchiere, undercabinet, IC-rated recessed canister, air-tight recessed canister, lamp/ballast platform fixture, and recessed troffer, each of which represent less than 1 percent of the total ENERGY STAR qualified hard-wired interior fixture models produced.

Source: www.energystar.gov

These fixtures fall into seven categories:

- **Architectural:** Many types of architectural light fixtures are found in family rooms and recreation rooms. These fixtures are commonly stocked in lighting stores and by electrical suppliers, and the use of T-8 fluorescent bulbs is recommended for these fixtures to provide the highest quality light with the lowest of energy use.
- **Ceiling-mounted Lighting:** Diffusers and track lighting are the most common in this lighting fixture category. These fixtures attach directly to the ceiling surface and are commonly used in entrance foyers, hallways, stairways, kitchens, basements, and garages. These products are typically available in home improvement and lighting stores and from electrical suppliers, and fit either compact or linear fluorescent bulbs.
- **Furniture/Cabinet Integrated Lighting:** Cabinet lighting is designed to provide task or accent lighting for specific uses, most commonly integrated into bathroom lighting systems. Lighting stores and electrical suppliers stock bulbs, sockets and fixtures, and some cabinet/furniture manufacturers also offer built-in fixtures as an option. Compact fluorescent bulbs and small-diameter T-5 and other linear fluorescent bulbs fit most fixtures.
- **Portable Lighting:** Portable lighting, such as a table lamp, is usually found in bedrooms and living rooms. One of the most common portable indoor lighting fixtures is the torchiere. ENERGY STAR-labeled torchieres operate at less than 100 °F and are recommended by the U.S. Department of Energy as a safer substitute for halogen lamps which burn at 1000 °F. Moreover, CFL torchieres offer the benefits of longer bulb life and lower operating costs.

- **Recessed Lighting:** Recessed light fixtures are most commonly found as troffers (with diffusing lenses), recessed circular downlights, wall-wash downlights, or accent lights. Troffers are commonly used in kitchens, whereas downlights and accent lights are commonly used in family rooms, living rooms, and recreation rooms. These fixtures can be purchased from home-improvement stores, lighting stores, and electrical suppliers. Linear and U-shaped fluorescent bulbs work well in troffers, and compact fluorescent bulbs are available for downlight applications.
- **Suspended Lighting:** Some of the more common types of suspended lighting fixtures include downlights, uplights, uplights/downlights, chandeliers, and ceiling fan light fixtures. Dining rooms and entrance hallways commonly use chandeliers, whereas ceiling fans can be found in almost any room in the house. Other styles of suspended fixtures can be found in kitchens and recreation rooms. Suspended light fixtures can be found in home-improvement stores, lighting stores, and from electrical suppliers. Some department stores stock a variety of suspended light fixtures as well. Many, but not all, suspended light fixtures can use compact fluorescent bulbs.
- **Wall-mounted Lighting:** Common wall-mounted light fixtures include sconces, diffusers, vanity lights, and track lights. Wall-mounted fixtures can be used in any room in a house, while sconces and diffusers are commonly used in hallways, bedrooms, and family rooms. Track lighting is most often found in family rooms, recreation rooms, and sometimes kitchens. Vanity lights are found in bathrooms. These fixtures can be purchased from home-improvement stores, lighting stores, and electrical suppliers and can utilize either linear or compact fluorescent bulbs.

Table 4-4 shows the ten companies that produce the largest number of ENERGY STAR indoor CF fixture models. All together these companies produce two-thirds of models available. In all 68 manufacturers produce 8,329 qualified indoor fixtures.

Table 4-4: Top 10 ENERGY STAR Indoor Fixture Model Producers, 2006

Company	# Models Produced	% Total Models Produced
ASL Energy Efficient Lighting	1,692	20%
VIVA Company Ltd.	943	11%
American Fluorescent Corp.	836	10%
Sea Gull Lighting Products	392	5%
Lithonia Lighting	365	4%
Access Lighting	356	4%
Lightway Industries	317	4%
Light Process Company	286	3%
Brownlee Lighting	220	3%
LaMar Lighting Company	209	3%
Total	**5,616**	**67%**

Source: www.energystar.gov

Outdoor Fixtures

In addition to interior lighting fixtures, the Upstream Lighting component of the 2004/2005 SFEER Program promoted a variety of ENERGY STAR-labeled exterior lighting products. The outdoor lighting section of the ENERGY STAR website describes a number of different uses and features associated with hard-wired exterior lighting fixtures. These fixtures can utilize either fluorescent or high-intensity discharge lighting technology.

There are 27 manufacturers producing 1,173 different models of ENERGY STAR hard-wired exterior lighting fixtures. Table 4-5 shows the ten companies that produce the largest number of qualified indoor CF fixture models. Combined, these companies produce 85 percent of models available. These manufacturers include some of the same top manufactures in the indoor fixture market as well as others.

Table 4-5: Top 10 ENERGY STAR Outdoor Fixture Model Producers, 2006

Company	# Models Produced	% Total Models Produced
Light Process Company	187	16%
ASL Energy Efficient Lighting	181	15%
Xing Nan Lighting Co., Ltd.	171	15%
Cooper Lighting	88	8%
Maxim Lighting International	88	8%
Minka Group	80	7%
Sea Gull Lighting Products LLC	63	5%
DESA Specialty Products	54	5%
Thomas Lighting	44	4%
Inter-Global Inc.	38	3%
Total	**994**	**85%**

Source: www.energystar.gov

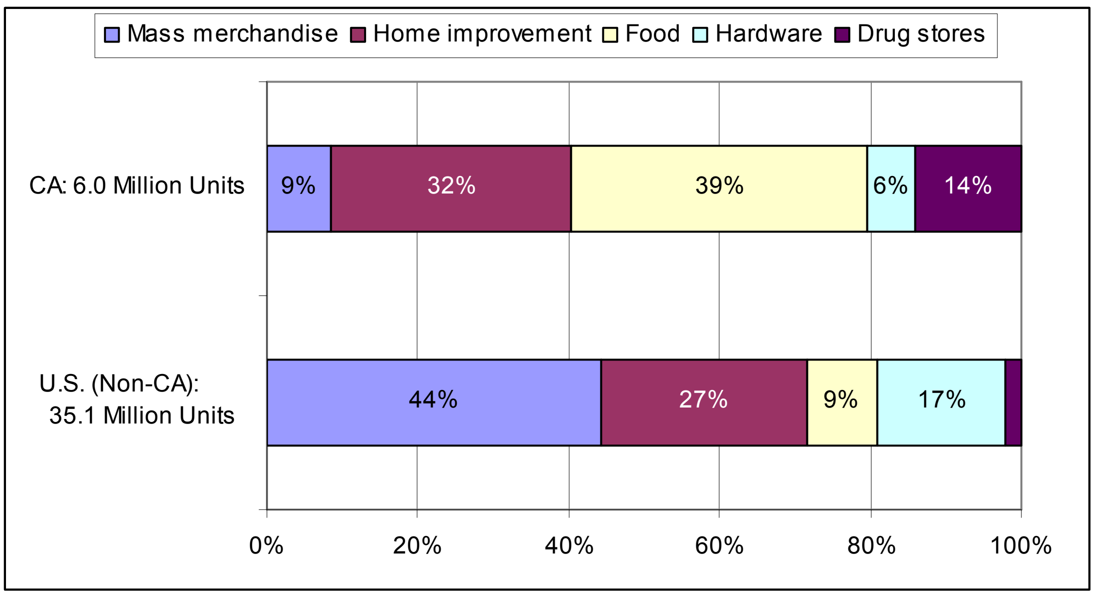
4.1.3 *CFL Product Market Structure*

<u>Distribution Channels</u>

CFL product distribution channels differ primarily depending on whether the product is hard-wired or freestanding/portable (replaceable by CFLs or energy-efficient torchieres). Most hard-wired lighting products are installed when the home is built or renovated, and usually by a construction contractor. However, end users do replace some existing hard-wired fixtures and install new ones over the life of a home. Freestanding lighting equipment, on the other hand, is usually purchased exclusively by owner-occupants from retail outlets such as home center chains, mass merchant chains, or independent stores.[41]

According to the 2005 California Residential Efficiency Market Share Tracking (RMST) study for lighting,[42] hardware stores and home improvement centers account for a larger percentage of lamp sales in the U.S. overall than in California. Correspondingly, sales through mass merchandisers account for a smaller percentage of lamp sales in California than they do nationally (see Figure 4-3). It is important to note that the data on CFL sales from the Tracking Report *do not include sales through the major retail chain Costco*, which accounted for approximately 10 percent of sales through the Upstream Lighting component of the 2004/2005 SFEER Program.

Figure 4-3: Medium Screw-Based CFL Sales by Market Channel, 2005



Source: Itron Inc, 2006. Note that the data reflected in this Figure do not include Costco sales.

CFLs

According to the latest data available from the RMST report, the total market for CFLs in the U.S. is steadily increasing. Between 1999 and 2005, residential sales of medium screw-based CFLs increased at a rate of 38 percent for the U.S. overall and 39 percent in California (Figure 4-4). CFL market share has also increased in California and the U.S. since 1999

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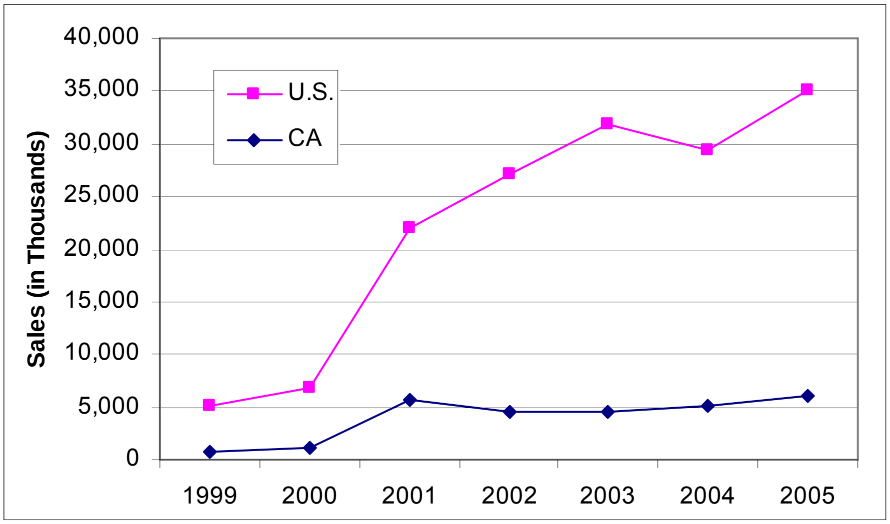
[41] KEMA-XENERGY, Inc. 1999, "Phase 1 Baseline Assessment for the Statewide Residential Lighting and Appliance Program," prepared for San Diego Gas and Electric Company.

[42] Itron, 2006. "California Residential Efficiency Market Share Tracking: Lamps 2005." Prepared for Southern California Edison. May 15, 2006.

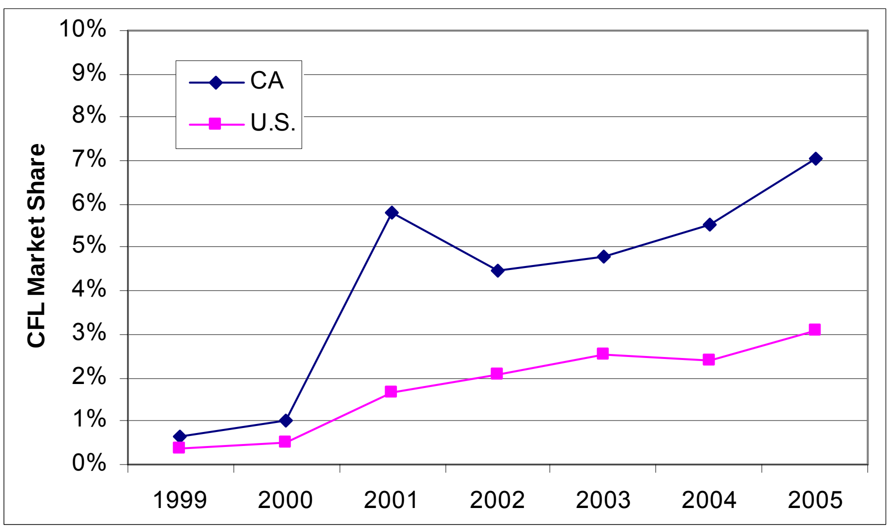
though, as illustrated in Figure 4-5, the 2005 market share in CA (6.4%) was more than double that in the U.S. overall (2.7%).[43] Again, note that these data exclude Costco sales.

Figure 4-4: Total Residential Sales of Medium Screw-Based CFLs in the U.S. and CA, 2000-2005



Source: Itron, Inc., 2006. Note that the data reflected in this Figure do not include Costco sales.

Figure 4-5: CFL Market Share for Medium Screw-Based Bulbs in the U.S. and CA, 2000-2005



Source: Itron, Inc., 2006. Note that the data reflected in this Figure do not include Costco sales.

43 Based on retail point-of-sale data; see Itron's "California Residential Efficiency Market Share Tracking: Lamps 2005" for more details.

4.1.4 *CFL Product Quality*

CFL product quality continues to be a concern for both suppliers and consumers. Problems with bulb performance hindered the adoption of earlier CFL models and may have created some long-standing customer prejudices against the technology. As discussed later in this chapter (Section 4.2.2), some of the lighting manufacturers interviewed in support of this Study expressed concerns that price competition may encourage the use of cheaper components for CFLs, ultimately leading to degradation of product quality.

The California IOUs have supported national efforts to improve CFL quality for several years by serving as members of the board for the Program for the Evaluation and Analysis of Residential Lighting (PEARL), discussed below. Additionally, the SFEER Program promotes only ENERGY STAR CF products, which have high quality standards established by the U.S. Department of Energy and Environmental Protection Agency.

Product quality can encompass many bulb characteristics. ENERGY STAR bulbs are required to meet performance standards covering lifespan, lumen maintenance, efficacy (lumens per Watt), color rendering (ability of the bulb to show colors realistically), color temperature (how “cool” or “warm” the light appears), startup times, run-up time (how long for bulb to reach full brightness), and other requirements.

There is some evidence that CFL quality has been improving in recent years. PEARL tests CFLs to determine whether they meet the specifications of the federal ENERGY STAR program. PEARL is a watchdog program. It was created in response to complaints received by utility program managers about the performance of certain ENERGY STAR® lighting products being promoted within their service territories and the lack of a self-policing mechanism within the lighting industry that would ensure the reliability of these products and their compliance with ENERGY STAR specifications. To remedy these problems, PEARL purchases and tests products available to the consumer in the marketplace.

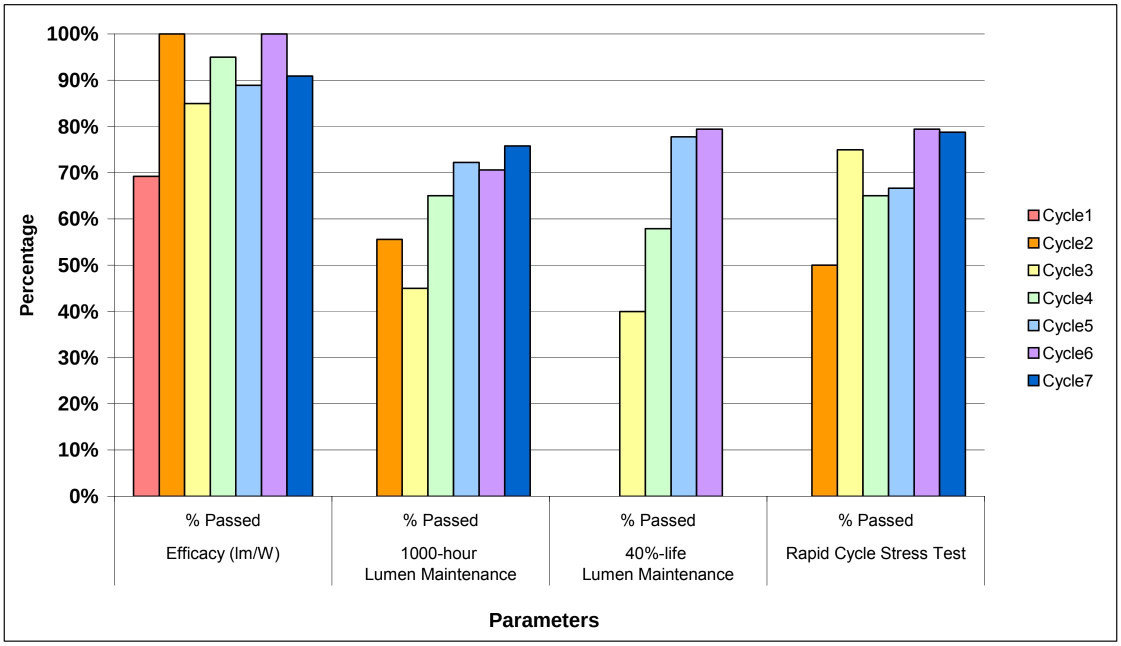
Utilities, energy efficiency advocates, and market transformation organizations that focus on residential lighting products and are part of the ENERGY STAR program created PEARL in the year 2000. The Lighting Research Center (LRC) at Rensselaer Polytechnic Institute administers the program and runs the PEARL testing laboratory, which is on site. The LRC tests products against current ENERGY STAR specifications with the exception of product lifetime (which the Center tests only to 40% of rated lifetime). PEARL does not have the authority to disqualify or de-list products from ENERGY STAR, but does provide the test results to PEARL sponsors, who then pass them on to the EPA and DOE. Relevant manufacturers also get copies of the testing results. The PEARL website reports that the Program has tested 156 CFL models and 52 fixture models as of June, 2007.[44]

The LRC tests approximately 25 to 30 models during each PEARL testing cycle and normally conducts two testing cycles per year. PEARL sponsors nominate the products to be tested, which generally include the biggest sellers, products about which sponsors have heard anecdotal problems, new or unproven products, and product types that have generally been found to have quality problems in the past. The Program attempts to purchase products from multiple lots and does so by enlisting sponsor agencies and partners to assist in purchasing the products from various locations around the country. Test results are reported to ENERGY STAR program managers who decide whether a given model should be de-listed as an ENERGY STAR product.

To date, PEARL has completed 7 testing cycles for CFLs. Figure 4-6 shows that in general, compliance with PEARL's testing requirements has increased since the first cycle of testing was completed in 2000. However, there is some concern with the performance of reflector or covered CFLs (as opposed to bare bulbs such as spiral-style CFLs). Figure 4-7 shows that covered bulbs have not performed as well in the PEARL testing as bare CFLs. One possible explanation is that covered bulbs tend to trap more heat than bare bulbs, which can reduce performance over time. They also represent a newer technology than the bare bulbs, so manufacturers have had less time to address issues with product quality.

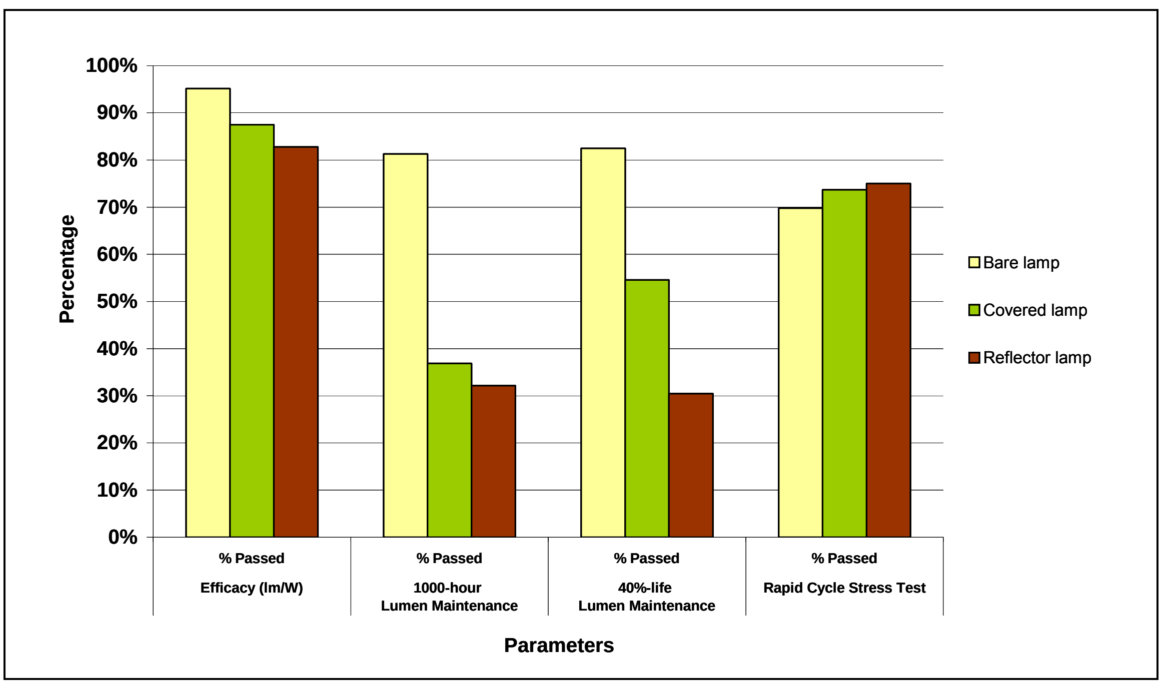
[44] http://www.lrc.rpi.edu/programs/PEARL/index.asp

Figure 4-6: Percentage of Compliance with ENERGY STAR Specification for All CFLS Tested by PEARL by Testing Cycle



Data source: PEARL. Personal communication with Noah Horowitz, 2007.

Figure 4-7: Percentage of Compliance with ENERGY STAR Specification for all CFLs Tested by PEARL by Lamp Type



Data source: PEARL. Personal communication with Noah Horowitz, 2007.

It is also important to note that both the PEARL tests as well as the tests required to qualify for ENERGY STAR have their limitations in preventing low-quality CFLs from reaching the market. PEARL only samples a very small percentage of the ENERGY STAR CFLs sold in the United States and does not test non-ENERGY STAR CFLs. It is also unclear how well the PEARL testing results represent the overall quality of CFLs since the models that PEARL chooses for testing are not randomly determined. To initially qualify their bulbs for ENERGY STAR status, all of the lighting manufacturers use hand-selected samples and many even use their own lighting laboratories. Changes in the factories or components used to produce a given CFL model may result in situations in which a consumer purchases a CFL model of lesser quality than the bulb tested to meet the ENERGY STAR specifications for that model.

There is currently a proposal to replace PEARL with a testing program administered by the U.S. Department of Energy. This new program is based on a “pay-to-play” format in which ENERGY STAR partners will pay to have up to six of their CFL models tested each year. This new testing process is expected to start in 2008.

4.2 Participating Supplier Summary

This section summarizes the findings from interviews of lighting manufacturers and retailers participating in the Upstream Lighting component of the 2004/2005 SFEER Program as they relate to the structure, dynamics, trends, and standard practices of the California CFL products market. It is based on interviews conducted in late 2006 and early 2007 with 14 lighting manufacturers and 23 lighting retailers that participated in the Program. The section covers the following topics:

- Relating participant findings to a market characterization;
- The structure and dynamics of the California CFL market;
- Retail distribution channels for CFLs;
- Promotion and training activities;
- Trends in the residential energy-efficient lighting market; and
- Supply and demand barriers.

“Participating suppliers” are defined as those who sold or installed equipment for which incentives had been provided by the HEER component of the SFEER Program during the 2004/2005 period.

4.2.1 *Relating Participant Findings to a Market Characterization*

Because the interviews only covered participating lighting manufacturers and retailers, a fair question is, "To what degree are these participant findings representative of all manufacturers or retailers selling CFL products in California?" The answer differs for lighting manufacturers and retailers.

- *Manufacturers.* The evaluators believe the participating manufacturer findings are fairly representative of all lighting manufacturers who are currently selling CFL products in California. The lighting manufacturers participating in the 2004/2005 Program represent the vast majority of lighting manufacturers selling CFL products in California. In fact, interviews with California lighting experts indicated that only one major lighting manufacturer selling CFL products in the state was not participating in the Program during this time period. Furthermore the evaluators were able to complete interviews with most of the larger lighting manufacturers who participated in the Program. Of the 15 lighting manufacturers who received the largest proportion of incentives through the 2004/2005 Program (out of a total of 27 participating manufacturers), the evaluation team completed interviews with 13 of these.
- *Retailers.* The evaluators do not believe that the participating retailer findings are representative of the California lighting retailer population as a whole. Although only one major lighting manufacturer selling CFL products in the state did not participate in the 2004/2005 SFEER Program, there were a number of major lighting retailers that did not participate. In addition, although the SFEER Program is starting to make important progress in getting CFL products into grocery, drug, discount, and small hardware stores, these types of lighting retailers are still likely underrepresented in the participating lighting retailer population compared to the California lighting retailer population as a whole.

For these reasons, more emphasis will be placed on the lighting manufacturer responses in characterizing the California CFL market.

4.2.2 *The Structure and Dynamics of the California CFL Market*

The lighting manufacturers were asked to characterize the current market for CFL products in California in terms of competitive structure. There was general agreement that the CFL market has three tiers of suppliers in terms of market presence. The top tier includes the "Big Three" lighting manufacturers – General Electric, Phillips, and Osram Sylvania. The middle tier includes medium- to large-sized manufacturers such as Feit Electric, Maxlite, Greenlite, Lights of America and TCP Industries. The bottom tier includes smaller manufacturers such as American Top Lighting, Broada, Duralamp, Sunpark Electronics, and Surya Roshni. The top tier manufacturers all produce incandescent bulbs while those in the middle and bottom tiers do not.

The California CF fixture and torchiere market has a different structure than the California CFL market. One group of manufacturers includes larger CFL makers such as "The Big Three" companies, Lights of America, Feit Electric, and TCP Industries. However, there is also a second group that includes companies that specialize in CF fixtures and torchieres rather than CFLs. This group includes companies such as Lithonia Lighting, Sea Gull, The Designer's Edge, and Good Earth Lighting.

In terms of competitive dynamics, a number of established lighting manufacturers claimed that low-cost CFL producers were getting increased penetration in the California lighting market. They pointed to the SFEER Program and other rebate programs as playing key roles in this trend by giving these manufacturers legitimacy and easier access to retailers. These claims are discussed in more detail in Chapter 5.

Some of these established manufacturers saw these new companies not only as low-cost producers but also as low-quality producers. "Unfortunately California promotes … the cheapest CFLs – instead of quality," one established manufacturer complained. Another established lighting manufacturer raised similar quality concerns when asked about the future trend of CFL prices:

> *I'm sure [the future CFL price] will go down more as low-end manufacturers still get involved and drive down that price for lower-quality products. That's just the nature of the business. It's going to happen. I really think that with ENERGY STAR and maybe something new that they put in place for the quality of CFLs would help that tremendously. Help all the way around with the erosion in quality. … I'm hoping that somebody interferes there and helps control the market a little bit more in terms of what's thrown out there.*

Still another manufacturer thought that this emphasis on price over quality could have long-term negative repercussions for the CFL market:

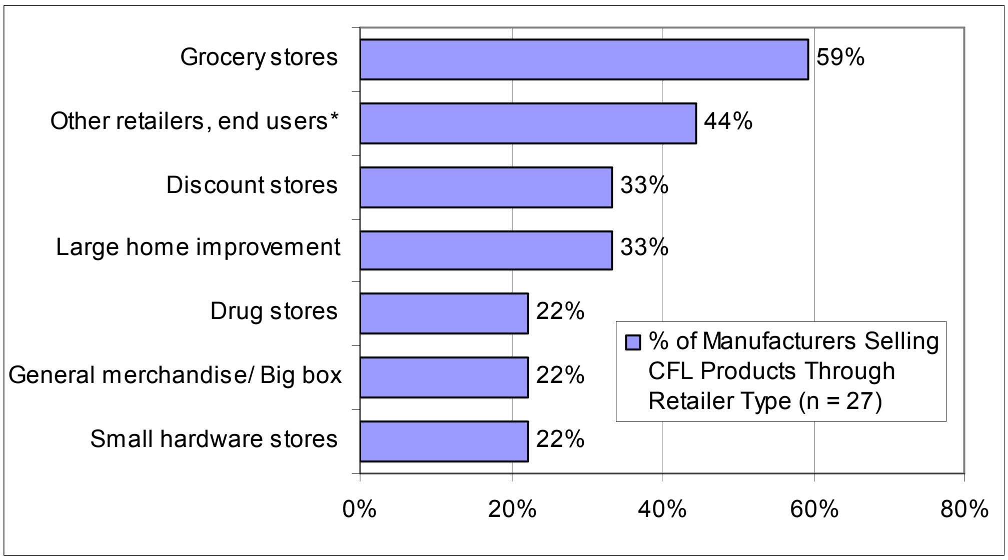
> *In order to survive, manufacturers will resort to means that may ultimately cause end-user rejection of CFL use. Most manufacturers are starting to use low-cost components which may translate to questionable reliability. In the end, many reputable manufacturers will have to get out of this market and leave it open to whomever can sell the units at the cheapest price.*

4.2.3 *Retail Distribution Channels for CFLs*

The evaluators examined Program tracking data to determine what types of retailers the lighting manufacturers used in 2004/2005 to distribute the CFL products receiving Program rebates. Figure 4-8 shows that almost two-thirds of the manufacturers were using grocery stores as a distribution channel.

However, while the grocery store was the common denominator for most of the manufacturers, there was greater differentiation among manufacturers for other retailer categories. For example, there was very little overlap between manufacturers who sold to discount stores and those who sold to big box or large home improvement stores. Of the nine lighting manufacturers who sold to discount stores, only two of these manufacturers also sold to big box stores or large home improvement stores.

Figure 4-8: Retail Distribution Channels for 2004/2005 SFEER Program Rebates

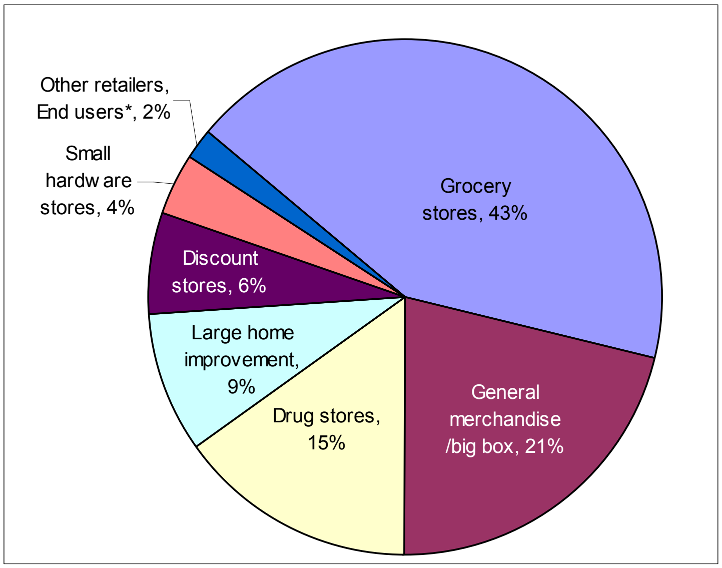


* Includes lighting stores, electronics stores, and CFL products distributed through promotions with non-profits or communities.
Data sources: 2004/2005 SFEER Program tracking databases.

The evaluators asked the lighting manufacturers why they had chosen those types of retailers to participate in the Program. Those who worked with the big box, large home improvement, or grocery stores said that they had chosen these retailer types due to anticipated sales volume and number of retail locations. “Everybody buys bulbs at Costco,” one manufacturer commented, “and [customers] buy bulbs in grocery stores when needed.” A few of the smaller manufacturers said that they have had difficulty winning business from the big box stores. For this reason they pursued underserved retail sectors such as discount stores and ethnic or small chain grocery stores. One manufacturer sent out invitations to a broad range of retailers and simply signed up any retailers who expressed interest in joining the Program.

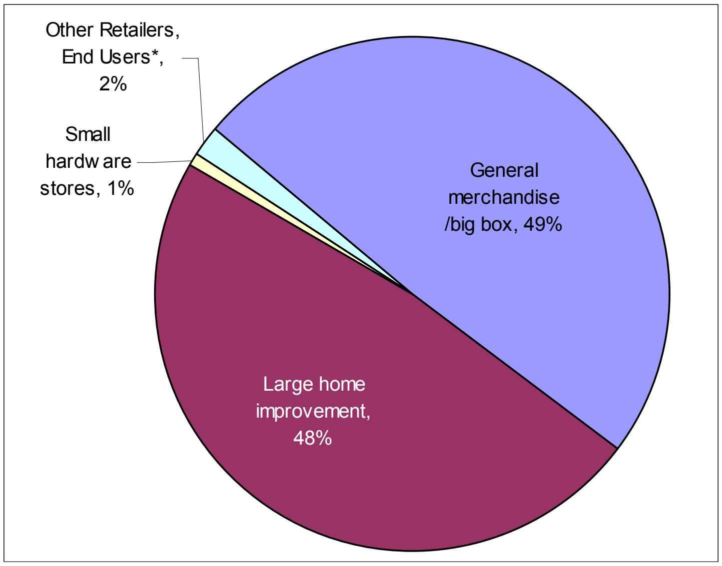
The retail distribution channels also differ significantly depending on which CF products were being rebated. Nearly half of the Program rebate dollars for low-wattage CFLs were for sales through grocery stores (Figure 4-9). Specialty CFLs are sold almost exclusively through general merchandise/big box or large home improvement stores (Figure 4-10). Two-thirds of the rebate dollars for CF fixtures were for sales through big box/general merchandise stores (Figure 4-11). The majority of CFL torchieres rebated through the Program were sold by retailers such as lighting or electronics stores (Figure 4-12).

Figure 4-9: Distribution of 2004/2005 Low-Wattage CFL Incentives by Retailer Type**



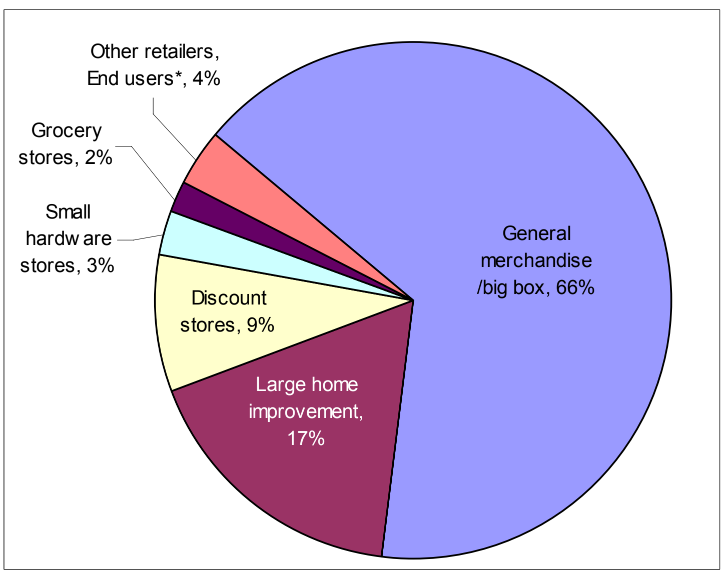
* Includes lighting stores, electronics stores, and CFL products distributed through promotions with non-profits or communities.
** Low-wattage CFLs are those that are less than 30 watts and do not have reflecting, dimming, or three-way capabilities.
Data source: 2004/2005 SFEER Program tracking databases.

Figure 4-10: Distribution of 2004/2005 Specialty CFL Incentives by Retailer Type**



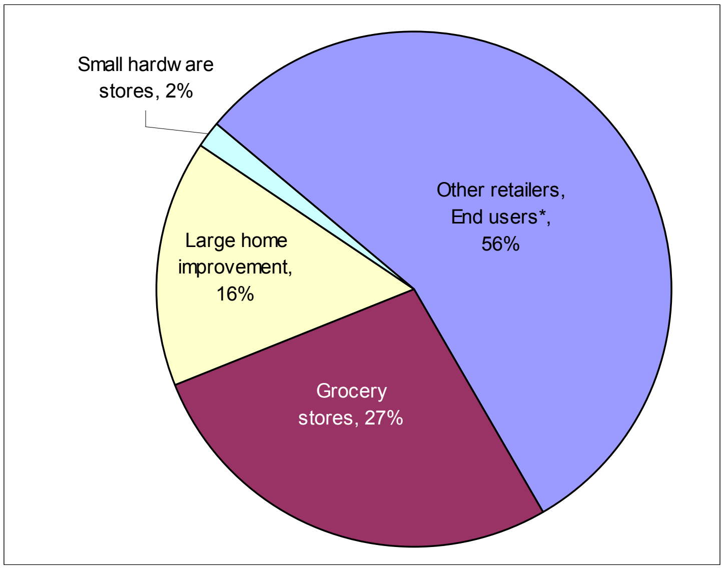
* Includes lighting stores, electronics stores, and CFL products distributed through promotions with non-profits or communities.
** Specialty CFLs include higher-wattage (>= 30 Watts) bulbs, reflectors, and dimmers.
Data source: 2004/2005 SFEER Program tracking databases.

Figure 4-11: Distribution of 2004/2005 CF Fixture Incentives by Retailer Type



* Includes lighting stores, electronics stores, and CFL products distributed through promotions with non-profits or communities.
Data source: 2004/2005 SFEER Program tracking databases.

Figure 4-12: Distribution of 2004/2005 CF Torchiere Incentives by Retailer Type



* Includes lighting stores, electronics stores, and CFL products distributed through promotions with non-profits or communities.
Data source: 2004/2005 SFEER Program tracking databases.

4.2.4 *Promotion and Training Activities*

Lighting retailers were asked how they market energy-efficient products, about sales staff training, and about sales staff incentives for selling energy-efficient products. Both large and small retailers tend to market energy-efficient products differently than they do standard products in general. Most large retailers do not dedicate time to training sales staff about energy-efficient products. If sales staff receive special performance incentive funds (SPIFs), they are almost never tied specifically to energy-efficient product sales.

When it comes to marketing energy-efficient products, some large retailers dedicate a lot of resources to moving these products off the shelf. One CEO, who claimed to have a well-educated sales staff, said his managers conduct trainings on energy-efficient products every week. He also said that all his stores advertisements feature energy-efficient products, and trained staff wear badges signifying their energy efficiency expertise. As mentioned above, these efforts are not common among large retailers.

Other large retailers were less dedicated to educating their staff about energy efficiency but indicated that they do use marketing to highlight the energy-efficient products they sell. For example, some stores tie product promotions to other rebate programs, some design special point-of-sale marketing for energy-efficient products, and it is standard practice among large retailers interviewed to feature energy-efficient products in advertisements. This may mean that the ENERGY STAR logo is embedded in the advertisement, or that energy and electric bill savings estimates are included in the ad. In terms of point-of-sale materials, some of the larger retailers said that they use whatever the lighting manufacturers provide to them.

Small drug, grocery, and hardware stores tend to move CFLs to prominent locations within their stores, such as an end cap or a front window, during the promotion period. Many of these stores run in-store or newspaper ads that feature the bulbs. One local grocery chain runs a special during the promotion period where customers are given a free CFL for every purchase of $20 or more. As will be discussed in Chapter 5, some of the lighting manufacturers are very involved with how these small retailers promote their CFL products within the stores.

4.2.5 *Trends in the Residential Energy-Efficient Lighting Market*

This subsection discusses lighting manufacturers' impressions of trends in the residential energy-efficient lighting market, including trends in product offerings, prices, and sales volumes.

Trends in Product Offerings

The lighting manufacturers were asked to identify which energy-efficient lighting products have been recent additions to their product line and which products they had recently discontinued. Table 4-6 shows the energy-efficient CFLs and CF fixtures that lighting manufacturers identified as a recent additions to their product lines. Different varieties of CFL globes were the most frequently cited type of new energy-efficient lamps.

Table 4-6: New Energy-Efficient Lighting Product Offerings

Lamps	Fixtures
CFL globes*	GU24 lighting fixtures
CFL reflector bulbs	CFL wall sconces
CFL BR40 and PAR38 flood lamps	New fixtures for T5 lamps
Low-Wattage (7W) CFLs	New fixtures for T8 lamps
LED lights for closets and other applications	

* Includes vanity globes, globes with invisible bases, and low-Wattage (9W) globes.

Only two of the 14 lighting manufacturers identified any product lines that they had recently discontinued. These discontinued products included low-wattage "A"-type CFLs, low-wattage (<15W) spiral CFLs, and two-piece 27W CFLs. One manufacturer said that the "A"-type CFLs had been discontinued because they were not bright enough for most applications and they were not meeting the 60 Watts per lumen standard. He also said that the lower-wattage spiral CFLs had been discontinued because they were simply not as popular as the higher-wattage spirals.

CFL Sales Trends

The evaluators asked the lighting manufacturers to describe their expectations of future CFL product sales. Twelve of the 13 lighting manufacturers expected their sales of CFL products to increase in the coming years. The one exception was a small lighting manufacturer that had been having trouble competing with large manufacturers who sell through big box stores. A few of the manufacturers provided estimates of the expected annual sales increases and these ranged from 10 to 30 percent. One manufacturer described the demand for compact fluorescent products as "insatiable" and another said that they expected to sell almost 3 million CFLs in 2007 compared to only 400,000 in 2006. One of the largest lighting manufacturers pointed to CFLs as the fastest growing segment of the lighting market.

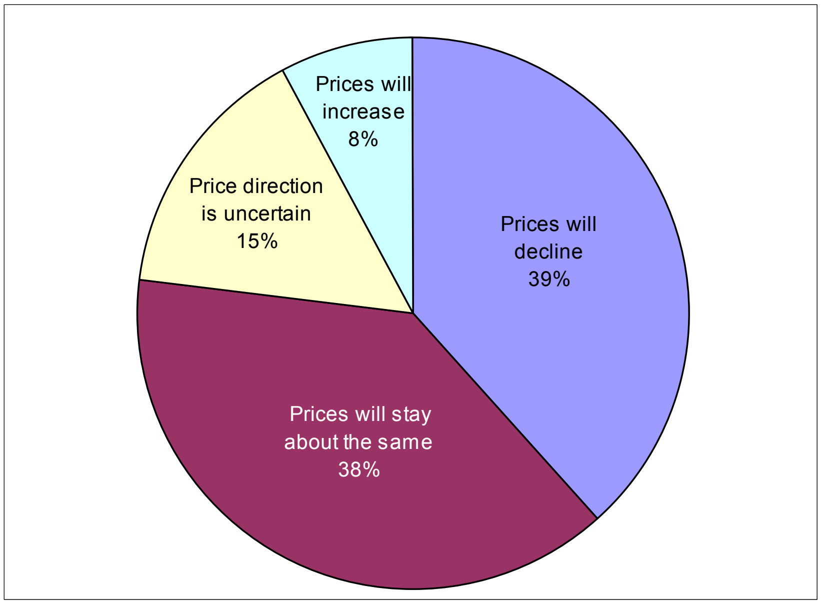
The lighting manufacturers pointed to greater awareness and acceptance of CFL technology by both customers and retailers as the primary drivers of this sales increase. However, they also pointed to factors that would restrain these sales increases: one was the limited number of rebates available through the SFEER Program, and another was the fact that CFLs last 6 to 10 times longer than incandescent bulbs (and thus require replacement less frequently than incandescent bulbs).

CFL Price Trends

Lighting manufacturers were asked about both the recent and future direction of CFL prices. There was broad agreement that CFL prices had dropped significantly in recent years – with some estimating the decline to be as much as 50 percent – yet there was no consensus on the future direction of CFL prices (although future declining prices or stable prices were the two most-cited opinions; see Figure 4-13).

While only one manufacturer definitely thinks that prices will increase, a couple of other manufacturers think this could happen under certain scenarios. One scenario for price increases would be if the currency exchange rate with China became even more unfavorable for American suppliers. Another scenario would be if CFL technology or production methods remained stagnant while production and shipping costs increased.

Figure 4-13: Future CFL Product Price Direction According to Lighting Manufacturers



n=13.

The lighting manufacturers cited a number of reasons for their price trend assessments. These included:

- Reasons for declining prices:
  - Continual improvements in technology;
  - Greater competitive pressures with low-cost manufacturers from China making greater inroads into the U.S. market;
  - Big box stores are setting lower target prices; and
  - Greater product demand leading to larger production economies of scale.
- Reasons for stable prices:
  - Higher currency, material, and shipping costs are being offset by innovations in technology and production methods;
  - CFL lamps can't be made as cheaply as incandescent lamps;
- Reasons for uncertain prices – influential but unknown variables include:
  - Future currency exchange rates with China;
  - Future program rebate levels; and
  - Future product quality standards – tougher standards will keep some low-end producers out of the market.
- Reasons for higher prices include:
  - Devaluation of the US dollar relative to Chinese currency;
  - Higher raw material costs;

- Higher labor costs; and
- Higher shipping costs primarily due to higher oil prices.

4.2.6 *Supply and Demand Barriers*

This subsection discusses recent and ongoing supply and demand barriers that suppliers face in selling CFL products, as well as supplier suggestions for mitigating some of these barriers. It also discusses lighting manufacturer attitudes towards CFL disposal issues.

Supply-side Barriers

The evaluators asked the lighting manufacturers about manufacturing, importing, or distributing problems that have restricted the production and supply of CFL products. Some of the recent and ongoing supply barriers they identified included:

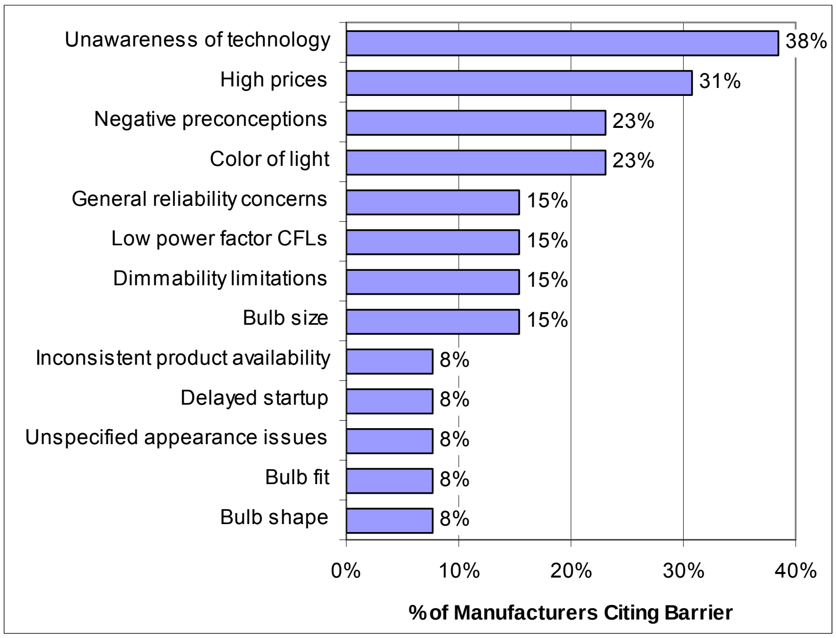
- Cuba recently outlawed incandescent bulbs and ordered 100 million CFLs (which made some production capacity unavailable for other markets);
- A shortage of capacitors in China (capacitors are electric circuit elements that store charge temporarily within the CFL);
- Shortages of silicon and phosphorous (phosphate powder is important for lumen maintenance and the glass tube structures of CFLs are made from silicon);
- Increases in the prices of copper, steel, and plastic;
- Higher currency exchange rates with China;
- Higher shipping costs due primarily to higher oil prices; and
- A CFL patent-infringement lawsuit by the Geo Foundation.

The last of these barriers – the Geo Foundation lawsuit – had a significant impact on the availability of rebates from the 2006 SFEER Program and thus on the California CFL market as a whole. It took months to devise legal language that would allow the Program to go forward while also indemnifying the utilities from the consequences of the lawsuit. The language required participating suppliers to either prove that they had an agreement with the Geo Foundation as a licensee or provide a letter from a certified patent attorney that their product did not violate the Geo Foundation's patents. Even when the Geo Foundation lost the lawsuit and the SFEER Program could proceed without these legal restrictions, it took suppliers time to deliver the necessary supply. All of the manufacturers have their production plants in China, most do not have large domestic inventories of bulbs, and deliveries from China normally take at least 60 days. As a result most of the suppliers were unable to put rebated bulbs on the shelf until September 2006.

Demand-side Barriers

The evaluators also asked the lighting manufacturers to identify the most important factors that are limiting customer demand for CFL products. All 13 of the respondents identified at least one demand-side barrier and most identified multiple barriers. Figure 4-14 shows that the lack of awareness of CFL technology, high prices, negative preconceptions of CFLs (likely due to experiences with first-generation CFL products), and dissatisfaction with CFL light color were the most frequently cited demand-side barriers.

Figure 4-14: CFL Demand-Side Barriers Identified by Lighting Manufacturers



n=13.

The lighting manufacturers were also asked if any progress had been made to reduce these CFL demand-side barriers. They acknowledged that progress had been made in mitigating most of these barriers – particularly the bulb size and price issues; although some bulb performance issues had been resolved (e.g., flickering), others remained difficult to overcome (e.g., delayed startup). In addition, some manufacturers claimed that product quality and reliability problems could re-emerge if current price pressures continue. For example, one manufacturer pointed to the increased use of cheaper electrolytic capacitors made in China instead of more expensive (higher-quality) capacitors made in Japan and said that this could compromise bulb reliability in the future.

Finally the manufacturers were asked what more could be done to overcome these demand-side barriers and what roles the utility programs could play in helping to mitigate these barriers. They mentioned four things they feel need to happen:

- *Continued technological improvement* – They noted that the industry was getting better at reproducing the light color of incandescent bulbs and that covered CFLs, reflectors, and other relatively new CFL products were helping to address the objections that some consumers had to conventional CFLs. One manufacturer believed that even greater CFL technological innovations would be available in about three years, but in the meantime CFL products still needed rebate support.
- *More marketing of the CFL technologies* – Manufacturers said that more marketing was needed to help overcome lingering consumer awareness barriers. Their recommendations included both mass marketing and in-store marketing such as point-of-purchase materials and in-store demonstrations. One manufacturer noted that many consumers are unaware that the aesthetics of CF fixtures have greatly improved.
- *Continued rebate support* – The manufacturers thought that the buy-down incentives were essential for helping to mitigate lingering price barriers. Those manufacturers who produced CF fixtures thought that more incentive dollars should be allocated to fixtures. One manufacturer noted that each participating retailer only gets a small amount of CF fixture incentive money and it runs out very fast. "Our opinion is for a switch of the funding more to the hard-wired type fixtures which make the use of CFLs a must," another manufacturer commented.
- *Revise Title 24 standards* – One manufacturer thought that California's new Title 24 building code was not encouraging the use of CF fixtures to the extent to which it was intended. First, he claimed that many builders have been installing the cheapest, least attractive CF fixtures just to comply with the code and "when the homeowner moved in, the first thing he would do is take that one down and put up a pretty incandescent one." Secondly, the manufacturer claimed that there were "loopholes" in the code that allowed builders to install incandescent fixtures with occupancy sensors in bathrooms and other rooms instead of installing fluorescent fixtures.

CFL Disposal Issues

The issue of how to dispose of CFLs has become more prominent in recent years. The typical CFL contains about 5 milligrams of mercury and as use of this technology grows, the danger of mercury contamination in landfills will be of increasing concern. Other states have already begun to address the issue: in July 2006, for example, Massachusetts adopted a mercury management law that requires lighting manufacturers to develop, implement, and market recycling programs for mercury-added product disposal, including CFLs. Manufacturers who fail to achieve the required recycling goals will be fined up to $1,000,000 per year of non-compliance. Money raised from these fines will be used as grants to municipalities or regional authorities to facilitate meeting recycling rates.

The evaluators asked the lighting manufacturers for their recommendations on how the issue of CFL disposal should be addressed. These recommendations included:

- *Government- or customer-directed recycling* – A number of manufacturers thought that product recycling was a promising option, but that the direction for these efforts should come from state or local governments, non-profits, or individual customers rather than manufacturers. "The state of California, which has an excellent waste recycling program, may already have plans for all CFLs and fluorescent tubes," one manufacturer claimed. A few of the manufacturers pointed to the recently-adopted Massachusetts CFL disposal tax as evidence that they are already helping to fund CFL disposal. However, one manufacturer was very skeptical that consumer recycling of CFLs was very practical. "You have no way for the ultimate user to conveniently – and that's the key word, *conveniently* – get rid of these things," he said. "They've got to make a convenient way to dispose of them – and right now there is none. … So either you need to have a deposit box on every corner or by each grocery store – something like that – [so customers can] take these things and dump them somewhere convenient and not one day a year when their city has a hazardous waste disposal."

- *Customer education* – One manufacturer said that his company prints the web address of an organization that handles CFL recycling on all of their product labels. Other manufacturers said that they put CFL disposal information on their company websites, work with local utilities on this issue, and engage in other unspecified forms of customer education.
- *Regulating mercury content* – Two manufacturers thought that CFLs should be mandated to have lower levels of mercury (less than 5-6 milligrams per bulb).

A number of manufacturers felt that serious regulation is not needed because CFLs contribute less to mercury pollution than incandescent bulbs. Several manufacturers pointed to studies by the U.S. Environmental Protection Agency that indicate that the amount of mercury emissions from power plants that CFLs offset (vs. incandescent bulbs) is much greater than the mercury they contribute to the environment due to improper disposal.

4.3 Consumer Summary

This chapter of the report presents data on CFL and compact fluorescent (CF) fixture awareness and purchases and well as CFL disposition, satisfaction, barriers, and future CFL purchase intentions among the general population. Data sources for this section include the General Population Telephone Survey (n = 1,000) and Lighting Onsite Survey (n=100).The data are intended to clarify whether downstream barriers to CFL purchase and installation have changed over time and to provide context for evaluating the success of the Upstream Lighting component of the SFEER Program in addressing and alleviating these barriers. Results are organized by the following topics:

- **CFL and CF fixture awareness.** Consumer familiarity with CFLs and CF fixtures, and how consumers became aware of CFLs.
- **CFL and CF fixture purchase.** Consumer reports of CFL and CF fixture purchases as well as reasons for choosing CFLs and where consumers have purchased CFLs.
- **CFL disposition.** Consumer reports of CFL installations, storage, and removal, as well as reasons for storing and removing CFLs.
- **Satisfaction.** General satisfaction with CFLs as well as specific product attributes (e.g., length of life, brightness) as well as reasons for dissatisfaction.
- **Barriers.** Consumer intentions to replace burned-out CFLs or incandescent bulbs with CFLs as well as factors influencing incandescent-to-CFL replacement likelihood, factors preventing increased CFL saturation within households, and reasons for choosing not to install CFLs in specific fixtures within the household.
- **Future CFL purchase intentions.** Likelihood of purchasing CFLs within the next year, reasons for it being unlikely, factors that could motivate purchase within a year, and likelihood of purchasing within a year after hearing a "market update" covering current CFL market characteristics such as pricing, size, and availability.

4.3.1 *CFL Awareness*

General Awareness

To determine consumer awareness of CFLs, the evaluators asked if telephone survey respondents had heard of CFLs prior to the survey. For respondents who were not sure, interviewers provided a brief description of CFLs.[45] Figure 4-15 shows changes in CFL awareness over time for California consumers. The percentage of consumers who are aware of CFLs increased significantly between 2001 and 2003 and again between 2003 and 2006 to 95 percent.[46] Approximately 38 percent of consumers who are aware of CFLs report that they became aware within the past two years (2005 or 2006). Twenty-seven percent report that

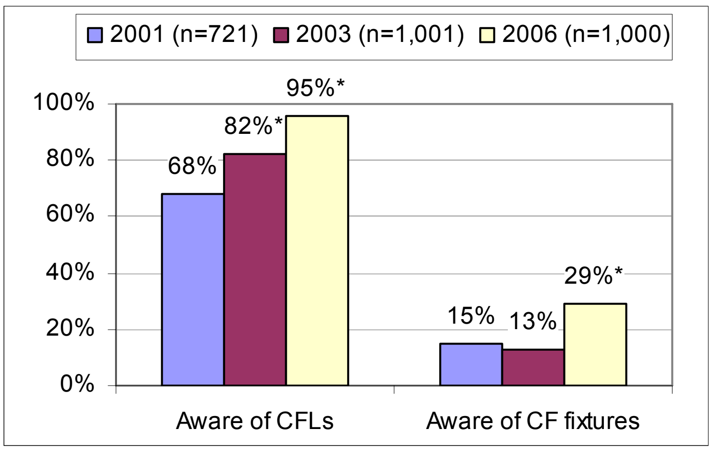
[45] The description was as follows: "Compact fluorescent light bulbs, or CFLs, are small fluorescent bulbs that fit in regular light bulb sockets. CFLs look different than standard bulbs. They are often made out of thin tubes of glass bent into loops or a spiral shape."

[46] These estimates include both prompted and unprompted awareness.

they first became aware between two and five years ago, and 29 percent became aware more than 5 years ago.[47]

The evaluators also asked consumers whether they had heard of compact fluorescent (CF) fixtures prior to the survey.[48] As shown in Figure 4-15, the proportion of the population that is aware of CF fixtures more than doubled between 2003 and 2006 from 13 to 29 percent of the population (a statistically significant increase).

Figure 4-15: CFL and CF Fixture Awareness Over Time[49]



* Difference from prior years is statistically significant at the 90 percent level of confidence.
2001 data source: XENERGY Inc., 2002.
2003 data source: KEMA-XENERGY and Quantum Consulting, 2003.
2006 data source: General Population Telephone Survey.

<u>How Consumers Became Aware of CFLs</u>

Telephone survey respondents were asked how they first heard about CFLs, and nearly a third (30%) reported that they first noticed CFLs in stores (see Table 4-7). A similar proportion (24%) reported that they first heard about CFLs through word of mouth.

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[47] An additional 6 percent of consumers did not know when they first became aware of CFLs (n=965).

[48] The question was phrased as follows: "Have you heard of compact fluorescent light fixtures? Most regular light fixtures use bulbs that screw in, but compact fluorescent fixtures use special pin-based CFLs that plug in. Pin-based bulbs don't have a screw base like other light bulbs. Compact fluorescent fixtures are also called ENERGY STAR light fixtures."

[49] 2001 data source: XENERGY Inc., 2002. Phase 4 Market Effects Study of California Residential Lighting and Appliance Program: Final Report. Prepared for San Diego Gas and Electric Company. April 26, 2002. KEMA-XENERGY and Quantum Consulting,

2003 data source: KEMA-XENERGY and Quantum Consulting, 2003. Evaluation of the 2002 Statewide Crosscutting Residential Lighting Program: Final Report. Prepared for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison. October 13, 2003.

Table 4-7: Source of First Awareness of CFLs, 2006*

Source of Awareness	% of Consumers Aware of CFLs
In-store display/point of sale materials	30%
Word of mouth (friends, family, neighbor, colleague)	22%
Television	14%
Utility (bill insert or mailing)	7%
Newspaper	6%
Magazines	5%
Other[†]	13%
Don't know/Refused	18%
n	**965**

* Question allowed multiple responses; total may exceed 100 percent.

[†] "Other" sources of awareness include radio, retail salespeople, contractors, Consumer Reports, and governmental announcements, each of which accounts for less than 5 percent of sources cited by the general population.

Data source: 2006 General Population Telephone Survey, 2006.

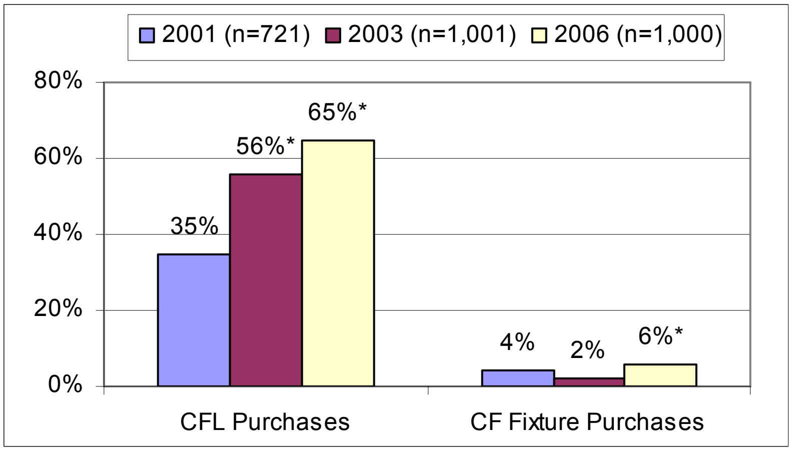
4.3.2 *CFL Purchases*

Purchase Rate

Figure 4-16 shows changes in consumer CFL purchase rates over time in California. As shown, the purchase rate increased significantly between 2001 and 2003 and again between 2003 and 2006. Increased CFL availability, improved quality, and declining prices may have played a role in these changes. As of 2006, nearly two-thirds of California consumers have purchased CFLs (65%).

During the 2006 telephone survey, interviewers asked consumers whether they had purchased a CF fixture or fixtures *during 2004 or 2005*; six percent of the population indicated that they had done so, a statistically significant increase over the proportion of the population who reported they had *ever* purchased a CF fixture during the 2003 survey. As shown in Figure 4-16, market acceptance for CF fixtures appears to be progressing far more slowly than for compact fluorescent lamps.

Figure 4-16: CFL and CF Fixture Purchase Rates Over Time



* Difference from prior year is statistically significant at the 90 percent level of confidence.
Note that the 2006 survey asked respondents whether they had purchased a CF fixture *during 2004 or 2005* while the 2001 and 2003 surveys asked respondents whether they had *ever* purchased a CF fixture.
2001 data source: XENERGY Inc., 2002.
2003 data source: KEMA-XENERGY and Quantum Consulting, 2003.
2006 data source: General Population Telephone Survey.

Reasons for Choosing CFLs

As shown in Table 4-8, the majority of CFL purchasers report that they chose CFLs over incandescent bulbs to save or conserve energy (66%). Consumers appear vastly more concerned with CFLs' energy saving benefits than with other factors such as length of CFL life (cited by 22% of consumers), electricity bill reduction (19%), or other reasons.

Table 4-8: Reasons for Choosing CFLs, 2006*

Reason	% of Purchasers
Save/conserve energy	66%
CFLs last longer	22%
Reduce electricity bill	19%
To try them out	7%
Product works better/higher quality	5%
“Right thing to do” (environmental/resource benefits)	3%
On sale/reduced cost	3%
Cost savings worth the extra up-front cost, acceptable payback	3%
Energy savings worth the extra up-front cost, acceptable payback	3%
Other†	9%
Don't know	2%
n	**756**

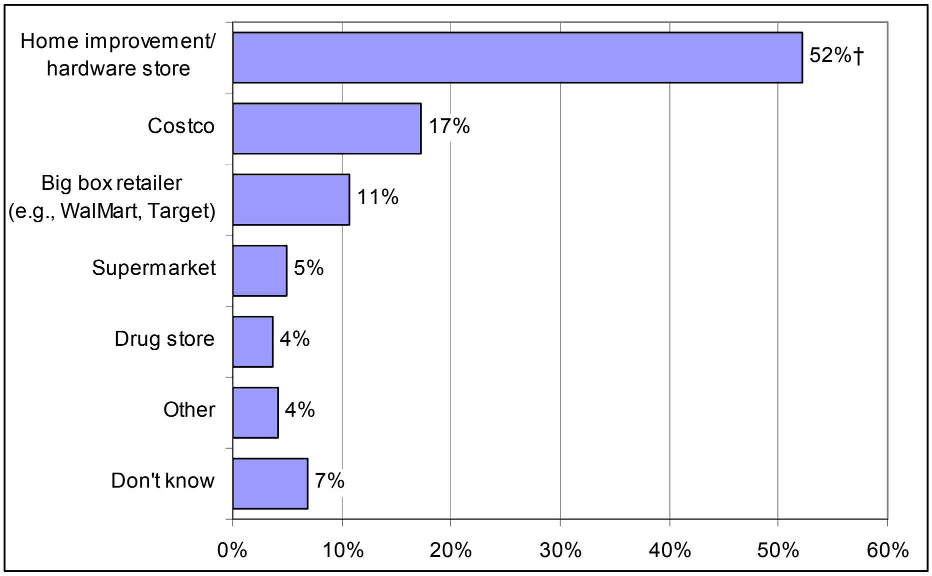
* Question allowed multiple responses; total may exceed 100 percent.
† “Other” reasons include suggestions from friend/family or from a retail salesperson; a desire to have new, high-tech products; the belief that CFLs are required by local building code; and to redeem a coupon. Each was cited by less than 3 percent of respondents.
Data source: General Population Telephone Survey, 2006.

Where Consumers Purchased CFLs

More than half of CFL purchasers indicated that they made their most recent CFL purchase at do-it-yourself (DIY) or hardware stores (52%; see Figure 4-17). The second most frequently cited store was Costco at 17 percent; based on these data, home improvement and hardware stores are clearly dominant among CFL purchase locations for California consumers. These results are statistically unchanged from 2003.[50]

50 KEMA-XENERGY and Quantum Consulting, 2003. Evaluation of the 2002 Statewide Crosscutting Residential Lighting Program: Final Report. Prepared for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison. October 13, 2003.

Figure 4-17: Where Consumers Purchased CFLs Most Recently, 2006



* Question allowed multiple responses; total may exceed 100 percent.
n =756.
† Difference from other stores is statistically significant at the 90 percent level of confidence.
Data source: General Population Telephone Survey, 2006.

4.3.3 *CFL Disposition*

Eighty-nine percent of CFL purchasers have one or more CFLs installed in their households. Table 4-9 presents results on CFL installation, storage, and removal for all CFLs ever acquired by CFL purchasers. CFL purchasers have, on average, approximately 7 CFLs installed (of approximately 41 sockets per household[51]) and approximately 3 additional bulbs in storage. The data show that 70 percent of all of the CFLs ever acquired by CFL purchasers are presently installed, and these installed bulbs represent approximately one-sixth of the sockets in the average household. A recent study in the Northwest revealed that consumers who purchase multi-packs of CFLs are storing at an even higher rate than single-pack purchasers.[52]

[51] RLW Analytics, 2005. California Statewide Residential Lighting and Appliance Efficiency Saturation Study. August, 2005.

[52] KEMA, 2007. Market Progress Evaluation Report (MPER3) for the Northwest Energy Efficiency Alliance ENERGY STAR Consumer Products Project. Draft report, June 2007.

Table 4-9: Bulb Disposition in Purchaser Households, 2006

Disposition of All CFLs Ever Acquired by Purchaser Household	Mean Number of Bulbs	% of Total Bulbs
CFLs currently installed	6.8	70%
CFLs currently in storage	2.5	26%
CFLs ever removed	0.3	3%
Total Number of CFLs Ever Acquired	**9.6**	**100%**

Data source: General Population Telephone Survey, 2006.

The onsite lighting survey conducted as part of the evaluation included households that purchased CFLs in 2004 or 2005 and had one or more CFLs installed. The average number of CFLs installed per household in the onsite survey was thus higher than in the general population (from our telephone survey data): onsite data showed an average of 11.1 CFLs installed per household (versus 6.8 across all purchaser households – whether they have installed CFLs or not – from the telephone survey). The average number of installed CFLs from the onsite survey was also driven up by households with large numbers of CFLs installed; eight percent of households had more than 30 CFLs installed. The median number of CFLs installed was 7.3.

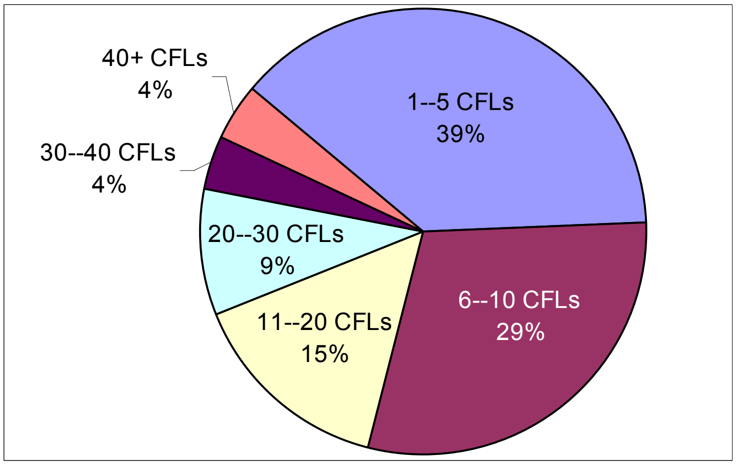
Figure 4-18 displays the distribution of number of CFLs installed per household from the onsite survey. As shown in the chart, approximately two-thirds of the households surveyed had 10 or fewer CFLs installed. Based on an average California home with 41 total bulbs[53], at least eight percent of households with CFLs are approaching full CFL saturation. Nearly 40 percent of households with CFLs have five or fewer installed, indicating significant potential for expanding CFL saturation even among households that have already installed one or more CFLs.

A 2005 study[54] found that of all lamps installed in California households, 92 percent were controlled by simple on/off switches, 7 percent by dimmers, 1 percent by motion sensors, and less than 1 percent each by photocells and timers. Of the average 11.1 CFLs installed per onsite household in the 2004/2005 SFEER Program evaluation, 95 percent were installed in fixtures with simple on/off switches versus dimmable fixtures, 3-way fixtures, or fixtures with other types of controls. Of the non-CFLs installed (incandescent, halogen, or other bulb types), approximately 1 in 4 (24%) were installed in fixtures with other types of controls.

[53] RLW Analytics, 2005.

[54] Ibid.

Figure 4-18: Number of CFLs Installed per Household, 2006



n=1,113.
Data source: Onsite Lighting Survey, 2006.

CFL Distribution by Room Type and Bulb Characteristics

Table 4-10 shows the average number of CFLs installed by room type from our onsite survey of CFL purchaser households. As shown in the table, CFLs comprise by far the greatest proportion of total bulbs installed in the bedrooms of the California households included in the sample; 61 percent of bulbs installed in bedrooms are CFLs. Overall, CFLs represent just over one-quarter of all lamps installed (27%), underscoring the potential for expanding CFL saturation.

The onsite survey also found that the average number of CFLs installed in wall-mounted fixtures in each household (4.3) was higher than the average number installed in other fixture types, including portable fixtures (e.g., table lamps; 3.0), recessed cans (1.9), ceiling fans (0.9), suspended fixtures (e.g., pendant lamps; 0.8), or other fixture types (0.1 CFL per household on average).

Table 4-10: Average Number of CFLs Installed by Room Type, 2006

Location	Average Number of CFLs	Average Number of Bulbs (All Types)	CFLs as Percentage of Total Bulbs	n
Bedroom	2.5	4.1	61%	255
Bathroom	2.2	5.7	38%	209
Living/family room	1.9	6.3	29%	192
Kitchen	1.2	5.1	23%	116
Exterior*	1.3	6.8*	19%	131
Hall/stairway	0.9	5.3	16%	89
Dining room	0.7	5.6	12%	65
Office/other room	0.3	4.8	7%	36
Laundry/utility room	0.2	3.7	6%	20
Overall	**11.1**	**41.0**	**27%**	**1,113**

Data sources: Average number of CFLs per room from Onsite Lighting Survey. Average number of bulbs (all types) per room from RLW Analytics, 2005. California Statewide Residential Lighting and Appliance Efficiency Saturation Study. August, 2005.

* RLW study did not include exterior bulbs; since the evaluation included a full inventory of exterior bulbs, average total exterior bulbs from the onsite survey is included instead.

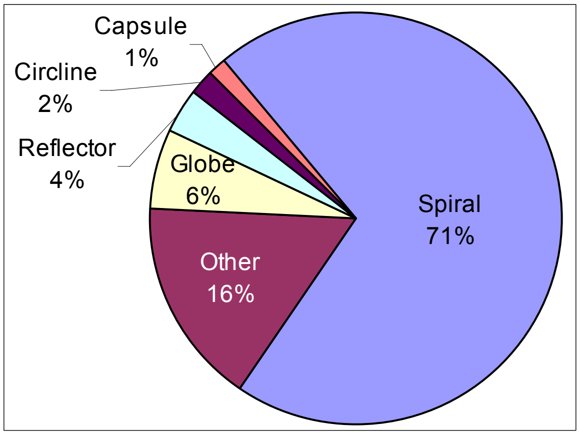
CFL Type and Wattage

During the onsite lighting survey, auditors investigated the type and wattage of installed CFLs. The majority of CFLs installed are spiral style (71%), but more than one quarter of all CFLs installed are non-spiral (Figure 4-19). The majority of these other types of bulbs are pin-based CFLs and a recent study in the Northwest found that these bulb types tend to be almost as readily available and as inexpensive as spiral CFLs.[55]

The onsite survey also found that the distribution of CFL types is the same for most room types as it is at the household level with a few noteworthy exceptions. The room diverging most from the average is the kitchen, where spirals represent about half of CFLs installed, and globes, reflectors, and other types of CFLs are more common than in other rooms. Bathrooms also diverge somewhat from the average in that they have a greater percentage of globes and "other" CFL types (presumably for use in vanity fixtures and other bathroom-specific fixture types).

[55] KEMA, 2006. Market Progress Evaluation Report for the Northwest Energy Efficiency Alliance (NEEA) ENERGY STAR Consumer Products Project (MPER2). Prepared for NEEA (Portland, OR). June 9, 2006.

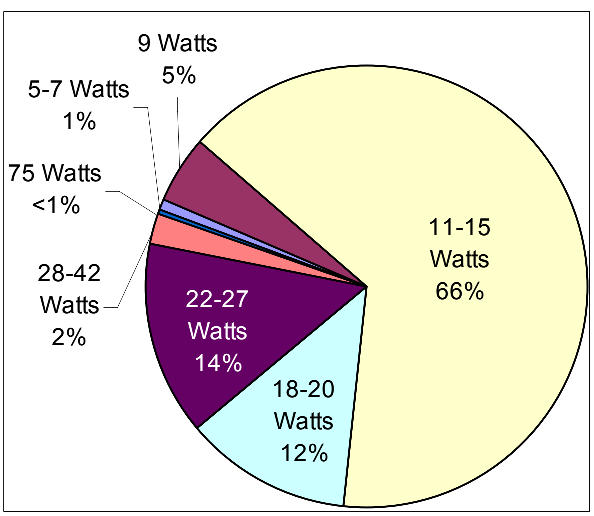
Figure 4-19: Types of CFLs Installed, 2006



n=1,113.
Data source: Onsite Lighting Survey, 2006.

The average wattage of all CFLs installed in households included in the onsite survey is 15.7 Watts. However, Figure 4-20 demonstrates that the majority of installed CFL lamps are in the 11 to 15 Watts range (roughly equivalent to a 60 Watt incandescent bulb), so this average is clearly driven up by a few high-wattage bulbs in the sample. The preponderance of 11-15 Watt CFLs (60-Watt equivalents) partially reflects the fact that bulbs within this wattage range are more likely to be installed in fixtures with multiple lamps than higher-wattage CFLs. It is interesting to note, however, that 11-15 Watt CFLs represent only 43 percent of total ENERGY STAR models produced in 2006 (see Figure 4-2 in Section 1 above); approximately half of the CFL models produced are higher-wattage bulbs (49%).

Figure 4-20: Wattage of CFLs Installed, 2006



n=1,113.
Data source: Onsite Lighting Survey, 2006.

CFL Storage

The General Population Telephone Survey found that nearly three out of five CFL purchasers are storing CFLs (59%). Interviewers asked all of these respondents why they are storing CFLs, and 77 percent indicated that they are storing CFLs so they have them on hand if another installed bulb burns out (Table 4-11). As mentioned above, approximately 80 percent of the light sockets in the average California household have non-CFLs installed in them; consumers could thus expand their existing CFL installations by up to a factor of five.

Seventy-four percent of CFL purchasers who are storing CFLs are also storing incandescent bulbs. The onsite lighting survey revealed that at least some of the incandescents in storage are being stored specifically for use in specialty fixtures in which CFLs may not be applicable (or in which householders *believe* CFLs are not applicable). This reason was cited for approximately nine percent of the total bulbs in storage (CFLs, incandescents, or other bulb types).

Table 4-11: CFL Purchaser Reasons for Storing CFLs, 2006*

Reason for Storing CFLs	% of CFL Purchasers Who Are Storing CFLs
So I have them on hand if a bulb burns out	77%
Purchased more CFLs than I needed	19%
Bought them on sale	6%
Can't use them in certain applications (e.g., 3-way/dimmable)	3%
Did not like them	3%
Other reason†	4%
Don't know	2%
n	**460**

* Question allowed multiple responses; total may exceed 100 percent.
† "Other" reasons include because CFLs do not fit into fixtures and because respondents don't want to use CFLs in certain rooms. Each was cited by less than 4 percent of respondents.
Data source: General Population Telephone Survey, 2006.

Seventy-one percent of the single-family households included in the Onsite Lighting Survey were storing CFLs. Of these households, the average number of CFLs in storage was 5.3lamps (Table 4-12). Because onsite auditors were able to visually observe and count CFLs in storage at these households, this data is likely more accurate than results from the telephone survey, which asks respondents to recall the number of lamps in storage without a visual cue. Eighty-three percent of households storing CFLs were also storing incandescent lamps, and the average number incandescents in storage among these households was 12.9 lamps.

Table 4-12: Lamp Storage Among Lighting Onsite Survey Households, 2006

Onsite Household (HH) Storage Characteristic	Onsite Results	n
% of HH storing CFLs	71%	100
Average Number CFLs in Storage (among HH storing CFLs)	5.3	71
% of HH Storing Incandescents (among HH storing CFLs)	83%	71
Average Number Incandescents in Storage (among HH storing CFLs)	12.9	59

Data source: Onsite Lighting Survey, 2006.

CFL Removal

Fifteen percent of CFL purchasers have removed one or more previously-installed CFLs. More than a third of purchasers who have removed CFLs said that they did so because the CFLs were not bright enough (31%; see Table 4-13). Fourteen percent said they removed the CFLs because they burned out, and 13 percent said they did so because the CFLs didn't fit into their fixtures. Eighty percent of telephone survey respondents who removed CFLs indicated that they replaced them with incandescent bulbs (Table 4-13).

Table 4-13: Reasons for Removing (Uninstalling) CFLs, 2006*

Reason	% of Purchasers Who Have Removed CFLs
Not bright enough	31%
Burned out	14%
Didn't fit	13%
Didn't like the color	10%
Cant use them in certain applications	8%
Too long to start up	6%
Other reason†	18%
Don't know	1%
n	**125**

* Question allowed multiple responses; total may exceed 100 percent.
† "Other" reasons include radio interferences; dissatisfaction with the way CFLs look; bulb broke/was damaged; CFL too bright. Each was cited by less than 4 percent of respondents.
Data source: General Population Telephone Survey, 2006.

Table 4-14: Type of Bulb Used to Replace Removed CFL – Among CFL Purchasers Who Have Removed (Uninstalled) CFLs, 2006

Replacement Bulb Type	% of Purchasers Who Have Removed CFLs
Incandescent	80%
CFL	13%
Halogen	3%
Other bulb type	3%
Don't know	1%
n	**125**

Data source: General Population Telephone Survey, 2006.

4.3.4 *Satisfaction with CFLs*

Satisfaction

Of telephone survey respondents who had purchased CFLs the interviewers asked, "Using a scale of 1 to 10, where 1 means you are 'not at all satisfied' and 10 means you are 'extremely satisfied,' how satisfied are you with the CFLs you purchased most recently?" Table 4-15 shows that the average satisfaction rating was moderately high: 7.7 out of 10. Respondents were then asked to rate their satisfaction with three specific CFL attributes (randomly selected for each respondent from a group of 6 total attributes) on the same scale. The table also shows that respondents are most satisfied with the length of bulb life for CFLs (8.5 rating) and least satisfied with the way they look in light fixtures (6.6 rating). More than half of the CFL purchasers who were less than satisfied with CFL brightness reported that CFLs are not bright enough.

Table 4-15: Satisfaction with CFLs and Their Attributes, 2006

	Satisfaction	
CFL Attribute	Mean Rating	n
Overall satisfaction with CFLs	**7.7**	**756**
Length of life	8.5	357
The way they fit into light fixtures	7.7	386
Amount of time to light up	7.5	347
Brightness	7.5	377
Color of light	7.4	395
The way they look in light fixtures	6.6	366

Data source: General Population Telephone Survey, 2006.

Satisfaction is higher among purchasers who bought CFLs more recently than among those who have not purchased CFLs during the past few years. This is not surprising as a result of the general increase in CFL quality and decrease in price (especially among twister-style bulbs, which are the most common) and the fact that purchasers who were unhappy with the CFLs they initially purchased may not have purchased them again. This may explain the difference in overall satisfaction ratings from the telephone survey versus the onsite survey: overall CFL satisfaction from the onsite lighting survey (8.9) is thus somewhat higher than among phone survey respondents (7.7), possibly because the onsite survey was conducted among households that purchased CFLs *recently* (during or since 2004) while the phone survey was conducted among all CFL purchasers (regardless of purchase date).

By room type, onsite survey households were significantly more satisfied with CFLs in halls/stairways and offices than with CFLs in dining rooms, kitchens, living rooms, laundry rooms and exterior spaces (Table 4-16). It is noteworthy that satisfaction is lowest in the room types generally associated with highest use (kitchen, bedroom, living room). One possible explanation is that consumers may be more critical of specific attributes of their lighting (such as color and brightness) in high-use rooms and have less concern about these attributes in other room types.

Table 4-16: Overall Satisfaction with CFLs by Room Type, 2006

Room Type	Mean Satisfaction Rating	Number of CFLs
Office/other room	9.6	36
Hallway/stairway	9.2	89
Dining room	8.9	65
Bathroom	8.9	209
Exterior	8.9	131
Bedroom	8.8	255
Laundry/utility room	8.8	20
Kitchen	8.7	116
Living room	8.3	116
Overall	**8.9**	**1,113**

Source: Onsite Lighting Survey, 2006.

Evaluators also examined differences in satisfaction by other CFL attributes and found the following:

- Satisfaction with standard spiral CFLs is significantly higher than with specialty CFLs (e.g., 3-way, reflector).
- By fixture type, onsite survey participants were significantly more satisfied with CFLs installed in ceiling fan fixtures than with those installed in wall-mounted, portable, or suspended fixtures or with CFLs installed in recessed cans.

Overall, satisfaction is highest with standard spiral-style CFLs in wall-mounted fixtures with simple on/off switches (versus dimmable, 3-way, or other controls). These data indicate that barriers exist to increased saturation of CFLs within CFL purchaser households. These barriers are discussed in subsequent subsections of this chapter.

Factors That Would Increase Satisfaction with CFLs

The onsite lighting survey investigated factors that could possibly increase satisfaction with each individual CFL installed. Householders indicated that nothing could make them more satisfied with nearly half of the CFLs they have installed (i.e., they are already quite satisfied; 46%). For 21 percent of the CFLs installed, householders felt that they should reach full brightness faster, and for 12 percent of CFLs installed, that respondents would be more satisfied if the bulbs' flickering were eliminated. These two comments are unusual in that newer-vintage CFLs tend to reach full brightness quickly and have little or no flicker. Evaluators investigated the date of purchase for these CFLs and found that most were purchased within the past few years so vintage is an unlikely explanation. However, it is possible that many of these are non–ENERGY STAR or other lower-quality CFLs (regardless of vintage).

Table 4-17: Factors That Would Increase Satisfaction with Installed CFLs, 2006

Factor	% of CFLs
Nothing would make me more satisfied	46%
Should reach full brightness faster	21%
Eliminate flicker	12%
Appearance	8%
Color	4%
Not bright enough	3%
Should last longer	2%
Other reason*	4%
n	**1,113**

* "Other reasons" include improved fit of CFLs in fixtures, need for 3-way CFLs, need for dimmable CFLs, need for CFLs to be less bright, and need for CFLs to dim better; each of these reasons was cited by 0.5 percent of respondents or less.

Data source: Onsite Lighting Survey, 2006.

4.3.5 *Barriers*

CFL to CFL Replacement Intentions

The evaluators asked CFL purchasers to rate their likelihood of replacing a CFL that has burned out with another CFL. Phone survey respondents used a scale of 1 to ten with 1 meaning, "not at all likely" and 10 meaning, "very likely" (Table 4-18). Currently, nearly three-quarters of CFL purchasers say they are very likely (a 9 or 10 rating) to replace CFLs with CFLs (73%). There are no statistically significant differences in CFL-to-CFL replacement likelihood by CFL purchase year. The mean satisfaction rating among CFL purchasers was 8.9.

Table 4-18: Likelihood of Replacing an Installed CFL with a CFL upon Burnout among CFL Purchasers, 2006

Likelihood	% of CFL Purchasers
Very likely (9-10)	73%
Likely (6-8)	15%
Somewhat unlikely (3-5)	5%
Not likely (1-2)	4%
Don't know	2%
n	**685**

Data source: General Population Telephone Survey, 2006.

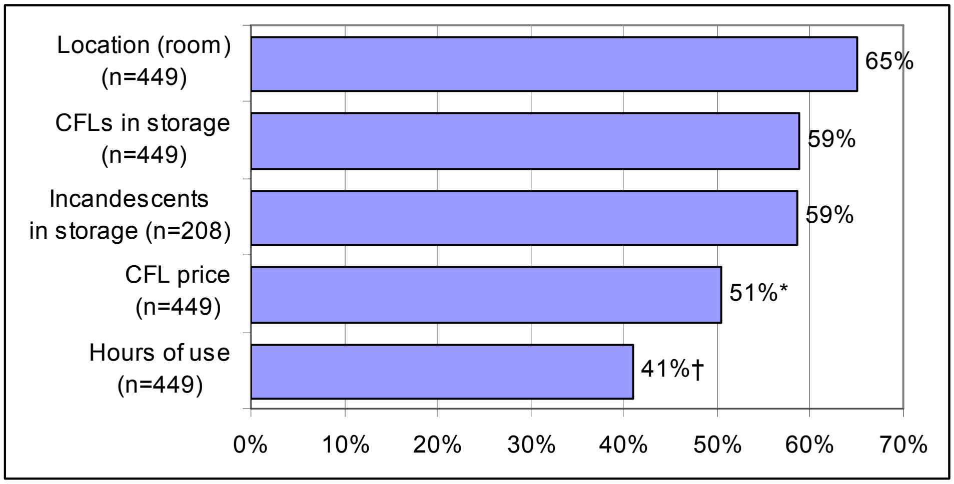
Incandescent to CFL Replacement Intentions

The evaluators asked all telephone survey respondents who are aware of CFLs how willing they would be to replace an incandescent bulb that has burned out with a CFL. Overall, 75 percent of respondents are at least somewhat likely to replace a burned-out incandescent with a CFL (27% say they definitely will and 48% say they possibly will). Less than one-fifth of respondents said they definitely will not do so (17%).

As one would expect, CFL-to-CFL replacement intentions and incandescent-to-CFL replacement intentions are correlated; more than 90 percent of phone respondents who definitely intend to replace a burned-out incandescent bulb with a CFL are "very likely" to replace a burned-out CFL with another CFL (rating of 9 or 10 on a 10-point scale; see above for details).

Respondents who indicated that they "possibly will" replace an incandescent bulb with a CFL upon burnout were prompted as to whether their decision would depend on a number of different factors. Nearly two-thirds said their decision would depend on the room in which the bulb would be used. Approximately 59 percent said the decision would depend on whether they had incandescent bulbs or CFLs in storage (Figure 4-21).

Figure 4-21: Factors Influencing Incandescent to CFL Replacement Likelihood among Aware Respondents Who "Possibly Will" Replace a Burned-out Incandescent with a CFL, 2006



* Difference from other factors is statistically significant at the 90 percent level of confidence.
† Difference from other factors is statistically significant at the 90 percent level of confidence.
Data source: General Population Telephone Survey, 2006.

Data from the onsite survey also revealed some differences in incandescent-to-CFL replacement intentions:

- Onsite survey households are significantly more likely to plan to replace incandescent bulbs installed in portable fixtures with CFLs upon burnout than incandescent bulbs installed in other fixture types.
- Households are significantly *less* likely to intend to replace specialty incandescent bulbs (e.g., reflectors) with CFLs upon burnout than standard incandescent bulbs (e.g., A-lamps).
- Households are least likely to plan to replace burned-out incandescent bulbs in bathrooms and dining rooms with CFLs, likely because of the high saturation of specialty bulbs (e.g., globes in bathroom vanities and small-base or torpedo-style bulbs in dining room chandeliers).

Factors Preventing Increased CFL Saturation

The evaluators asked telephone survey respondents who had one or more incandescent bulbs installed in their homes to indicate the main factor preventing them from increasing the number of CFLs installed in their homes.[56] Approximately 15 percent said they do not like the way CFLs fit in their fixtures. Fourteen percent said CFLs are not bright enough and the same proportion said that CFLs are too expensive.

[56] The assumption is that respondents who have no incandescent bulbs installed are unlikely to have many (if any) opportunities to expand their CFL installations.

Table 4-19: Main Factor Preventing Increased Saturation of CFLs in Home among Respondents Who Have 1 or More Incandescent Bulbs Installed, 2006

Reason	% of Respondents Who Have One or More Incandescent Bulbs Installed
Don't like the way CFLs fit in fixtures	15%
Not bright enough	14%
CFLs too expensive/cost too much	14%
Waiting for installed bulbs to burn out	8%
Lack of information/education about CFLs	7%
Don't like the color	5%
Don't like the look of CFLs	4%
Need dimmable bulbs	3%
Need 3-way bulbs	3%
Storing incandescent bulbs	2%
Inertia – haven't gotten to it	2%
All fixtures already have CFLs	2%
Too bright or too harsh	2%
Other reason*	11%
Don't know	7%
n	**614**

* "Other" reasons include CFLs are not easily available; CFLs take too long to light up; habit of buying traditional bulbs/resistance to change; CFLs don't last long enough; CFLs don't work with timers/motion detectors/security lights; storing CFLs; hours of use (don't use them enough); and no other reason. Each was cited by less than 2 percent of respondents.

Data source: General Population Telephone Survey, 2006.

Reasons for Choosing Not to Install CFLs

During the lighting onsite survey, auditors asked householders why they chose not to install a CFL in each fixture in which other bulb types (e.g., incandescent, halogen) were installed. For more than a third of the fixtures in which non-CFLs are installed, householders indicated they installed the bulbs simply because they had them on hand (assumedly in storage; 37%). Householders indicated that for 16 percent of the fixtures, they installed the non-CFLs (incandescent bulbs) because they had incandescent bulbs they needed to use up. These results indicate that storage of incandescent bulbs may be a barrier to increasing CFL saturation in California households.

Householders also indicated that for 17 percent of the fixtures in which non-CFLs are installed, the reason for choosing not to install CFLs was that the fixtures require specialty bulbs. Additionally, householders indicated that four percent of the fixtures have non-CFLs installed because they require dimmable bulbs and two percent because they require 3-way bulbs. These results indicate that many householders may still be unaware that specialty CFLs – such as dimmable and 3-way – exist or that they are readily available in many areas.

Table 4-20: Reasons for Choosing Not to Install CFLs, 2006*

Reason	% of Interior Fixtures in which Non-CFLs are Installed
This was what I had on hand	37%
Fixture requires a specialty bulb	17%
I have incandescent lamps I need to use up	16%
I don't like the way CFLs fit in fixtures	9%
CFLs don't have the right appearance	9%
CFLs aren't bright enough	7%
Operating hours – don’t use the fixture enough	7%
Previous CFLs have not lasted as long as expected	4%
CFLs take too long to light up	4%
Fixture is dimmable	4%
CFLs are too bright	4%
I did not choose the installed bulb (e.g., here when I moved in)	3%
This fixture is turned on/off a lot – CFLs not appropriate	3%
CFLs are too expensive	2%
Fixture is 3-way	2%
Number of Fixtures in which Non-CFLs are Installed	**400**

* Question allowed multiple responses; total may exceed 100 percent.

4.3.6 *CFL Purchase Intentions*

Likelihood of CFL Purchases within a Year

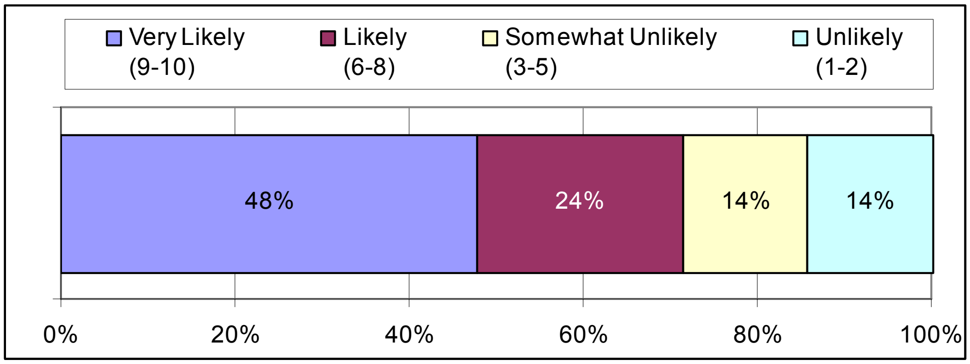
Telephone survey respondents who were aware of CFLs were asked to rate their likelihood of purchasing any CFLs within the next year. Ratings were on a scale from 1 to 10 with 1 meaning “not at all likely” and 10 meaning “very likely.” Respondents who were unaware of CFLs prior to the survey were first read a description of CFLs[57] before they were asked this question.[58] Among all of the survey respondents, the average rating among CFL Purchasers is significantly higher than among respondents who are aware of CFLs but have not purchased them (7.3 and 5.8, respectively; a statistically significant difference).[59] Figure 4-22 shows the breakdown of likelihood ratings among CFL purchasers.

[57] The CFL description read: “CFLs use two-thirds less energy than a standard bulb, and last up to 10 times as long. Some styles of CFLs are available for $2 or less – and they are about the same size and color as a standard bulb and can be installed in almost any fixture. They can be purchased at the same places you purchase standard bulbs, including some drug and grocery stores. CFLs save about $30 in electricity costs over the life of the bulb. By using less energy, CFLs also help the environment.”

[58] At this point in the survey, respondents who were aware of CFLs prior to the survey have not been read the same CFL description as Unaware respondents and may thus actually be less informed about current CFL market conditions than Unaware respondents.

[59] The total number of Unaware survey respondents is 28, too small to yield statistically valid results.

Figure 4-22: Likelihood of CFL Purchase within the Next Year among CFL Purchasers, 2006



n =756.
Data source: General Population Telephone Survey, 2006.

<u>Reasons for Being Unlikely to Purchase CFLs within the Next Year</u>

Phone survey respondents who indicated they are not likely to purchase CFLs within the next year (ratings of 1 to 5 on the 10-point scale; see Figure 4-22 above) were asked to explain their reasons for being unlikely. The most common reason cited by unlikely future purchasers is that they are waiting for installed bulbs (incandescents or CFLs) to burn out (16%). The second most common reason is that respondents are storing CFLs (Table 4-21). CFL brightness and cost were also among the top three factors preventing increased saturation of CFLs in respondent homes (see Table 4-19 above).

The only statistically significant difference between CFL Purchasers and Non-Purchasers is that 17 percent of Non-Purchasers cited a lack of information about CFLs as the main reason for being unlikely to purchase CFLs; no CFL Purchasers cited this reason.

Table 4-21: Main Reason for Being Unlikely to Purchase CFLs within the Next Year among Unlikely Future Purchasers, 2006

Reason	% of Unlikely Future Purchasers
Waiting for installed bulbs to burn out	16%
Storing CFLs (have enough in storage)	15%
Not bright enough	12%
CFLs too expensive/cost too much	10%
Lack of information/education about CFLs	8%
Storing incandescent bulbs	5%
Don't like the color	5%
Don't like the way CFLs fit in fixtures	5%
Don't like the way CFLs look	3%
CFLs take too long to light up	2%
Other reason*	12%
Don’t know	6%
n	**290**

* “Other” reasons include habit of buying traditional bulbs/resistance to change; need dimmable bulbs; don’t have faith in CFLs’ ability to save energy; availability; inertia; quality of light too bright/harsh; need 3-way bulbs; operating hours (don’t use them enough); and all fixtures already have CFLs installed. Each was cited by less than 2 percent of respondents.

Data source: General Population Telephone Survey, 2006.

Likelihood of Future Purchase within a Year with Current Market Information

To gauge whether lack of current information of CFLs was impacting stated future CFL purchase intentions among those already aware of CFLs, interviewers read the CFL market description to aware phone survey respondents who reported that they were not likely to purchase CFLs within the next year (ratings of 1 to 5 on a 10-point scale where 1 means “not at all likely” and 10 means “very likely”). Interviewers then read these “initially unlikely” respondents the CFL description and asked whether they were more likely to purchase CFLs after hearing the description. Forty-nine percent of respondents reported that they were *more* likely to purchase CFLs after hearing the description and the remainder were not more likely or didn’t know. These results indicate that a lack of knowledge about the CFL market and benefits of CFLs may affect the potential for future CFL purchases.

Of the “initially unlikely” respondents who changed their minds to “likely” after hearing the CFL description, nearly one-quarter stated that the main reason for changing their minds was that CFLs are cheaper than they thought (Table 4-22).

Table 4-22: Main Reason for Changing Mind from Unlikely to Purchase CFLs within the Next Year to Likely Among Respondents Who Changed Their Minds, 2006

Main Reason	% Who Changed Their Minds from Unlikely to Likely
Cheaper than I originally thought	23%
Use less energy	14%
CFLs last longer	13%
Save on electricity cost	11%
Information about CFLs	6%
Fit in most fixtures	5%
Helps environment	5%
Other reason*	17%
Don't know	9%
N	**88**

* "Other" reasons include no reason at all; size and color same as standard bulb; survey phone call; and improved start-up time. Each was cited by less than 5 percent of respondents.
Data source: General Population Telephone Survey, 2006.

The evaluators asked "initially unlikely" phone survey respondents who did *not* change their minds after hearing the CFL description whether anything would motivate them to purchase CFLs within the next year (Table 4-23). More than one-quarter of respondents indicated that improved CFL light quality might motivate them to purchase CFLs within the next year (27%).

Table 4-23: Factors That Could Motivate Future Purchases Within the Next Year Among Initially Unlikely Future Purchasers Who Did Not Change Their Minds After Hearing CFL Description, 2006*

Factor	% Who Did Not Change Their Minds from Unlikely to Likely
Improve the quality of light	27%
Nothing at all	**18%**
Need to be cheaper	13%
Need different sizes to fit my fixtures	8%
Need to be convinced of energy savings	8%
More information about CFLs	6%
Prefer incandescent/standard bulbs	6%
Need to make them more attractive	5%
If use up incandescent bulbs on hand	5%
Need them to be in stores where I normally buy bulbs	5%
Other†	26%
Don't know	3%
n	**134**

* Question allowed multiple responses; total may exceed 100 percent.

† "Other" reasons include: Different sizes to fit my fixtures; more features such as dimmable/3-way; availability of rebates/free samples; longer life; improved start-up; more attractive; and less heat. Each was cited by less than 5 percent of respondents.

Data source: General Population Telephone Survey, 2006.

5

Assessment of Upstream Lighting Component

This chapter of the report presents findings related to the Upstream Lighting component of the 2004/2005 Single Family Energy Efficiency Rebate (SFEER) Program. The evaluators obtained information for this chapter largely from primary research conducted for this study. Key primary data sources include the General Population Telephone Survey (n = 1,000) and interviews conducted with representatives of lighting suppliers (n = 37) that participated in the 2004/2005 SFEER Program.

This report chapter is organized as follows:

1. The **Participating Supplier Perspectives** section summarizes lighting manufacturers' and retailers' assessments of the Upstream Lighting component of the SFEER Program including satisfaction with the Program and related processes as well as recommendations for Program improvements. Recall from Chapter 4 that "participating suppliers" are defined as those who sold or installed equipment for which incentives were provided through the 2004/2005 SFEER Program.
2. The **Consumer Summary** discusses when consumers purchased compact fluorescent lamps (CFLs) as well as various influences on consumer purchasing decisions (e.g., in-store marketing materials or product discounts).

5.1 Participating Supplier Perspectives

This section summarizes participating lighting manufacturers' and retailers' assessments of the Upstream Lighting component of the SFEER Program. It is based on interviews conducted in late 2006 and early 2007 with 14 lighting manufacturers and 23 lighting retailers that participated in the 2004/2005 SFEER Program. The section covers the following topics:

- Lighting supplier satisfaction with Program marketing;
- Lighting supplier satisfaction with other Program processes; and
- Lighting supplier recommendations for Program improvements.

5.1.1 *Lighting Supplier Satisfaction with Program Marketing*

As discussed in more detail in Chapter 3, the SFEER Program's manufacturer buydown required at least one promotional activity for each approved project. Allowable activities included print/radio/TV advertising, retail circulars, promotional display space, additional signage, and point-of-purchase (POP) materials. Although the manufacturers and retailers could choose which approved promotional method(s) to use, the SFEER Program had message and format requirements for the signage and other promotional materials. Besides supplying the product stickers, the utilities were not responsible for any of the in-store promotional costs. Yet the SFEER Program, by providing funding to the Flex Your Power Program, did contribute to the mass marketing of the CFL products.

Lighting Manufacturers

Of all the supply-side market actors that participated in the SFEER Program – both lighting and non-lighting – lighting manufacturers gave the highest satisfaction ratings for the Program's marketing efforts. With 5 as the maximum rating, they gave the Program's mass marketing efforts an average satisfaction rating of 4.6 and the Program's in-store promotional efforts an average satisfaction rating of 4.3 (Figure 5-1).[60] This compares to average marketing satisfaction ratings in the 3.1 to 3.4 range from lighting retailers, HVAC contractors, and pool contractors.

The lighting manufacturers' relatively high satisfaction rating for the Program's in-store promotional efforts is somewhat surprising since the manufacturers – and not the Program – did most of the in-store promotion work and paid for their own POP materials. However, this gave the manufacturers the freedom to choose their own promotional activities and materials as long the materials met the Program's format and content requirements.[61] Some of the manufacturers viewed this hands-on involvement in the in-store promotion as necessary, especially those who dealt with smaller retailers. One such manufacturer said:

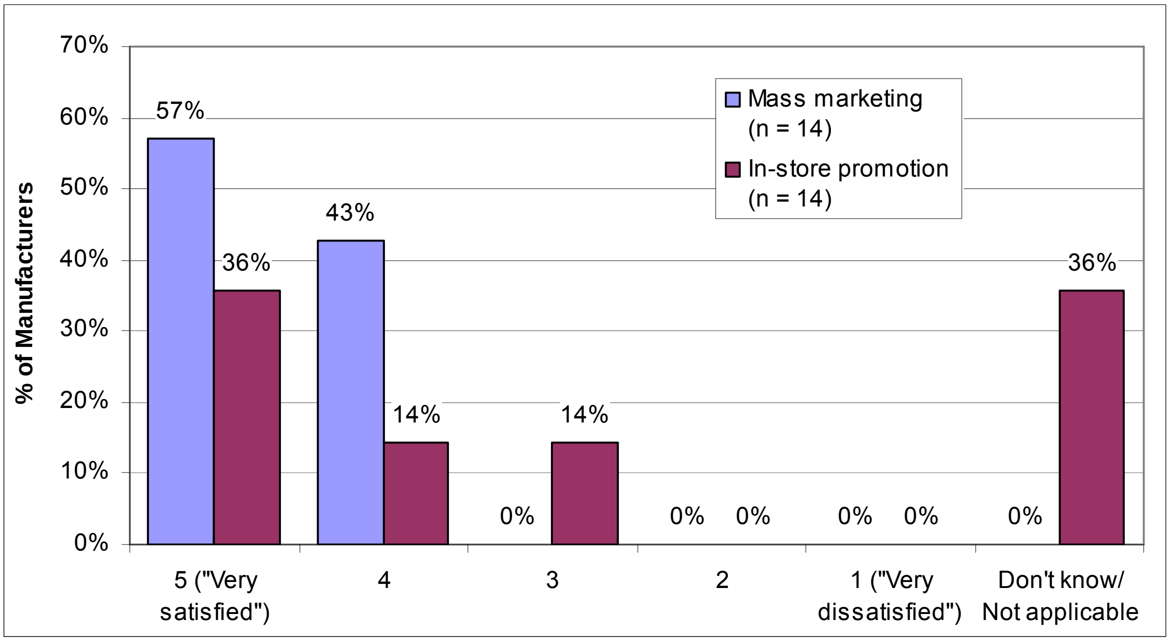
> *The point-of-sale material is also our cost. The utility won't pay anything for that so with the money that we get, we pay a certain percentage to create the point-of-sale material. We create our own signage, but we put the utility logos in very obvious areas and we distribute those materials to customers for free. … I think that more than 90% [of in-store promotion] is our own doing. The retailers when they get product they just follow your instructions. And sometimes they don't follow so you have to do this. So in order to save time and get money quick and make sure that people understand this, you have to send your workforce, your manpower to help the retailers do this.*

[60] Using a 5-point satisfaction scale where 5 means "very satisfied" and 1 means "very dissatisfied;" n = 14 for both ratings.

[61] Lighting manufacturers were asked to explain their dissatisfaction ratings (3 or less) but not their satisfaction ratings.

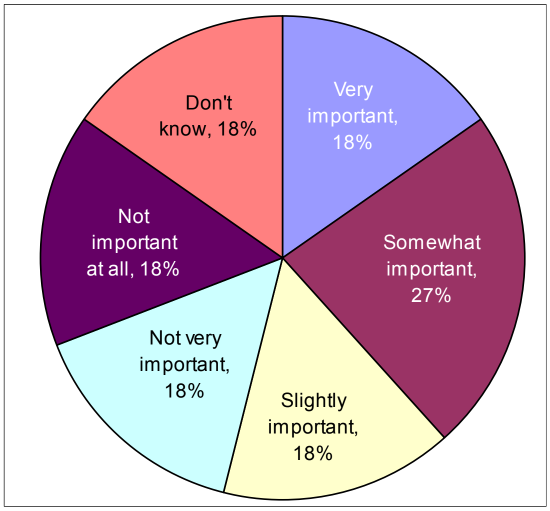
This manufacturer said that the most useful Program material for its promotional efforts was actually a letter from the utility describing the rebate Program. He said that this letter was very useful in convincing small retailers that there was no "catch" to receiving no-cost or very-low-cost CFL products.

Figure 5-1: Lighting Manufacturer Satisfaction with Program Marketing Efforts, 2004/2005



Besides asking the lighting manufacturers to rate their satisfaction with the Program's mass marketing efforts, the evaluators also asked them to assess how important the efforts of California's Flex Your Power (FYP) marketing campaign were in influencing their 2004/2005 CFL product sales. During this period, FYP handled most of the SFEER Program's mass marketing efforts. Figure 5-2 shows that the manufacturers were divided as to the importance of the FYP campaign's influence. One of the manufacturers who rated FYP's influence as "not very important" commented: "From a consumer's standpoint, you hardly ever see Flex Your Power in the media except every once in a while in the newspapers." Another manufacturer said that FYP "helps educate consumers, but many consumers are still ignorant of the Program."

Figure 5-2: Lighting Manufacturer Assessment of Importance of Flex Your Power Influence on CFL Product Sales, 2004/2005



n=14.

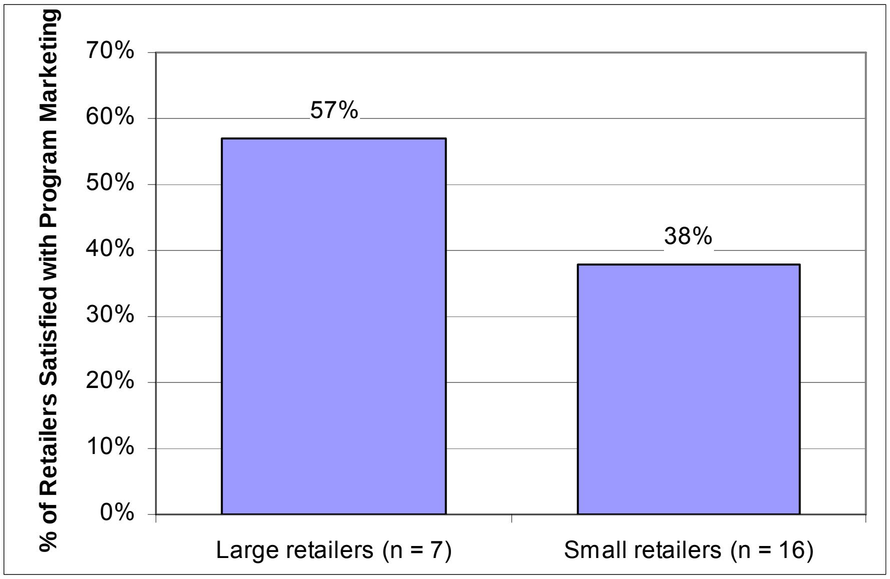
Lighting Retailers

The lighting retailers, especially the smaller retailers, were less satisfied with the Program's marketing efforts than were the lighting manufacturers. The evaluators asked these retailers how satisfied they were with the way that the utility marketed the rebates for CFL products during the 2004/2005 Program period. The average satisfaction rating for the large lighting retailers was 3.7 (n = 7) and for small lighting retailers it was 3.4 (n = 16).[62] This compares to Program marketing satisfaction ratings in the 4.3 to 4.6 range for lighting manufacturers. Figure 5-3 shows the percentage of large and small retailers that were satisfied (ratings of 4 or 5 on the 5-point satisfaction scale) with Program's marketing efforts. When retailers who were not satisfied with Program marketing were asked why, their comments included:

- "[The utilities] need more staff dedicated to it;"
- "Retailers do all the marketing;"
- "I was completely unaware of some rebates in the past;" and
- "I don't see television ads for the Program."

[62] Using a 5-point satisfaction scale where 5 equaled "very satisfied and 1 equaled "very dissatisfied." N = 14 for both ratings.

Figure 5-3: Lighting Retailer Satisfaction with Program Marketing Efforts, 2004/2005



The evaluators also asked the retailers how satisfied they were with the way that the utility websites promote and explain the CFL product rebates. Here the problem was simple unfamiliarity with the websites. All seven of the large retailers and 10 of the 16 small retailers were not familiar with the Program websites. Of the six small retailers that were familiar with the websites, four were satisfied and two were dissatisfied.

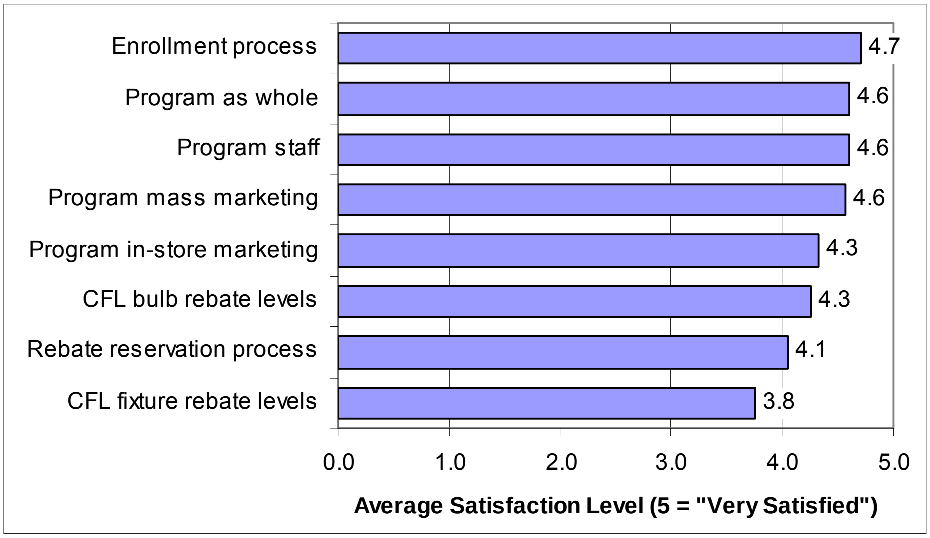
5.1.2 *Lighting Supplier Satisfaction with Other Program Processes*

Lighting Manufacturers

The evaluators asked the lighting manufacturers how satisfied they were with a variety of Program processes, using a scale of 1 to 5 where 5 means "very satisfied." Figure 5-4 shows that the lighting manufacturers were generally very satisfied with the Program. The lowest satisfaction ratings were for the rebate levels and the rebate reservation process. One lighting manufacturer pointed to higher production costs in China, due in part to a less favorable currency exchange rate, as a reason for wanting to increase the rebate levels. These higher China supply costs were also mentioned by other lighting manufacturers when asked about supply-side barriers (see Chapter 4).

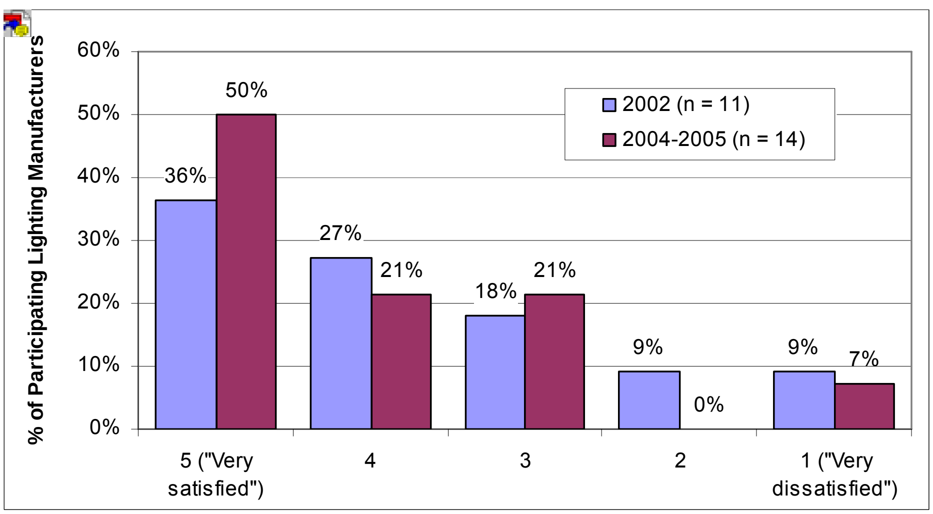
Another lighting manufacturer thought that specialty CFL bulbs, in particular, were in most need of higher rebate levels. As discussed in the next subsection, a number of manufacturers thought that the requirements for documenting CFL product placement and submitting proofs of sales were excessive. However, satisfaction with the rebate reservation process is actually higher than it was in the past, as Figure 5-5 shows.

Figure 5-4: Lighting Manufacturer Satisfaction Levels, 2004/2005



n = 14 for all satisfaction scores except for CFL fixture rebate levels where n = 4.

Figure 5-5: Lighting Manufacturer Satisfaction with Rebate Fund Reservation Process, 2002 and 2004/2005[63]



2002 Data Source: KEMA-XENERGY and Quantum Consulting, 2003.
Note that the evaluation of the 2002 Program also covered PY 2003 indirectly (respondents were asked about PY2002 and then were asked whether anything was different for PY2003).

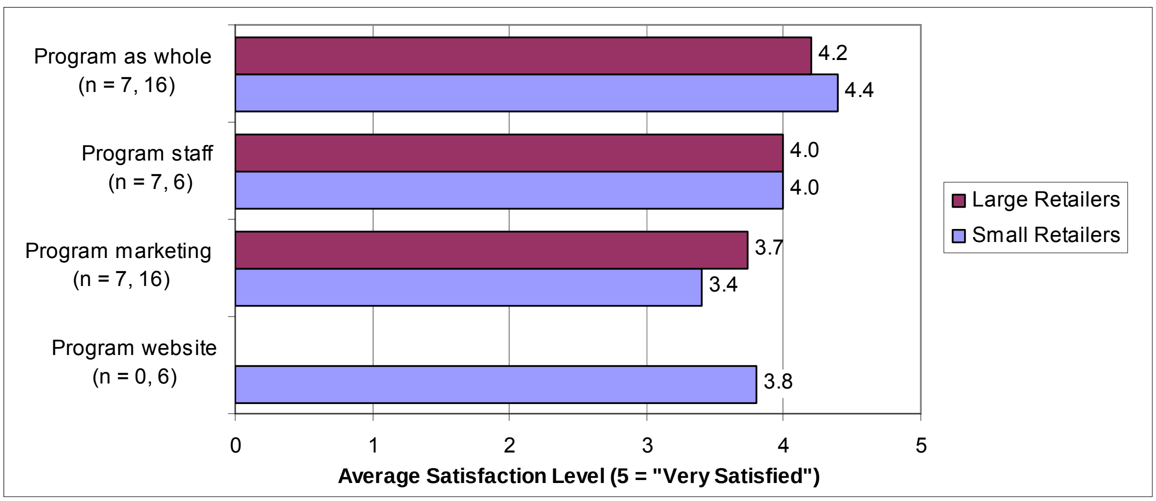
[63] KEMA-XENERGY and Quantum Consulting, 2003. Evaluation of the 2002 Statewide Crosscutting Residential Lighting Program: Final Report. Prepared for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison. October 13, 2003.

Lighting Retailers

In addition to asking lighting retailers how satisfied they were with the Program marketing efforts and website, the evaluators also asked how satisfied they were the Program staff and the Program as a whole. Figure 5-6 shows that the satisfaction levels were higher than the marketing-related Program processes, although only a few of the small retailers had interactions with the Program staff.

The few dissatisfied respondents pointed to two issues: inadequate communications from Program staff and a process for allocating the rebated CFL products that was unpredictable, confusing, and primarily controlled by the lighting manufacturers. Retailer problems with the rebate allocation process are discussed more in the next subsection.

Figure 5-6: Lighting Retailer Satisfaction Levels, 2004/2005



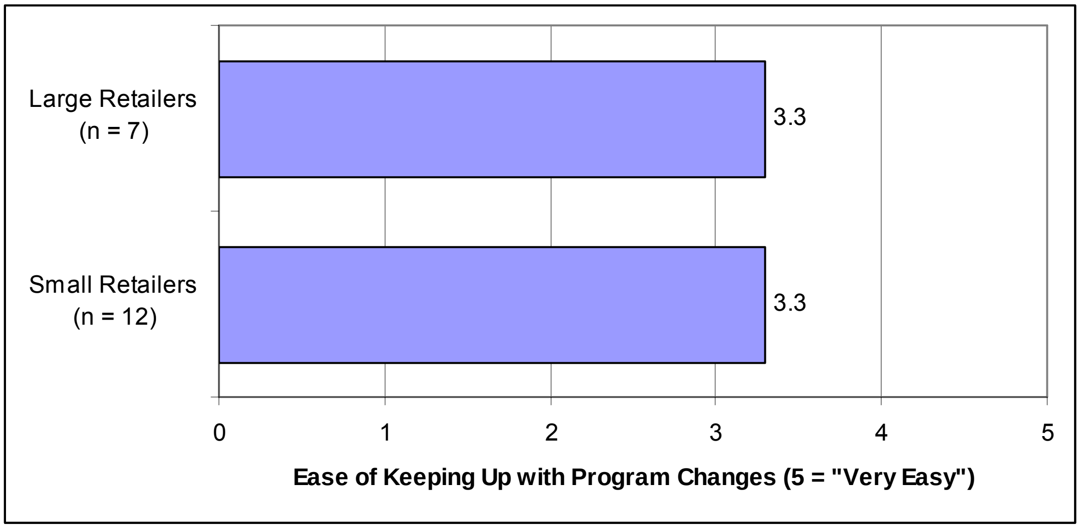
Note: None of the large lighting retailers said that they were familiar with the Program's websites and therefore did not provide satisfaction ratings.

Dissatisfaction with Program communications also emerged in response to another survey question: "How easy or difficult has it been to keep up with changes in the Program?" Figure 5-7 shows that both large and small lighting retailers gave middling ratings in terms of how easy it was to keep up with Program changes. Those who said it was difficult to keep up again pointed to the unpredictability of the rebate allocation process. One large retailer said:

> *It's a mystery as to how the Program works. The utilities don't deliver what they say they're going to deliver when they say they're going to deliver it. It's very hard to get behind the Program and market it. I have had to cancel advertising campaigns because the allocations did not come when they were supposed to.*

Most of the retailers said that they depended primarily on the lighting manufacturers to keep them informed of Program changes (although some of the large retailers also were contacted by Program staff). It should be noted that the vast majority of the lighting retailers participated through the manufacturer buydown channel of the Program, rather than the point-of-sale channel, so it is understandable that they would rely more heavily on lighting manufacturers for this information.

Figure 5-7: Lighting Retailer Ability to Track Program Changes, 2004/2005



The evaluators also asked the lighting retailers with multiple stores how they keep all their stores informed of Program changes. Communication methods included inter-store memoranda/letters, email, mailings of point-of-purchase signage, and face-to-face contact with store managers.

5.1.3 *Lighting Manufacturer Concerns About Program Assisting Low-Cost Producers*

As mentioned in Chapter 4, a number of established lighting manufacturers pointed to the SFEER Program and other rebate programs as playing key roles in giving low-cost producers legitimacy and easier access to retailers. These established manufacturers associated these new low-cost producers with lower quality CFL products. One such manufacturer remarked:

> *…The utility can only give [us] so much money. And so it allows the opportunity for other small and sometimes no-name companies who are just importing cheap CFLs from China to walk into somebody like a Wal-Mart or a Costco or a Big Lots and say, 'Hey I can give you these bulbs for free.' And what it does is that it allows them to get into a market that they never would have had a chance to get into before. And*

> *even though we may have a full 40-foot shelf of CFLs and do everyday business with Big Lots, it's allowing our competitors to go in and obtain kind of a false business.*

Not surprisingly, some of these new manufacturers had a very different perspective on the opportunities that the Program offers for new market entrants as well as the quality of their products. "With the Program a relatively small company like us gets some kind of a share to produce qualified products and provide qualified products to the general public," one of the new manufacturers said. He also defended the quality of his products:

> *They're standards like the ENERGY STAR-rated … And you've got to meet this standard in order to show your product is qualified – your quality is at that level in order to get that rebate. … It's not junk. So I think it's important for people to know that the product getting rebates – it's not a cheap product. It's a qualified product.*

Some of these newer manufacturers also pointed out that they have been pursuing retail market segments – such as discount stores and ethnic or small chain grocery stores – that many more established manufacturers have been neglecting.

5.1.4 *Lighting Manufacturer/Retailer Recommendations for Program Improvements*

The evaluators asked both lighting manufacturers and retailers to suggest ways that the Program could be improved. The following sections summarize their recommendations.

Lighting Manufacturers

Recommendations for Program improvements from lighting manufacturers included:

- *Make reporting requirements less onerous:* A number of manufacturers thought that the existing requirements for documenting product placement and submitting proofs of sales were excessive and compared California's requirements unfavorably to similar Programs in other states. "To present sales proofs is a whole another level with California than it is anywhere else," said one manufacturer. "You would think you can just give them a sales report but no, you have multiple templates to manually fill out and it's just cumbersome." "It's a horrible administrative paperwork burden," said another manufacturer. Requirements he identified as being excessive included requirements that shippers provide physical proof of delivery for every shipment, that multiple photographs be provided for every product display in every store, and that stickers must be placed on every product and every carton.
- *Provide more advanced notice of rebate allocations:* Manufacturers said that they would prefer more lead time in knowing how many CFL products they need to supply so that they do not over- or under-produce. All the manufacturers have their production plants in China and most do not have domestic inventories of bulbs. One manufacturer estimated that it takes around 60 days to get an order of CFL products

from China, and yet the Program typically only gives them 30 to 45 days of advanced notice. Manufacturers also said that a more consistent Program launch date would make it easier to time and coordinate promotions with retailers.

- *More uniformity and better coordination of Program requirements:* Manufacturers claimed that it was often difficult dealing with Program requirements or retailer allocations that were not uniform across the different service territories. One manufacturer pointed out that the utilities use different time periods for their rebate allocations. He also noted that the utilities differ in their bulb preferences with some preferring higher power factors, some preferring higher lumens, etc. Another manufacturer noted that some large retailers had to deal with multiple manufacturers depending on the service territories in which their stores were located.
- *Higher incentives for specialty bulbs:* A number of manufacturers thought that rebate levels should be raised for specialty bulbs (reflectors, dimmables, high-heat bulbs etc.).

Lighting Retailers

Recommendations for Program improvements from lighting retailers included:

- *Make allocations more consistent and timely; give retailers more control:* Many retailers said that the allocations of rebated CFLs products usually do not arrive when they are expected, and often the amount of allocated product is more or less than expected. This unpredictability can lead to allocation strategies that can make the problem even worse. For example, one small retailer was told by his manufacturer that he should "over order" the amount of product he would actually need because he probably wouldn't get everything he ordered. So the retailer submitted a higher order number – 10,000 bulbs. However, the manufacturer raised the allocation to 16,000 bulbs, figuring that only a portion of these would actually be allocated. Yet it turned out that all 16,000 bulbs were allocated and now the retailer has nowhere to store them all. One of the Program's largest retailers said that it didn't make sense that his stores are selling large volumes of CFLs through the Program and yet they have little or no say in how allocations are determined.
- *Better marketing strategies:* Retailers recommended more television and newspaper advertising, greater use of cooperative ads that feature both manufacturers and retailers, more creative point-of-purchase displays, and greater use of manufacturing representatives as an arm of the Program marketing efforts.
- *Better Program communications with participating retailers:* A number of retailers thought that Program communications could be a lot better, especially with smaller retailers and those in rural or ethnic communities. For example, a couple of the small retailers said that they had only recently learned that specialty CFLs were eligible for rebates.

5.1.5 *Net-to-Gross Analysis*

The evaluators chose an upstream approach for calculating the net-to-gross (NTG) factors for lighting. Lighting manufacturers and retailers were asked to estimate free-ridership rates for their CF products that received financial incentives from the SFEER Program.

There are a number of good reasons for an upstream approach. We believe that lighting manufactures and retailers are more knowledgeable than end users about the effect of financial incentives on CFL sales. For example, lighting manufacturers in the Upstream Lighting component of the Program chose the CF products for which the Program provided incentives as well as their preferred retail channels and in-store promotional strategies. The relative transparency of the manufacturer buydown and point-of-sale incentives (POS) to the customer, as opposed to mail-in rebates, for example, also makes it more doubtful that a customer would recall having received a Program discount on a CF product or the size of the discount. Finally, there is an important logistical barrier to a downstream NTG approach: the Program has no records of individual customers who received the manufacturer buydown or point-of-sale incentives.

This section shows the free-ridership estimates provided by lighting manufacturers and retailers of CF products for which the SFEER Program provided incentives, mostly through the Upstream Lighting component. The section also explains how the evaluators arrived at these estimates. The net-to-gross ratios – the inverses of the free-ridership rates presented in this section -- will be applied to the verified gross CF product savings estimates explained in Chapter 6. Utility-specific net-to-gross estimates are also presented in Chapter 6.

The evaluators asked lighting manufacturers and lighting retailers to estimate the Program's impact on their 2004/2005 sales of CF products for which the Program provided incentives in terms of how their sales would have differed if Program incentives had not been available. These manufacturers and retailers were asked to provide free-ridership estimates that were differentiated based on three different criteria:

- *Retailer category* –Distinct free-ridership rates were sought for six different lighting retailer categories: general merchandise/big box, large home improvement, grocery, drug, discount, and small hardware. General merchandise/big box stores include those such as Costco and Wal-Mart. Large home improvement stores include those such as Home Depot or Lowe's. These six retailer categories were identified as useful disaggregations based on interviews with Program staff and other lighting market experts. There was also a small group of miscellaneous participants that included lighting stores, electronic stores, and non-retailers for which free-ridership estimates were not collected. However, these miscellaneous participants only accounted for about two percent of CF products for which the Program provided incentives.
- *Compact fluorescent (CF) product type:* Distinct free-ridership rates were also sought for four different categories of CF products: low-Wattage CFLs, specialty CFLs, CF

fixtures, and CF torchieres. Low-wattage CFLs are those of less than 30 Watts that do not have any special characteristics such as reflectors or dimming capabilities. Specialty CFLs are those that are 30 Watts or greater or which have these special characteristics. During the 2004/2005 program years the vast majority of products for which the Program provided incentives were low-Wattage CFLs.

- *Incentive type:* Distinct free-ridership rates were sought for two different categories of SFEER Program incentives: manufacturer buydowns and point-of-sale. During the 2004/2005 Program years, the vast majority of incentives were manufacturer buydowns.

Table 5-1 shows the free-ridership rates for low-Wattage CFL bulbs for which the SFEER Program provided incentives. As the bottom row of the table indicates, low-Wattage CFL bulbs accounted for 97 percent of the CF products incentivized by the program. The table also provides information on the volume of low-Wattage CFL bulbs for which the Program provided incentives in each category, the number of market actors providing free-ridership estimates for this retail category/CF product combination, and the share of incentivized products that these manufacturers/retailers represented of the retailer category/CF product combination. The number of Program CF products sold by the manufacturer/retailer free-ridership estimators (Column G) was used to produce the combined weighted free-ridership estimates appearing in Column I. Only one of the retailers participating in both the manufacturer buydown and point-of-sale components of the 2004/2005 SFEER Program provided free-ridership estimates and these estimates were the same for both incentive types. Therefore separate free-ridership estimates based on incentive type are not presented in the table.

Table 5-1: Free-ridership Rates for Low-Wattage CFLs Receiving Incentives by Retailer Category, 2004/2005

A	B	C	D	E	F	G	H	I
Retailer category	# of Low-Wattage CFLs Sold Through 2004/2005 Program (N)	% of Total Low-Wattage CFLs Sold Through 2004/2005 Program	Lighting Market Actor	# of Market Actors Providing FR Estimates for Retail Category	# of Incentivized Low-Wattage CFLs Sold Through Program by FR Estimator (n)	Estimators' Representation of Total Low-Wattage CFLs Sold Through Program for Retail Category (N/n)	Market Actor Sales-Weighted Free Ridership Estimates	Combined Sales-Weighted Free Ridership Estimate
General Merchandise/ Big Box	3,146,140	21%	Manufacturers	1	1,049,444	55%*, 33%**	**63%**	**75%**
			Retailers	1	2,283,338	73%**	**80%**	
Large Home Improvement	1,337,244	9%	Manufacturers	3	968,208	72%	**63%**	**66%**
			Retailers	1	130,662	10%	**85%**	
Grocery	6,310,142	43%	Manufacturers	9	4,435,512	70%	**21%**	**16%**
			Retailers	7	2,127,680	34%	**6%**	
Drug	2,192,366	15%	Manufacturers	3	1,537,972	70%	**41%**	**41%**
			Retailers	1	1,000	<1%	**5%**	
Discount	940,162	6%	Manufacturers	5	884,806	94%	**3%**	**3%**
			Retailers	0	-			
Small Hardware	593,264	4%	Manufacturers	3	160,366	27%	**63%**	**52%**
			Retailers	9	76,606	13%	**29%**	
Other	269,706	2%	No free ridership estimate sought for this retailer category					
Total	**14,789,024**	**100%**			**10,270,202**	**69%**		**38%**
% of All 2004-2005 Rebated CF Products Represented by Table						**97%**		

* Percentage based on using manufacture buydown incentives only as denominator.

** Percentage based on using manufacture buydown and point-of-sale incentives as a denominator.

Note that the total in Column F is based on summing the highest number in Column F for each retailer category. For each retailer category there is usually some overlap between low-wattage CFLs sold through the Program as accounted for by manufacturer and retailers so these cannot be added together without double-counting. Since no free-ridership estimates were obtained for the Other retailer category, the weighted average free-ridership rate for the rest of the retailer categories was used as a proxy in calculating the overall sales-weighted free-ridership rate (38%).

The overall sales-weighted free-ridership rate for the low-Wattage CFLs is 38 percent. This was calculated by weighting the free-ridership estimates in Column I with the number of low-Wattage CFLs for which the Program provided incentives appearing in Column B.

The table shows that free-ridership estimates for low-Wattage CFLs vary widely depending on what type of retailer through which they are sold. The manufacturers and retailers estimated high free-ridership rates for low-Wattage CFLs sold through general merchandise/big box and large home improvement stores, middling free-ridership rates for

CFLs sold through drug and small hardware stores, and low free-ridership rates for CFLs sold through grocery and discount stores.

Low free-ridership rates for grocery and discount stores, which accounted for about half of the incentivized low-Wattage CFLs, were influential in reducing the overall free-ridership rate. In particular, free-ridership is low among discount stores because they have 99¢/$1 price limits on their products and would simply not be able to sell such CFLs without the Program incentives.

Free-ridership rates are lower for grocery stores than large home improvement stores or general merchandise/big box stores because shoppers in the former are more price-sensitive than in the latter. This is borne out not only by the observations of lighting manufacturers and retailers interviewed for this study, but also by the end user survey results discussed later in this chapter (see Section 5.2). The lighting manufacturers and retailers identified that grocery store customers are more likely to comparison shop between CFLs and incandescent bulbs because these products are likely to be placed very close together. Thus, price differences between CFLs and incandescent bulbs become much more prominent and important in a customer's purchasing decision. In large home improvement and general merchandise/big box stores, CFLs and incandescent bulbs are likely to be placed further apart thus discouraging comparison shopping by casual shoppers. In addition, consumers shopping for light bulbs in large home improvement stores, such as "do-it-yourselfers," are likely to have a specific type of light bulb in mind when they enter the store. They are thus unlikely to comparison shop and will likely buy the CFL they were seeking whether it costs $4.50 or $2.50.

There are also other factors that help explain why free-ridership rates are lower for grocery stores than large home improvement stores or general merchandise/big box stores. One lighting expert noted that while a $4.50 CFL (for which no Program incentive was provided) would be a very small-ticket item for a person shopping at a large home improvement store, it would be a bigger ticket item for a person shopping at a grocery store. Finally, the interviews revealed that some very large general merchandise/big box chains set their prices for CFLs based on their own internal pricing strategies that are not based on whether SFEER Program incentives are available.

These explanations of differences in shopper behavior and price sensitivity help make the free-ridership estimate more credible. Further support for these estimates is the lack of variance in these estimates for certain retailer categories. For example, the manufacturers' weighted average estimate of free-ridership for the grocery stores was 21 percent, and eight of the nine manufacturers independently provided estimates in the zero to 30 percent range. The retailers' weighted average estimate of free-ridership for the grocery stores was 6 percent and six of the seven retailers independently provided estimates in the zero to 13 percent range.

The lighting manufacturers who provided free-ridership estimates were also the major participants in the Program, even though the number of manufacturers was relatively small. Table 5-1 above shows that the manufacturers providing free-ridership estimates accounted for the large majority (70 to 94%) of the low-Wattage CFLs sold through large home improvement, grocery, drug, and discount stores.

The evaluators had less success completing interviews with lighting retailers – especially large retailers – than lighting manufacturers. Retailers providing free-ridership estimates were, with the exception of the general merchandise/big box retailer category, representative of only a small minority of the Program-discounted low-Wattage CFLs. However, since the retailer category free-ridership estimates were weighted by sales, these estimates were appropriately weighted according to their Program representation. Overall the manufacturers or retailers providing free-ridership estimates accounted for 69 percent of the low-Wattage CFLs discounted by the Program.

The retailer category in which the highest variance in free-ridership estimates was apparent was the small hardware category. There was considerable variance in the estimates provided by both lighting manufacturing and retailers. One possible explanation for this is that a small hardware store's need for Program incentives is greatly dependent on whether it is competing against a large home improvement store. As discussed in the spillover section of this chapter, some lighting manufacturers even give their own price subsidies in addition to the SFEER Program incentives to assist small hardware stores who are facing such price competition. Small hardware stores are also likely to have more variance in their free-ridership estimates because this retailer category is comprised of independent and franchise stores that make decisions based on the local conditions and that have a lot of autonomy as far as what to stock and promote. This is in contrast to national chains where decision-making is more centralized.

Table 5-2 and Table 5-3 show the free-ridership estimates for specialty CFLs and CF fixtures. Together these products accounted for only 3 percent of the total CF products for which the Program provided incentives in 2004/2005. This small number of CF products also meant that the number of lighting manufacturer and retailers available to provide free-ridership estimates was very limited. For a few retailer category/CF product combinations – such as specialty CFLs in large home improvement stores or CF fixtures in discount stores – the free-ridership estimators accounted for a large volume of Program incentives. However, these were the exception rather than the rule and in general, these free-ridership estimates are less reliable than those for the low-Wattage CFLs. The evaluators were unable to obtain any free-ridership estimates for CF torchieres, as Table 5-4 shows. CF torchieres only accounted for less than 1 percent the total CF products for which the Program provided incentives.

Table 5-2: Free-ridership Rates for Specialty CFLs Receiving Program Incentives by Retailer Category, 2004/2005[64]

A	B	C	D	E	F	G	H	I
Retailer category	**# of Specialty CFLs Sold Through the 2004/2005 Program (N)**	**% of Total Specialty CFLs Sold Through the Program**	**Lighting Market Actor**	**# of Market Actors Providing FR Estimates for Retail Category**	**# of Specialty CFLs Sold Through the Program by FR Estimator (n)**	**Estimators' Representation of Total Specialty CFLs Sold Through the Program for Retail Category (N/n)**	**Market Actor Sales-Weighted Free Ridership Estimates**	**Combined Sales-Weighted Free Ridership Estimate**
General Merchandise/ Big Box	51,120	49%	Manufacturers	0	-			
			Retailers	0	-			
Large Home Improvement	49,824	48%	Manufacturers	1	42,336	85%	**28%**	**28%**
			Retailers	0	-			
Grocery	0	0%	None rebated by 2004-2005 program					
Drug	0	0%	None rebated by 2004-2005 program					
Discount	0	0%	None rebated by 2004-2005 program					
Small Hardware	936	1%	Manufacturers	0	-			
			Retailers	0	-			
Other	1,932	2%	No free ridership estimates sought for this retailer category					
Total	**103,812**	**100%**			**42,336**	**41%**		**28%**
% of All 2004-2005 Rebated CF Products Represented by Table						**1%**		

[64] Due to the nature of the data received from SCE this next series of tables (Table 5-2 through 5-5) includes lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Table 5-3: Free-ridership Rates for CF Fixtures Receiving Program Incentives by Retailer Category, 2004/2005*[65]

A	B	C	D	E	F	G	H	I
Retailer category	# of CF Fixtures Sold Through the 2004/2005 Program (N)	% of Total CF Fixtures Sold Through the Program	Lighting Market Actor	# of Market Actors Providing FR Estimates for Retail Category	# of CF Fixtures Sold Through the Program by FR Estimator (n)	Estimators' Representation of Total CF Fixtures Sold Through the Program for Retail Category (N/n)	Market Actor Sales-Weighted Free Ridership Estimates	Combined Sales-Weighted Free Ridership Estimate
General Merchandise/ Big Box	240,235	66%	Manufacturers	0				**80%**
			Retailers	1	59,367	25%	**80%**	
Large Home Improvement	62,658	17%	Manufacturers	1	8,088	13%	**28%**	**28%**
			Retailers	0	-			
Grocery	6,894	2%	Manufacturers	0				
			Retailers	0				
Drug	0	0%	None rebated by 2004-2005 program					
Discount	31,220	9%	Manufacturers	1	30,500	98%	**30%**	**30%**
			Retailers	0				
Small Hardware	9,365	3%	Manufacturers	0	-			
			Retailers	0	-			
Other	13,584	4%	No free ridership estimates sought for this retailer category					
Total	**363,956**	**100%**			**97,955**	**27%**		**64%**
% of All 2004-2005 Rebated CF Products Represented by Table						**2%**		

* For the missing free-ridership estimates for grocery and small hardware stores the free-ridership estimates for low-Wattage CFLs were used to calculate the overall free-ridership rate (62%). Since no free-ridership estimates were obtained for the Other retailer category, the weighted average free-ridership rate for all the rest of the retailer categories was also used as a proxy for the Other retailer category in calculating the overall sales-weighted free-ridership rate.

[65] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Table 5-4: CF Torchieres Receiving Program Incentives by Retailer Category, 2004/2005[66]

A	B	C	D	E	F	G	H	I
Retailer category	# of CF Torchieres Sold Through the 2004/2005 Program (N)	% of Total CF Torchieres Sold Through the Program	Lighting Market Actor	# of Market Actors Providing FR Estimates for Retail Category	# of CF Torchieres Sold Through the Program by FR Estimator (n)	Estimators' Representation of Total CF Torchieres Sold Through the Program for Retail Category (N/n)	Market Actor Sales-Weighted Free Ridership Estimates	Combined Sales-Weighted Free Ridership Estimate
General Merchandise/ Big Box	0	0%	None rebated by 2004-2005 program					
Large Home Improvement	9,481	62%	Manufacturers	0	-			
			Retailers	0	-			
Grocery	1,892	12%	Manufacturers	0	-			
			Retailers	0	-			
Drug	0	0%	None rebated by 2004-2005 program					
Discount	0	0%	None rebated by 2004-2005 program					
Small Hardware	110	1%	Manufacturers	0	-			
			Retailers	0	-			
Other	3,849	25%	No free ridership estimates sought for this retailer category					
Total	**15,332**	**100%**			-	**0%**		
% of All 2004-2005 Rebated CF Products Represented by Table						**0%**		

[66] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Table 5-5 summarizes the information from the previous four tables. It shows that the Program's overall free-ridership rate for lighting is 38 percent – about the same as the free-ridership rate for low-Wattage CFLs due to the very large weight for this product category. The relatively high representation of manufacturers and retailers providing free-ridership estimates for low-Wattage CFLs (69 percent) also figures heavily in the representation percentage for the Program as a whole.

Table 5-5: Free-ridership Rates by CF Product Type*[67]

A	B	C	D	E	F
CF Product Category	**# of CF Products Sold Through the 2004/2005 Program (N)**	**% of Total CF Products Sold Through the Program**	**# of CF Products Sold Through the Program Represented by Free Ridership Respondents (n)**	**% of Total CF Products Sold Through the Program Represented by Free Ridership Respondents (N/n)**	**Combined Sales-Weighted Free Ridership Estimate**
Low-Wattage CFLs	14,789,024	97%	10,270,202	69%	**38%**
Specialty CFLs	103,812	1%	42,336	41%	**28%**
CF Fixtures	363,956	2%	97,955	27%	**64%**
CF Torchieres	15,332	<1%	-	0%	**N/A**
Total	**15,272,124**	**100%**	**10,410,493**	**68%**	**38%**

***** Since no free-ridership estimates were obtained for the **CF Torchiere** category, the weighted average free-ridership rate for all the rest of the **CF product** categories was used as a proxy for the **CF Torchiere** category in calculating the overall sales-weighted free-ridership rate. **The total percentage in Column E is the total in Column D divided by the total in Column B.**

5.1.6 *SFEER Program Spillover*

This section describes the findings from interviews with participating lighting manufacturers and retailers concerning spillover effects – both spillover effects from the SFEER Program in particular as well as spillover effects from past and current California IOU lighting incentive programs in general. Although current California M&V protocols do not allow spillover effects to be used in the calculation of net savings, the CPUC and SFEER Program managers expressed great interest in gaining some understanding of the extent of these effects.

Both lighting manufacturers and large lighting retailers were asked about possible spillover effects from their participation in the SFEER Program. Such spillover effects would be increased sales of CFL products due to Program influence but not directly due to the receipt of Program incentives. The participating manufacturers and retailers were asked directly about one type spillover benefits to consumers resulting from the influence of SFEER

[67] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Program incentives – lag incentives. They were then asked an open-ended question as to what effects, if any, they thought that the Program might have on the sales and purchase of CFL bulbs for which the Program did not provide incentives. The following is a summary of these spillover and related effects:

- *Lag incentives* – Because the Program incentives were not always available – due to Program interruptions or a retailer's allocation of Program-discounted product running out – lighting manufacturers and large lighting retailers were asked what would happen to the CFL product price point when the incentive went away. All 14 of the manufacturers and 4 of the large lighting retailers said that when the Program incentives went away the bulb prices would go up. However, four of the manufacturers said that they would take actions to mitigate the impact of this disappearing incentive. Two of the manufacturers said that they would not allow their bulbs to return to the full pre-incentive prices, but would provide some carryover discount of their own – especially for bulbs sold in retailer categories (grocery, drugstores) where direct competition with incandescent bulbs makes lower CFL price points all the more important. Two other manufacturers said that if incentives suddenly went away, they would allow their retailers to sell the remaining bulbs that had been ordered under the Program at the incentive price point, even if they (the manufacturers) had to subsidize the cost.
- *Participant spillover* – Four of the lighting manufacturers noted that if people have a positive experience with the CFLs for which the Program provided incentives, they may continue to purchase CFL bulbs even at non-incentive price points.
- *Discounts for non-Program lighting products* - One lighting manufacturer reported that the Program incentives had forced him to offer discounts on his non-Program lighting products. He cited the example of a 24W ENERGY STAR-rated bulb that he is selling through the Program. If he wants to sell the same or similar product to one of his lighting distributors he has to offer a similar discount as that given by the Program. Because if he doesn't, "they can buy from a 99 cent store at very low price, much lower than my price to them." He said that he has given these additional discounts not only for non-Program CFL products, but also for incandescent and halogen lamps. "I hate to do this because it can reduce our margins," he said, "but sometimes I have to."
- *Non energy positive effects from increased foot traffic and product visibility:* One manufacturer thought that the increased foot traffic generated by the Program incentives "helped the sell rate of the [energy-efficient lighting] products that were carried on the shelf and weren't being promoted." "Any time you get an extra consumer into the stores," she said, "you have an opportunity for a sale." She also thought that the more prominent positioning of the Program products would also encourage sales of the non-Program products.
- *Matching incentives* – Participating lighting manufacturers and large lighting retailers were asked whether they provide any of their own discounts for CFLs discounted by the Program in addition to the Program incentives. It is important to note that these "matching incentives" *would not* produce spillover savings as they are strictly

defined, since the bulbs receiving these matching incentives will already be counted toward the Program savings goals. However, these matching incentives from the manufacturers or retailers could lead to *more* Program-rebated products being sold than the Program incentive alone (since the ultimate price of the product is lower). Eight of the 14 lighting manufacturers and 1 of the 7 large lighting retailers said that they did offer additional price reductions of their own, with the main purpose of these discounts being a further narrowing of the price gap between CFLs and incandescent bulbs. A number of the manufacturers said that they offered these additional price discounts to some retailers but not others. For example they would offer these additional discounts to types of retailers – such as discount, drug, or grocery stores – where consumers expect a lower price point, or to small hardware stores that compete against large home improvement stores. However, they would not offer these same discounts to big box or large home improvement stores because their price.

- *Negative effects:* A number of manufacturers noted that by reducing the price point for CFL products, the program also created new expectations about what was a reasonable price for a CFL product. This could reduce sales of CFL products that were not receiving Program incentives. "If they could buy the bulb for $1.99 and all the others are $5.99 or $6.99," explained one manufacturer, "they might not want to buy those and want everything for $1.99."

5.1.7 *Generic California CFL Program Market Effects*

Because California programs have been offering rebates on CFL bulbs for a number of years, the evaluators were interested in getting the perspective of lighting manufacturers on the market effects of these programs. More specifically, the evaluators were interested in how these long-term rebates have affected the prices, quality, and familiarity/acceptability of all CFL bulbs, whether these received program rebates or not. Table 5-6 summarizes the responses of the lighting manufacturers. It shows that at least half of the lighting manufacturers thought that the California CFL rebate programs were "very important" in decreasing the price point, increasing the quality, and increasing the customer familiarity/acceptability of all CFL bulbs.

Table 5-6: Lighting Manufacturer Assessments of the Market Effects of Long-Term California CFL Programs, 2004/2005

Market Effect	Summary of question	Importance of Influence of Long-Term California CFL Programs				
		Very important	Somewhat important	Slightly important	Not very important	Not at all important
Long-term price effects	Importance of long-term California CFL rebate programs on decreases in all CFL prices, included non-rebated CFLs?	50%	21%	7%	14%	7%
Lon-term quality effects	Importance of long-term California CFL rebate programs on increases in CFL quality, including non-rebated CFLs?	64%	14%	7%	7%	7%
Long-term customer familiarity/acceptability effects	Importance of long-term California CFL rebate programs on increases in consumer familiarity and acceptability of CF products?	57%	14%	14%	0%	14%

5.2 Consumer Summary

Section 4.3 of the report provided background on CFL awareness and purchase rates among the general population. This section of the report focuses on consumers who purchased CFLs during 2004 and/or 2005 and discusses when consumers purchase CFLs as well as various influences on consumer purchasing decisions (e.g., in-store marketing materials or product discounts).

As reported previously, the Lighting component of the Program is delivered upstream and customer-specific data are not collected at the point of sale. Thus, the evaluators were unable to obtain a list of 2004/2005 Program Participants from which to draw our sample. Instead, the evaluators conducted random-digit dialing within utility service territories and relied on customer self-reports of CFL purchase activity to identify whether customers purchased CFLs during 2004 or 2005. While these purchasers may not have bought CFLs specifically rebated by the Program, it is possible that some proportion of CFL purchases in 2004 and 2005 were either directly or indirectly influenced by the Program because of its powerful influence on the market.[68] This section thus focuses on CFL purchases during 2004 and 2005.[69]

Table 5-7 shows the proportion of CFL purchasers who purchased CFLs by year. The surveys were fielded in early 2007, and more than half of CFL purchasers had purchased CFLs after 2005 (i.e., after the Program period). All together, two-thirds of the CFL purchasers surveyed bought CFLs in 2004 or 2005 (67%). The remainder of this section focuses on these 2004/2005 Purchasers.

[68] The program's effects on CFL sales prior to 2004 are well documented in the prior evaluation studies including the KEMA-XENERGY and Quantum Consulting's 2003 "Evaluation of the 2002 Statewide Crosscutting Residential Lighting Program: Final Report" prepared for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison. October 13, 2003.

[69] In addition to identifying consumers who bought CFLs in 2004 and 2005, the evaluators also asked 2004/2005 purchasers whether they recall receiving a discount on their purchases (which may indicate Program participation); these results are presented below.

Table 5-7: When Consumers Purchased CFLs, 2006 Survey*

CFL Purchase Year	% of CFL Purchasers
Prior to 2004	9%
2004	46%
2005	63%
2006	56%
2007	8%
Don't know	2%
N	**756**

* Multiple responses allowed; results may total more than 100 percent.
Data source: General Population Telephone Survey, 2006.

5.2.1 *Program Influence*

Promotion

The evaluators asked 2004/2005 CFL purchasers if they purchased their CFLs during a special sale or promotion. Roughly one-fourth said they recalled receiving a discount (24%). Based on these results, one can extrapolate that approximately 16 percent of the 2005 California population received discounts for CFLs purchased in 2004 or 2005.[70]

Sixty-three percent of 2004/2005 purchasers who recalled receiving a discount indicated that they would have been somewhat likely, not very likely, or very unlikely to purchase CFLs in absence of the discount (Table 5-8) and 81 percent indicated that the discount encouraged them to purchase more CFLs than they would have in its absence (Table 5-9). Each of these proportions is higher than among Participants in the 2002 Statewide Crosscutting Residential Lighting Program by a statistically significant margin.

When these two types of influences are taken together, more than nine out of ten 2004/2005 purchasers who recalled receiving a discount were influenced to some degree by the discount (91%). The proportion of 2004/2005 purchasers who were influenced by the discount is far greater than the proportion of 2002 Program purchasers (75%; a statistically significant difference). These results may reflect the increased purchaser base, as declining CFL prices may have made them more appealing to consumers who are focused on price.

[70] Based on 2005 estimate of California population (36,132,147) from the U.S. Census Bureau: U.S. Census, 2007. Annual Estimates of the Population for the United States and States, and for Puerto Rico: April 1, 2000 to July 1, 2005 (NST-EST2005-01). Updated January 10, 2007. On the web at http://www.census.gov/popest/states/tables/NST-EST2005-01.xls.

Table 5-8: Likelihood of Purchasing CFLs in Absence of the Discount Among CF: Purchasers Over Time[71]

Likelihood	% of CFL Purchasers Who Purchased During a Promotion	
	2002 Program	2004/2005 Program
Very likely	52%	34%*
Somewhat likely	20%	37%*
Not very likely	17%	17%
Very unlikely	8%	9%
Don't know	-	3%
n	**101**	**131**

* Difference from 2002 Program is statistically significant at the 90 percent level of confidence.
2002 Program data source: KEMA-XENERGY and Quantum Consulting, 2003.
2004/2005 Program data source: General Population Telephone Survey, 2006.

Table 5-9: Whether Discount Encouraged Purchasers to Buy More CFLs Among 2004/2005 Purchasers Over Time

Response	% of 2004/2005 Purchasers Who Purchased During a Promotion	
	2002 Program	2004/2005 Program
Yes	61%	81%*
No	39%	18%*
Don't know	0%	1%
n	**101**	**131**

* Difference from 2002 Program is statistically significant at the 90 percent level of confidence.
2002 Program data source: KEMA-XENERGY and Quantum Consulting, 2003.
2004/2005 Program data source: General Population Telephone Survey, 2006.

<u>Retail Marketing Materials</u>

The Upstream Lighting component of the 2004/2005 SFEER Program included in-store marketing materials such as point-of-purchase displays, signage, and stickers (see Chapter 3 for marketing details). The evaluators asked 2004/2005 CFL purchasers whether they noticed any CFL displays, information, or signage when they purchased their bulbs and, of those who saw the informational materials, how likely they would have been to purchase CFLs if they had not seen the materials.

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71 KEMA-XENERGY and Quantum Consulting, 2003. Evaluation of the 2002 Statewide Crosscutting Residential Lighting Program: Final Report. Prepared for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison. October 13, 2003.

One-third of 2004/2005 CFL purchasers reportedly noticed retailer advertising related to CFLs displayed in the store. This proportion is statistically unchanged from the 2002 Program, during which 36 percent reportedly noticed in-store advertising.

As shown in Table 5-10, the in-store displays were at least somewhat influential for approximately 72 percent of purchasers who noticed the displays (39 percent said the materials were "very influential" and an additional 33 percent said they were "somewhat influential"). Although the question was asked differently during the evaluation of the 2002 Statewide Crosscutting Residential Lighting Program, this appears to be an increase over the proportion of participants who found the in-store materials influential when the 2002 was evaluated.[72] It is possible that the materials were more influential during the 2004/2005 period because many of the lighting manufacturers responsible for in-store materials had a few more years of Program experience and my have refined their messaging and/or improved their in-store marketing techniques.

Table 5-10: Influence of Marketing Materials on CFL Purchase Decision Among 2004/2005 Purchasers

Likelihood	% of 2004/2005 Purchasers Who Noticed In-Store Marketing Materials
Very influential	33%
Somewhat influential	39%
Not at all influential	27%
Don't know	1%
n	**199**

Data source: General Population Telephone Survey, 2006.

5.2.2 *Indirect Influence of Program Incentive*

The average self-reported price paid for CFLs by 2004/2005 purchasers ranged from $0.25 to $12.00 and averaged $2.50 per bulb.[73] If discounts were applied to CFLs (e.g., through the Upstream Lighting component of the Program), the likely discount amount was $2.00. To elucidate whether 2004/2005 CFL purchasers would still have purchased CFLs in absence of this discount, interviewers asked whether they would still have purchased the CFLs if each bulb cost $2.00 more. Nearly half of purchasers said they would have purchased the CFLs for

[72] Respondents were asked to rate their likelihood of purchasing CFLs if they had not seen in-store displays on a 10-point scale where 1 means "very unlikely" and 10 means "very likely;" 42 percent said they would have been "very likely" to purchase CFLs if they had not seen the in-store materials (ratings of 8, 9, or 10).

[73] This is a bulb-weighted average.

$2.00 more per bulb (46%) while a similar proportion said they would *not* have purchased the CFLs (44 percent). These results indicate that a $2.00 discount has some level of influence on the CFL purchasing decisions of approximately 2 out of 5 CFL purchasers.

A significantly smaller proportion of consumers who made their most recent CFL purchase at supermarkets reported that they would have been willing to pay an additional $2.00 for the CFLs they purchased than in any other store type (31%). These results indicate that shoppers who buy CFLs in supermarkets may be more price-sensitive than shoppers who buy them elsewhere, and that CFL prices in these retail outlets must remain low to encourage future purchases.

Table 5-11: Willingness to Purchase CFLs at $2.00 More Than Price Paid Among 2004/2005 Purchasers

Store Type	% of 2004/2005 Purchasers Willing to Pay $2.00 More
Home improvement/hardware store	52%
Big box store	49%
Costco	43%
Supermarket	31%*
Drug store	45%
n	**219**

* Difference from other store types is statistically significant at the 90 percent level of confidence.
Data source: General Population Telephone Survey, 2006.

6

Lighting Impact Assessment

This section presents results from the lighting verification activities completed as part of this evaluation, a summary of the gross impact methods and results, and a summary of the net impact methods and results, for lighting measures rebated by the Program. First, we present the results of the verification activities, followed by the per unit gross electricity and demand savings estimate, and then present net-to-gross results. This section is concluded with a presentation of the effective useful life (EUL) estimates used in this evaluation.

6.1 Verification Results

6.1.1 *Overview of Verification Activities*

Verifying energy and peak demand savings was a key objective of this study to be met through primary research. Three separate Lighting verification activities were conducted to verify various aspects of the program accomplishments. The specific activities that were conducted are as follows:

1. **Application Verification** - Verify that lighting vendor invoices were correctly entered into the program tracking systems, for a sample of applications. Also verify that the rebated equipment was program qualifying by comparing the vendor invoices attached to the applications with the qualifying requirements for lighting measures.
2. **Measure Accomplishments Verification** - Verify that the total number of units rebated through the Program by measure type, as reported by each IOU[74], match the Program tracking systems.
3. **HTR Accomplishments Verification** - Verify that the percent of participants that received incentives in HTR segments (based on geographic location and retailer type for lighting measures) as reported by each IOU, match the Program tracking systems.

[74] Sources for the final number of rebated units varied by Utility. PG&E was based upon the *Residential Summary Database*, SCE was based upon the *Annual Energy Efficiency Reports* (May 2005/May 2006), and SDG&E and SCG were based on the *December 2005 Statewide Residential Single Family Rebate Workbooks.*

6.1.2 *Approach*

In order to conduct these activities, the Itron/KEMA Team obtained the following detailed information from each IOU:

- A sample of approximately 35 retailer/manufacturer invoices from PG&E, SCE and SDG&E (105 total) for a subset of lighting measures,
- The program tracking systems,
- Definitions and data sources used to classify participants as hard-to-reach,
- Reports of final SFEER Lighting Program performance. The reports received varied by utility (PG&E provided figures from the *Residential Summary Database*, SCE provided the *Annual Energy Efficiency Reports* (May 2005/May 2006), and SDG&E and SCG provided the *December 2005 Statewide Residential Single Family Rebate Workbooks.)*

6.1.3 *Findings*

The results of the five verification activities for the SFEER Lighting Program are presented in this section.

<u>Application Verification</u>

To ensure that all key parameters were entered correctly into the program tracking system a total of 105 lighting vendor invoices were verified across three of the IOUs (35 for PG&E, SCE and SDG&E). This verification also ensured that all rebated equipment was program qualifying.

PG&E: Itron randomly selected 35 upstream lighting rebates for verification. PG&E provided the rebate applications and the corresponding vendor invoices for verification. The payee, measure description, quantity, and rebate amounts were compared with the entries in PG&E's tracking database. All of the 35 upstream lighting rebates were verified.

SCE: Itron randomly selected 35 upstream lighting rebates for verification. The rebate applications and corresponding vendor invoices were obtained from SCE for verification. The payee, measure description, quantity, and rebate amounts were compared with the entries in SCE's tracking database. All but one of the 35 upstream lighting rebates were verified (no invoice was provided by SCE for this rebate).

SDG&E: Itron randomly selected 35 upstream lighting rebates for verification. The rebate applications and corresponding vendor invoices were obtained for verification. The payee, measure description, quantity, and rebate amounts were compared with the entries in SDG&E's tracking database. All available lighting invoices were correctly entered in the tracking database.

Measure Accomplishments Verification

To verify measure accomplishments the Itron team calculated the total number of units rebated through the program by measure type, based on each IOUs tracking data. These figures were compared to the final reports provided by each of the IOUs (the reports varied by IOU – for PG&E the figures are based on the *Residential Summary Database*, for SCE they are based on the *Annual Energy Efficiency Reports* (May 2005/May 2006), and for SDG&E and SCG they are based on the *December 2005 Statewide Residential Single Family Rebate Workbooks.* Table 6-1 below summarizes the findings of the measure accomplishments verification task by measure and IOU.

Table 6-1: Comparison of Lighting Measure Accomplishments, by IOU Tracking Database vs. Final IOU Reported Values[75]

Measure Description	PG&E		SCE		SDG&E	
	Database	Reported	Database	Reported	Database	Reported
ENERGY STAR® (ES) CFL 450 to 799 Lumens	409,390	425,678	26,507	26,507	14,330	14,330
ES CFL 800 to 1,099 Lumens	2,387,725	2,079,976	410,334	410,334	285,980	285,980
ES CFL 1,100 to 2,599 Lumens	5,915,686	5,690,158	802,890	792,890	1,359,422	1,359,422
ES CFL 2,600 Lumens or Greater	13,824	13,824	0	0	0	0
ES Int./ or Ext. Fixture Less Than 1,100 Lumens	1,782	1,902	1,089	1,089	0	0
ES Int./ or Ext. Fixture 1,100 Lumens or Greater	191,799	197,255	57,468	57,468	3,768	3,768
ES Torchiere < 65 Watt	1,640	1,640	300	300	0	0
ES Torchiere > 65 Watt	10,877	12,777	0	0	0	0
Total	8,932,723	8,423,210	1,298,588	1,288,588	1,663,500	1,663,500
Percent Difference	6.05%		0.78%		0.00%	

PG&E: The reported quantity of every measure sold through the program in PG&E's final reports exceeded the actual quantity in their tracking database by 6 percent. The differences stemmed from the quantity of committed rebates.

SDG&E: The reported quantity of every measure sold through the program in SDG&E's final reports matched the actual quantity in their tracking database.

SCE: The quantity of measures sold through the program reported by SCE in their final report was slightly lower than the quantity observed in their tracking databases. However, the difference between the actual quantity and the reported quantity was less than one percent.

[75] This table includes SCE lighting measures rebated under the PGC funded rebate program only.

Hard-to-Reach (HTR) Accomplishments Verification

For lighting measures, the HTR segments were defined based upon retailer stores being located in rural locations and/or being grocery or drug stores establishments. The percentage of applications (or incentives for PG&E) that fell into any of these HTR areas was then calculated based on these flags for the lighting measures. The percent of the total lighting retailer incentives classified as HTR were then compared to the final IOU reported numbers to determine if the values matched.

Table 6-2 summarizes the findings of the lighting portion of the HTR accomplishment verification task. Presented are the percentages of the incentives that went to stores identified as HTR that were (1) set as goals for the program, (2) found in their program tracking database and (3) reported by each IOU in their final reports.

Table 6-2: Comparison of Lighting HTR Goal and Accomplishment, by IOU Tracking Database vs. Final IOU Reported Values

Hard-to-Reach		PG&E	SCE	SDG&E
HTR Area	Goal	15%	15%	15%
	Database	43%	47%	13%
	Reported	24%	48%	16%
Food or Drug	Goal	10%	10%	10%
	Database	42%	32%	71%
	Reported	56%	36%	107%

PG&E: According to our database PG&E underreported their HTR area accomplishments and over reported their food and drug outlets HTR achievements. In both cases they still significantly exceeded their HTR goals. We found discrepancies in the consistency of how retail stores were identified as food and drug outlets in the utility databases (i.e. some instances of a particular retail chain would be classified as food and drug and others would not be).

SCE: SCE slightly over-reported their HTR accomplishments relative to what was found in the tracking database. They still however exceeded their HTR goal.

SDG&E: SDG&E also over-reported their HTR accomplishments relative to what was found in the tracking database. They exceeded their HTR goal for food and drug outlets, but not the for HTR location based goal.

SCE and SDG&E reached their HTR goals of 10 percent sold from food or drug stores, but only SCE and PG&E reached their HTR location goal.

6.2 Gross Impacts

6.2.1 *Overview of Methods*

The basis for the lighting gross impact assessment was the 100-point Lighting Onsite Survey of customers who reportedly bought CFLs during 2004/2005. These customers were identified during the course of the General Population Telephone Survey (n=1,000) which was administered in late 2006 through early 2007. Consumers were asked whether they bought CFLs and, if so, whether they bought any in 2004 or 2005. Upon completion of the telephone survey, respondents who had purchased CFLs in 2004 or 2005 were invited to participate in a 30 to 45 minute onsite lighting inventory and survey, for which they would receive an incentive of $50.

Using a population-weighted sampling technique, zip codes were randomly selected from which we would call back CFL purchasers who had agreed to participate in the onsite survey. 100 total surveys were conducted in PG&E (40), SCE (40), and SDG&E (20) service territories. Each household was assigned a household weight such that results are representative of CFL purchasers from 2004/2005 in the combined service territories.

Once on site, we collected information about every CFL installed in the household (including both interior and exterior fixtures.) We also inventoried all CFLs in storage. For CFLs installed in interior fixtures, we collected a basic set of information for all CFLs (used for delta watts calculation) and collected more detailed information on a sample (used for HOU, coincident factor and installation rate analysis). Table 6-3 below shows the number of bulbs included in our sample that were used for the gross impact analysis. When we used the sample of interior CFLs, we developed and applied bulb weights by room type such that the results presented in this section are representative of the distribution of CFLs found in the 100 sampled households.

Table 6-3: Onsite CFL Sample Size for Lighting Impact Parameter Questions

Location	Sampled CFLs: delta watts	Sampled CFLs: HOU/Coincident Factor analysis	Sampled CFLs: installation rate
Interior	350	126	126
Exterior	50	50	50
Stored			153
Total	400	176	329

Four KEMA auditors conducted these onsite surveys during which they collected pre- and post-wattage and recorded room location of each CFL reportedly purchased during 2004/2005 and installed in an interior fixture. We used the 2004 California CFL Metering

Study[76] to calculate average hours of use and coincident factor by applying the Metering Study results by room type to the 2004/2005 sample. For CFLs installed in exterior fixtures (which were not addressed by the CFL Metering Study), we collected self-reported hours of use from respondents. To estimate the in-service rate, we computed the ratio of CFLs purchased during 2004/2005 that were currently installed (based on our inventory) to the sum of CFLs purchased during 2004/2005 that were currently installed or in storage (also based on our inventory.) To calculate delta watts, we took the difference between prior bulb wattage (based on respondent self-report) and current CFL wattage (based on auditor observation). We used all CFLs for this calculation (not just CFLs reportedly purchased during 2004/2005) and applied CFL wattage category weights based on the distribution of rebates paid by the 2004/2005 program.

First-year gross electricity savings were estimated using a simple engineering model of savings as shown in Equation 6-1.

Equation 6-1: First-Year Gross Electricity Savings Calculation

2004/2005 CFL In-Service Rate **X** Average Change in Wattage **X** Average Hours of Use per Day **X** Days per Year **/** 1000 **=** kWh savings per year per bulb

Gross demand savings were calculated as shown in Equation 6-2.

Equation 6-2: Gross Demand Savings Calculation

2004/2005 CFL In-Service Rate **X** Average Change in Wattage **X** Average Coincidence Factor **/** 1000 **=** demand savings (kW)

Note that this analysis focused only on compact fluorescent bulbs. It was cost-prohibitive to include fixtures and torchieres in our sample since we used general population surveys to screen for 2004/2005 Program-qualifying lighting product purchasers — fixtures and torchieres combined accounted for only two percent of total Program lighting units. We did calculate net-to-gross ratios for torchieres and fixtures separately, which are reported at the end of this section.

6.2.2 *Results*

Table 6-4 shows the parameter estimates used to calculate per unit savings by compact fluorescent bulb product category and Table 6-5 provides additional detail on the delta watts calculation. Below, we provide more detail regarding the estimation of these parameters.

[76] KEMA. 2005. “CFL Metering Study: Final Report.” Prepared for California’s Investor-Owned Utilities.

Table 6-4: Parameter Estimates for Gross Ex Post Electricity and Demand CFL Impacts

Lighting Product Category	In-Service Rate	Delta Watts	Average Daily Hours of Use	Days per Year/ 1000	Coincidence Factor
ENERGY STAR CFL 450–799 Lumens	0.76	46.8	2.6	0.365	0.07
ENERGY STAR CFL 800–1,099 Lumens	0.76	51.3	2.6	0.365	0.07
ENERGY STAR CFL 1,100–2,599 Lumens	0.76	68.5	2.6	0.365	0.07
ENERGY STAR CFL ≥ 2,600 Lumens	0.76	58.1	2.6	0.365	0.07

Table 6-5: Details on Delta Watts Calculation for Gross CFL Ex Post Electricity and Demand Impacts

Lighting Product Category	Average Pre Wattage	Average Post Wattage	Average Change in Wattage (Delta Watts)	# bulbs in sample
ENERGY STAR CFL 450–799 Lumens	57.0	10.3	46.8	72
ENERGY STAR CFL 800–1,099 Lumens	64.9	13.6	51.3	220
ENERGY STAR CFL 1,100–2,599 Lumens	92.6	24.2	68.5	107
ENERGY STAR CFL ≥ 2,600 Lumens	100.0	41.9	58.1	14

Table 6-6 below shows the evaluation estimates for per unit electricity and demand savings by compact fluorescent bulb product category. As mentioned above, the evaluation did not include estimation of gross savings for fixtures and torchieres. For these products, the ex post per unit gross savings in the table below are equal to the claimed (ex ante) total statewide gross savings divided by the claimed number of rebated units.

Table 6-6: Gross Ex Post Per-Unit CFL Electricity and Demand Savings

Lighting Product Category	Gross Ex Post Per-Unit Savings	
	kWh	kW
ENERGY STAR CFL 450–799 Lumens	33.8	0.002
ENERGY STAR CFL 800–1,099 Lumens	37.0	0.003
ENERGY STAR CFL 1,100–2,599 Lumens	49.4	0.004
ENERGY STAR CFL ≥ 2,600 Lumens	41.9	0.003
ENERGY STAR Int/Ext. Fixture < 1,100 Lumens	63	0.005
ENERGY STAR Int/Ext. Fixture >= 1,100 Lumens	246	0.008
ENERGY STAR Torchiere < 65 Watt	172	0.027
ENERGY STAR Torchiere > 65 Watt	153	0.024

In-Service Rate

The in-service rate for CFLs purchased during 2004/2005 based on our onsite inventory of both installed and stored bulbs reportedly purchased during 2004/2005 was 76 percent. The 90 percent confidence bounds on this estimate are 72 to 80 percent.

Change in Wattage

Based on inspection of CFLs during the onsite survey and interviews with respondents while onsite, we calculated the change in wattage as the difference between the prior bulb and current CFL wattage. We applied weights by CFL wattage category based on the distribution of CFLs rebated by the Program, since we found that our sample distribution was different.[77]

Table 6-7 below shows the average change in wattage for four categories of CFL wattages.

Table 6-7: Change in Wattage by CFL Wattage Category

CFL Lumen Category[78]	Average Change in Wattage
ENERGY STAR CFL 450–799 Lumens	46.8
ENERGY STAR CFL 800–1,099 Lumens	51.3
ENERGY STAR CFL 1,100–2,599 Lumens	68.5
ENERGY STAR CFL ≥ 2,600 Lumens	58.1

There were no cases in which CFLs reportedly replaced CFLs – each CFL replaced either an incandescent or halogen bulb type. Just under 10 percent of bulbs were already there when the respondent moved into the home.

Hours of Use and Peak Coincidence Factor

As mentioned above, we combined room type information for interior CFLs with hours of use by room type from the CFL Metering Study in order to estimate hours of use for interior CFLs. We also applied load shape data from the metering study with room type to develop peak coincidence factors for interior CFLs, defined as a non-holiday summer weekday

[77] Our sample contained more low-wattage bulbs, which without weights would understate the change in wattage associated with Program bulbs. Our sample distribution is different from the Program because we were unable to directly sample actual Program bulbs.

[78] Note that during our survey, we observed CFL wattage, not lumens. We used the Program tracking database, which provided both lumen and wattage category for Program CFLs, to determine the appropriate lumen category for our sample of bulbs.

between the hours of 11 am and 7 pm. For exterior CFLs, we collected self-reported hours of use. We assumed that no exterior CFLs were operated during peak[79].

Table 6-8 below shows the distribution of the sample of 2004/2005 CFLs by room type. Also shown are the average hours of usage per day and coincidence factor by room type that represents the percentage of lamps on during the peak period in each room type by room from the CFL Metering Study.

Table 6-8: Distribution of 2004/2005 CFLs and CFL Metering Study Hours of Use and Coincidence Factors by Room Type

Room Type	Distribution of Program CFLs	Average Hours of Use	Coincidence Factor for Peak kW
Bedroom	11%	1.6	5.5%
Bathroom	6%	1.5	6.5%
Family room	10%	2.5	6.6%
Halls/entry	9%	1.6	3.3%
Kitchen	25%	3.5	12.3%
Living room	21%	3.3	9.0%
Other room	1%	1.9	11.2%
Exterior	17%	2.0	0.0%
Weighted Average		**2.6**	**7.0%**

The 90 percent confidence bounds on the average hours of use estimate (based on the standard errors from the CFL Metering Study applied to the updated distribution of rooms shown in Table 6-7) are 2.4 to 2.9 and for coincidence factor 6.99 to 7.01 percent.

6.3 Net Impacts

This section provides an overview of the methods and results that were used to determine the Net-to-Gross (NTG) ratios for calculating net lighting savings for the SFEER Program. More details on both the lighting NTG methods and results are found in Chapter 5.

6.3.1 *Overview of Methods*

In summary the evaluators asked lighting manufacturers and lighting retailers to estimate how much their 2005 sales of compact fluorescent (CF) products rebated by the SFEER

[79] This is a conservative assumption. Many exterior CFLs were controlled by timers (which were set to nighttime hours only), motion sensors or photocells. Those controlled by switch were likely operated minimally if at all during peak hours

Program would have changed if these rebates had not been available. These manufacturers and retailers were asked to provide these estimates of free-ridership that were differentiated based on three different criteria: retailer category, CF product type, and rebate type. Distinct free-ridership rates were sought for six different lighting retailer categories: general merchandise/big box, large home improvement, grocery, drug, discount, and small hardware. Distinct free-ridership rates were also sought for four different categories of CF products: low-Wattage CFLs, specialty CFLs, CF fixtures, and CF torchieres. Finally distinct free-ridership rates were sought for two different categories of SFEER Program rebates: manufacturer buydowns and point-of-sale rebates.

6.3.2 *Results*

Table 6-9, taken from Chapter 5, shows the free-ridership rates for low-Wattage CFLs, which account for 97 percent of the CF products rebated by the SFEER Program. The table shows that free-ridership estimates for low-Wattage CFLs vary widely depending on the type of retailer through which they are sold. The manufacturers and retailers estimated high free-ridership rates (similarly high CFL sales volumes in absence of the program) for low-Wattage CFLs sold through general merchandise/big box and large home improvement stores, middling free-ridership rates for those sold through drug and small hardware stores, and low free-ridership rates for those sold through grocery and discount stores. The reasons for these differences are discussed in Chapter 5. Similar free-ridership results for Specialty CFLs, CF Fixtures, and CF Torchieres can also be found in Chapter 5.

Table 6-9: Free-ridership Rates for Low-Wattage CFLs Receiving Incentives by Retailer Category, 2004/2005[80]

A	B	C	D	E	F	G	H	I
Retailer category	# of Low-Wattage CFLs Sold Through 2004/2005 Program (N)	% of Total Low-Wattage CFLs Sold Through 2004/2005 Program	Lighting Market Actor	# of Market Actors Providing FR Estimates for Retail Category	# of Incentivized Low-Wattage CFLs Sold Through Program by FR Estimator (n)	Estimators' Representation of Total Low-Wattage CFLs Sold Through Program for Retail Category (N/n)	Market Actor Sales-Weighted Free Ridership Estimates	Combined Sales-Weighted Free Ridership Estimate
General Merchandise/ Big Box	3,146,140	21%	Manufacturers	1	1,049,444	55%*, 33%**	**63%**	**75%**
			Retailers	1	2,283,338	73%**	**80%**	
Large Home Improvement	1,337,244	9%	Manufacturers	3	968,208	72%	**63%**	**66%**
			Retailers	1	130,662	10%	**85%**	
Grocery	6,310,142	43%	Manufacturers	9	4,435,512	70%	**21%**	**16%**
			Retailers	7	2,127,680	34%	**6%**	
Drug	2,192,366	15%	Manufacturers	3	1,537,972	70%	**41%**	**41%**
			Retailers	1	1,000	<1%	**5%**	
Discount	940,162	6%	Manufacturers	5	884,806	94%	**3%**	**3%**
			Retailers	0	-			
Small Hardware	593,264	4%	Manufacturers	3	160,366	27%	**63%**	**52%**
			Retailers	9	76,606	13%	**29%**	
Other	269,706	2%	No free ridership estimate sought for this retailer category					
Total	**14,789,024**	**100%**			**10,270,202**	**69%**		**38%**
% of All 2004-2005 Rebated CF Products Represented by Table						**97%**		

Table 6-10, also from Chapter 5, summarizes the free-ridership rates, as well as other relevant information, for all four CF product categories. It shows that the Program's overall free-ridership rate for lighting is 38 percent – about the same as the free-ridership rate for low-Wattage CFLs due to the very large weight for this product category. The relatively high representation of manufacturers and retailers providing free-ridership estimates for low-Wattage CFLs (69%) also figures heavily in the representation percentage for the Program as a whole.

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[80] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Table 6-10: Free-ridership Rates by CF Product Type, 2004/2005*[81]

A	B	C	D	E	F
CF Product Category	**# of CF Products Sold Through the 2004/2005 Program (N)**	**% of Total CF Products Sold Through the Program**	**# of CF Products Sold Through the Program Represented by Free Ridership Respondents (n)**	**% of Total CF Products Sold Through the Program Represented by Free Ridership Respondents (N/n)**	**Program-Average FR Rates**
Low-Wattage CFLs	14,789,024	97%	10,270,202	69%	**38%**
Specialty CFLs	103,812	1%	42,336	41%	**28%**
CF Fixtures	363,956	2%	97,955	27%	**64%**
CF Torchieres	15,332	0%	-	0%	**N/A**
Total	**15,272,124**	**100%**	**10,410,493**	**68%**	**38%**

* Since no free-ridership estimates were obtained for the CF Torchiere category, the weighted average free-ridership rate for all the rest of the CF product categories was used as a proxy for the CF Torchiere category in calculating the overall sales-weighted free-ridership rate. The total percentage in Column E is the total in Column D divided by the total in Column B.

Because these CF product free-ridership rates are heavily influenced by the mix of retailer categories through which the CF products were sold, to produce utility-specific net savings estimates it is necessary to account for the different mixes of participating retailers in each utility service territory. Table 6-11 show the mix of retailers used by the different participating utilities for the sale of Program-discounted low-Wattage bulbs and the resulting utility-specific free-ridership rates. SDG&E and SCE have lower free-ridership rates for this product than PG&E because they sold a higher percentage of their product through grocery and discount stores, which have low free-ridership rates.

It is important to note, however, that these utility-specific free-ridership estimates are based on the particular mix of retailers used in the 2004/2005 SFEER Program. Current and future programs will likely have different mixes of retailers. For example, PG&E Program managers have indicated that in the 2006/2008 Mass Markets Program they are selling a greater proportion of CF products through grocery stores than in the past, so this should reduce their free-ridership estimates.

[81] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Table 6-11: Utility-Specific FR Rates for Low-Wattage CFLs, 2004/2005*[82]

A	B	C	D	E	F	G	H	I
			PG&E		SCE		SDG&E	
Retailer category	Program Weighted Average FR Rates	Program Total	# of Low-Wattage CFLs Sold Through Program	% of All Low-Wattage CFLs Sold by Utility	# of Low-Wattage CFLs Sold Through Program	% of All Low-Wattage CFLs Sold by Utility	# of Low-Wattage CFLs Sold Through Program	% of All Low-Wattage CFLs Sold by Utility
General Merchandise/ Big Box	**75%**	**3,146,140**	2,146,806	26%	898,310	18%	101,024	6%
Large Home Improvement	**66%**	**1,337,244**	735,570	9%	579,048	12%	22,626	1%
Grocery	**16%**	**6,310,142**	2,675,742	33%	2,534,022	51%	1,100,378	66%
Drug	**41%**	**2,192,366**	1,848,946	23%	207,700	4%	135,720	8%
Discount	**3%**	**940,162**	165,760	2%	577,006	12%	197,396	12%
Small hardware	**52%**	**593,264**	411,770	5%	95,872	2%	85,622	5%
Other	**38%**	**269,706**	211,146	3%	41,800	1%	16,760	1%
Total	**38%**	**14,789,024**	**8,195,740**		**4,933,758**		**1,659,526**	
Utility-Specific FR Rates		**38%**	**44%**		**33%**		**23%**	

* For SCE, unit counts include procurement and public goods charge-funded rebates.

Table 6-12 shows the utility-specific free-ridership estimates for all CF product types. We only calculated utility-differentiated free-ridership estimates for low-Wattage CFLs and CF fixtures. Only these measures had sufficient volume of products and free-ridership estimates to make such differentiation meaningful. As noted in Chapter 5, no free-ridership estimates were obtained for CF torchieres so the sales-weighted average free-ridership rate for all CF products was used as a proxy. Table 6-13 shows the NTG ratios that were derived from these free-ridership estimates.

[82] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Table 6-12: Utility-Specific FR Rates for All CF Product Types, 2004/2005[83] [84]*

CF Product Category	# of CF Products Incentivized by 2004-2005 Program	Program-Average FR Rates	PG&E FR Rates	SCE FR Rates	SDG&E FR Rates
Low-Wattage CFLs	14,789,024	**38%**	44%	33%	23%
Specialty CFLs	103,812	**28%**	28%	28%	28%
CF Fixtures	363,956	**64%**	64%	63%	76%
CF Torchieres	15,332	**38%**	38%	38%	38%
Total	**15,272,124**	**38%**	**44%**	**34%**	**23%**

* For SCE, unit counts include procurement and public goods charge-funded rebates.

Table 6-13: Utility-Specific NTG Ratios for All CF Product Types, 2004/2005[85]*

CF Product Category	# of CF Products Incentivized by 2004-2005 Program	Program-Average NTG Ratios	PG&E NTG Ratios	SCE NTG Ratios	SDG&E NTG Ratios
Low-Wattage CFLs	14,789,024	**62%**	56%	67%	77%
Specialty CFLs	103,812	**72%**	72%	72%	72%
CF Fixtures	363,956	**36%**	36%	37%	24%
CF Torchieres	15,332	**62%**	62%	62%	62%
Total	15,272,124	**62%**	**56%**	**66%**	**77%**

* For SCE, unit counts include procurement and public goods charge-funded rebates.

[83] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

[84] Note that for PG&E, unit counts include committed and paid rebates. For SCE, unit counts include procurement and public goods charge-funded rebates (but exclude committed rebates). For SDG&E, we excluded procurement-funded rebates. (PG&E did not have any procurement-funded lighting rebates.)

[85] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Table 6-14 below provides the ex post net savings estimates resulting from the net and gross impact analysis described above. Note that the CF product categories used in the free-ridership analysis were slightly different from the product categories reported by the utilities, and there was overlap between the low-wattage and specialty CFL categories. We used a weighted average net-to-gross ratio based on each utility's claimed unit counts by product category to apply the net-to-gross ratio results accurately to the reporting categories shown below. The statewide ex post net kWh estimate was 456 million and the ex post net kW estimate was 32 thousand.

Table 6-15 provides the final realization rates on the ex ante net savings estimates. As this table shows, the overall net realization rate for electric energy usage on a statewide basis was estimated to be 47 percent. The net realization rates for electric demand (kW) was approximately 23 percent of the ex ante net estimates.

Table 6-14: Ex Post Net Savings Estimates[86]

Utility	Technology	Ex Post Net Energy Savings	
		kWh	kW
PG&E	ES CFL 450 to 799 Lumens	16,638,669	1,227
	ES CFL 800 to 1,099 Lumens	33,743,865	2,489
	ES CFL 1,100 to 2,599 Lumens	157,428,841	11,612
	ES CFL 2,600 Lumens or Greater	417,083	31
	ES Int/Ex. Fixture < 1,100 Lumens	39,475	3
	ES Int/Ext. Fixture >= 1,100 Lumens	17,286,595	528
	ES Torchiere < 65 Watt	178,205	28
	ES Torchiere > 65 Watt	1,233,990	191
	TOTAL	226,966,724	16,109
SCE	ES CFL 450 to 799 Lumens	2,405,012	177
	ES CFL 800 to 1,099 Lumens	33,722,425	2,487
	ES CFL 1,100 to 2,599 Lumens	116,853,773	8,619
	ES CFL 2,600 Lumens or Greater	860,233	63
	ES Int/Ex. Fixture < 1,100 Lumens	12,972	1
	ES Int/Ext. Fixture >= 1,100 Lumens	14,850,153	453
	ES Torchiere < 65 Watt	66,827	10
	ES Torchiere > 65 Watt	28,974	4
	TOTAL	168,800,369	11,817
SDG&E	ES CFL 450 to 799 Lumens	372,445	27
	ES CFL 800 to 1,099 Lumens	8,147,485	601
	ES CFL 1,100 to 2,599 Lumens	51,714,356	3,815
	ES CFL 2,600 Lumens or Greater	-	-
	ES Int/Ex. Fixture < 1,100 Lumens	-	-
	ES Int/Ext. Fixture >= 1,100 Lumens	222,746	7
	ES Torchiere < 65 Watt	-	-
	ES Torchiere > 65 Watt	-	-
	TOTAL	60,457,032	4,450
Statewide	ES CFL 450 to 799 Lumens	19,416,127	1,432
	ES CFL 800 to 1,099 Lumens	75,613,775	5,577
	ES CFL 1,100 to 2,599 Lumens	325,996,970	24,046
	ES CFL 2,600 Lumens or Greater	1,277,316	94
	ES Int/Ex. Fixture < 1,100 Lumens	52,447	4
	ES Int/Ext. Fixture >= 1,100 Lumens	32,359,495	988
	ES Torchiere < 65 Watt	245,032	38
	ES Torchiere > 65 Watt	1,262,964	196
	TOTAL	456,224,125	32,376

[86] This table includes SCE lighting measures rebated under both the Public Good Charge (PGC) and Procurement funded lighting rebate programs.

Table 6-15: Net Realization Rates[87]

Utility	Technology	Net Realization Rates	
		kWh	kW
PG&E	ES CFL 450 to 799 Lumens	75%	35%
	ES CFL 800 to 1,099 Lumens	44%	21%
	ES CFL 1,100 to 2,599 Lumens	42%	20%
	ES CFL 2,600 Lumens or Greater	27%	13%
	ES Int/Ex. Fixture < 1,100 Lumens	42%	53%
	ES Int/Ext. Fixture >= 1,100 Lumens	44%	51%
	ES Torchiere < 65 Watt	79%	79%
	ES Torchiere > 65 Watt	79%	79%
	TOTAL	44%	21%
SCE	ES CFL 450 to 799 Lumens	85%	40%
	ES CFL 800 to 1,099 Lumens	52%	25%
	ES CFL 1,100 to 2,599 Lumens	47%	22%
	ES CFL 2,600 Lumens or Greater		
	ES Int/Ex. Fixture < 1,100 Lumens	62%	31%
	ES Int/Ext. Fixture >= 1,100 Lumens	47%	41%
	ES Torchiere < 65 Watt	79%	78%
	ES Torchiere > 65 Watt		
	TOTAL	48%	23%
SDG&E	ES CFL 450 to 799 Lumens	159%	75%
	ES CFL 800 to 1,099 Lumens	61%	29%
	ES CFL 1,100 to 2,599 Lumens	65%	31%
	ES CFL 2,600 Lumens or Greater		
	ES Int/Ex. Fixture < 1,100 Lumens		
	ES Int/Ext. Fixture >= 1,100 Lumens	34%	19%
	ES Torchiere < 65 Watt		
	ES Torchiere > 65 Watt		
	TOTAL	64%	30%
Statewide	ES CFL 450 to 799 Lumens	76%	36%
	ES CFL 800 to 1,099 Lumens	49%	23%
	ES CFL 1,100 to 2,599 Lumens	46%	22%
	ES CFL 2,600 Lumens or Greater	27%	13%
	ES Int/Ex. Fixture < 1,100 Lumens	45%	45%
	ES Int/Ext. Fixture >= 1,100 Lumens	45%	45%
	ES Torchiere < 65 Watt	79%	79%
	ES Torchiere > 65 Watt	79%	79%
	TOTAL	47%	23%

6.4 Effective Useful Life (EUL)

This Study did not include an analysis of EULs for lighting measures. The evaluators did compare the EUL assumptions included in each of the IOUs reporting workbooks with those published in the CPUC Energy Efficiency Policy Manual (Table 4.1)[88] and found that the

[87] These Net Realization Rates have been built up from the retail channel results (and are thus "channel-weighted" estimates).

[88] California Public Utilities Commission Energy Division, 2003. Energy Efficiency Policy Manual, Version 2. August, 2003.

reported EULs were similar or the same for most lighting products. The exceptions are that SCE assumed nine years instead of eight years for CF bulbs, and PG&E and SCE assumed 20 years for some fixtures instead of 16 years. The EULs used in the impact evaluation analyses were thus based on those in the Policy Manual where available and based on the each of the utilities reported EULs in the remaining cases (i.e., for torchieres). Table 6-16 below provides the IOU reported EULs from the IOU workbooks, the EULs from Table 4.1 of the Policy Manual v2 and the final EULs used for this evaluation.

Table 6-16: IOU, CPUC, and Evaluation EULs for 2004/2005 SFEER Program Lighting Measures

	Effective Useful Life (EUL) in Years				
Measure	**PG&E**	**SCE**	**SDG&E**	**Table 4.1***	**Used in Evaluation Report**
ENERGY STAR CFL 450–799 Lumens	8	9	8	8	8
ENERGY STAR CFL 800–1,099 Lumens	8	9	8	8	8
ENERGY STAR CFL 1,100–2,599 Lumens	8	9	8	8	8
ENERGY STAR CFL ≥ 2,600 Lumens	8	9	8	8	8
ENERGY STAR CF Fixture < 1,100 Lumens	16/20	20	16	16	16
ENERGY STAR CF Fixture >= 1,100 Lumens	16/20	20	16	16	16
ENERGY STAR Torchiere <65 Watts	9	9	-	Not Available	9
ENERGY STAR Torchiere >65 Watts	9	9	-	Not Available	9

* Source: CPUC Energy Division, 2003.

It should be noted that there is a need for the EULs in the EEPM to be updated since the language in the manual is for screw-in modular and not screw-in integral.

7

Non-Lighting Measure Market Characterization

This chapter of the report provides extensive background on products and structure within the market for non-lighting energy-efficiency measures (including home improvement measures, appliances, and heating, cooling, and ventilation [HVAC] equipment), detail on participating supplier practices regarding promotion and salesperson training specific to energy-efficient equipment, and an overview of consumer knowledge, attitudes, and behavior with regard to energy efficiency. The evaluators obtained information for this chapter from a combination of primary and secondary data sources. The key primary data sources include the General Population Telephone Survey (n = 2,511) and interviews with appliance dealers (n = 26), HVAC contractors (n = 32), and swimming pool retailers/contractors (n = 25). Secondary sources include the ENERGY STAR® website,[89] the 2005 California Lighting and Appliance Efficiency Saturation study (CLASS)[90] and the 2006 California Residential Efficiency Market Share Tracking study of appliances[91].

Non-lighting market characterization information is organized as follows:

1. The **Product and Market Background** section provides detailed, technical information about high-priority measures (i.e., those accounting for a significant portion of the Program's energy and demand savings) including clothes washers, central air conditioners, insulation, single speed pool pumps, programmable thermostats, windows, and refrigerators. The section also details market structure including distribution as well as retail sales and market share where this information is available.
2. The **Participating Supplier Perspectives** section presents the findings from interviews of non-lighting market actors (retailers and contractors) regarding their standard practices for promoting energy-efficient equipment and training their sales staff to sell such equipment. This section focuses on market actors who have been experiencing, or will soon experience, the most significant changes in Program processes or equipment standards including appliance dealers, HVAC contractors,

[89] www.energystar.gov

[90] RLW Analytics, 2005, 2005 California Statewide Residential Lighting and Appliance Efficiency Saturation Study. Prepared for California's Investor Owned Utilities, August 23, 2005.

[91] Itron, 2006. California Residential Efficiency Market Share Tracking: Appliances 2005. Prepared for Southern California Edison, October 30, 2006.

and pool retailers/contractors.[92] Recall from prior chapters that "participating supplier" refers to a manufacturer, retailer, or contractor who sold or installed equipment for which incentives were provided through the 2004/2005 SFEER Program.

3. The **Consumer Summary** provides an overview of consumer knowledge of ways to save energy in their homes, awareness of energy-efficiency programs, and attitudes and behaviors related to energy efficiency and conservation. These findings relate to energy efficiency in general, rather than focusing on specific measures.

7.1 Product and Market Background

This section of the report provides detailed, technical information about the "high-priority" non-lighting measures included in the Study. These measures contributed at least 10 percent each to the 2004/2005 SFEER Program's non-lighting kWh, kW or Therm savings: clothes washers, central AC, insulation, pool pumps, programmable thermostats and windows. In addition, product and market background is included for refrigerators because SCE and SDG&E provided a substantial number of rebates for refrigerators during 2004/2005 using procurement dollars, accounting for 5 percent of combined procurement and PGC-funded Program energy savings and 3 percent of demand savings[93]. Background is also provided (where available) on product market structure including distribution and retail sales as well as market share information.[94]

7.1.1 *Clothes Washers*

ENERGY STAR qualified clothes washers use about 50 percent less energy to clean clothes than standard washers. Qualified horizontal axis washers use considerably less water as well; 18 to 25 gallons per load as opposed to about 40 gallons per load used by standard washers.[95,96] On January 1, 2004, the federal, California, and ENERGY STAR standards

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[92] Changes in Program processes include redesigned rebate forms, removal of rebate offerings, significant changes in rebate levels, or new Program initiatives. Equipment standards changes could include changes to federal minimum efficiency standards, Energy Star standards, or California's Title 20 appliance standards as well as changes in the Program's own equipment eligibility standards.

[93] These savings estimates are based on the total HEER measure savings only.

[94] Note that information regarding ENERGY STAR reflects products that qualified *by the end of 2006*.

[95] www.energystar.gov

[96] Horizontal axis washers use less water (and therefore less water-heating energy), because their tumbling action effectively moves the clothes through a relatively small volume of water. In contrast vertical axis machines typically use enough water to submerge the clothes and use an agitator to move the clothes through the water. Clothes washers are powered by electricity, but use additional energy indirectly, through hot water. This additional energy use may be either gas or electric. Clothes drying energy is also affected by the clothes washer: the remaining moisture content of the clothes at the end of a wash cycle varies significantly between clothes washers.

changed the performance metric used to evaluate clothes washers from Energy Factor (EF) to Modified Energy Factor (MEF).[97] The MEF accounts for washer volume, electrical energy use, hot water use, and the energy needed for removing the remaining moisture in the wash load.[98]

ENERGY STAR qualified clothes washers have become, on average, more efficient since 2000. To qualify for ENERGY STAR status today, clothes washers must have an MEF of at least 1.72. Qualified washers exceed this standard by 11 percent, on average, and some exceed it by over 30 percent.

As of the end of 2006, there were 169 ENERGY STAR qualified clothes washers on the market being produced under 26 brand names. Kenmore produces the largest number of qualified models, at 38, followed by LG Electronics, at 26, and Bosch, at 15; together these companies produce nearly half of the qualified models available.[99]

The majority of California single- and multi-family homes have a clothes washer (82%).[100] According to the latest California Residential Efficiency Market Share Tracking report (Itron 2006), ENERGY STAR qualified clothes washers accounted for about half of the clothes washers sold in California in 2005; saturation levels were closer to 40 percent in 2003 and 20 percent in 2000 (see Figure 7-1). National retail chains have consistently sold a lower percentage of qualified clothes washers than independent retailers.[101]

[97] Energy factor (EF) does not account for remaining wash load moisture.

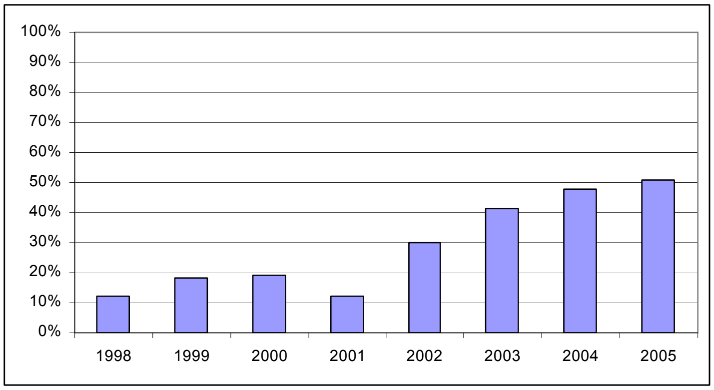
[98] MEF=C/(M+E+D), where C=clothes washer capacity in cubic feet, M=machine electrical energy consumption, E=the hot water energy consumption and D=the energy required for removal of the remaining moisture in the wash load.

[99] www.energystar.gov

[100] RLW Analytics, 2005.

[101] Itron, 2006.

Figure 7-1: ENERGY STAR Clothes Washer Market Share of Total Clothes Washer Sales in California Over Time



Source: Itron, 2006.

The share of qualified clothes washers sold by national chains has been consistently lower than the share sold by the independent appliance retailers. Recently however, national chains have seen a consistent increase in share, rising from 30 percent the first quarter of 2002 to 85 percent by the fourth quarter of 2005. Conversely, the ENERGY STAR share of independently owned stores has stayed relatively stable since 2002, fluctuating between 80 and 100 percent.[102]

7.1.2 *Refrigerators*

ENERGY STAR qualified refrigerator models use at least 15 percent less energy than required by current federal standards and 40 percent less energy than the conventional models sold in 2001. Many ENERGY STAR qualified refrigerator models include automatic ice-maker and through-the-door ice dispensers. Qualified models are available in several configurations, including bottom freezer, refrigerator only (single door), refrigerator/freezer (single door), side-by-side, and top freezer.

Refrigerator energy use ratings are expressed in terms of expected annual energy use (kWh) under "typical conditions." Federal energy use standards vary by refrigerator configuration and are a function of the unit's adjusted volume.[103] Federal energy use standards for refrigerators changed on July 1, 2001. The required energy use reductions from the former standard to the 2001 standard vary by configuration, ranging from 27 to 32 percent.[104]

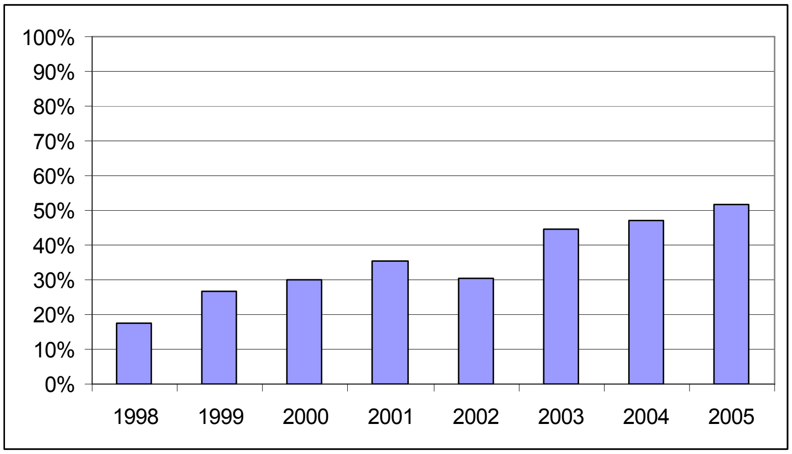
[102] Ibid.

[103] Adjusted volume takes into account the differing temperatures between the refrigerator and freezer compartments with the following calculation: fresh volume + (freezer volume*1.63). The result is called the total adjusted volume and is used in the energy factor (EF) calculation. The EF for refrigerators is:
EF= Adjusted Volume/(Annual Energy Usage/365)

[104] Itron, 2006.

On average, qualified refrigerators are 20 percent more efficient than federal standards; some exceed federal standards by over 100 percent.[105] ENERGY STAR refrigerators accounted for 50 percent of refrigerator sales in 2005, up from 30 percent in 2000 (see Figure 7-2). The share of qualified refrigerators sold by the national chains is lower than the share sold by the independent appliance retailers in California.[106] Also, results of the 2005 CLASS study showed that all homes have at least one refrigerator, and nearly a fifth own a second unit.[107]

Figure 7-2: ENERGY STAR Refrigerator Market Share of Total Refrigerator Sales in California Over Time



Source: Itron, 2006.

As of the end of 2006, there were 1,458 ENERGY STAR qualified refrigerator models on the market under 53 brand names. Kenmore produces the largest number of qualified models, at 291, followed by General Electric, at 188, and Frigidaire, at 184; together these brands account for 45 percent of the ENERGY STAR models available.

7.1.3 *Central Air Conditioners*

ENERGY STAR qualified residential (less than 65 Mbtuh) central air conditioners (CAC) are about eight percent more efficient than standard models. To qualify for ENERGY STAR, central air conditioners must be rated at least 14 SEER, which is higher than the federal standard of 13 SEER.[108] Currently, there are 17 manufacturers producing ENERGY STAR qualified CACs.

[105] www.energystar.gov

[106] Itron, 2006.

[107] RLW, 2005.

[108] As of January 1, 2006, the federal standard for minimum installed efficiency of central air conditioners was raised to 13 SEER. SEER is a measure of equipment energy efficiency over the cooling season. It represents the total cooling of a central air conditioner or heat pump (in Btu) during the normal cooling season as compared to the total electric energy input (in watt-hours) consumed during the same period. SEER is based

The 2005 CLASS study showed that the majority of systems installed in California homes are split CACs, which corresponds to common building practices. The second most predominant system was packaged CAC units, and the remaining were split or packaged heat pumps or evaporative coolers. Most CAC capacities were found to be between 0.5 and 5.0 tons; nearly a quarter were between 4.0 and 4.5 tons. The average age of the CACs was 11 years and about 80 percent of the systems were rated below 12 SEER, which was the baseline for new ENERGY STAR qualified units being produced at the time.[109]

7.1.4 *Programmable Thermostats*

ENERGY STAR qualified programmable thermostats (pstats) must be shipped with a default energy saving program that is capable of maintaining two separate programs (to address the different comfort needs of weekdays and weekends) and four temperature settings or more for each day.[110] Table 7-1 provides additional detail.

There are currently 42 ENERGY STAR partners manufacturing a total of 242 qualified pstats. Honeywell makes the largest number of qualified models, at 28, followed by Aube Technologies, at 24, then Lux Products at 18; combined these three partners produce about 30 percent of the qualified models available.[111]

Table 7-1: ENERGY STAR Programmable Thermostat Setting Requirements, 2006

Setting	Setpoint Temp (Heat)	Setpoint Temp (Cool)
Wake	≤70°F	≥78°F
Day	setback at least 8°F	setup at least 7°F
Evening	≤70°F	≥78°F
Sleep	setback at least 8°F	setup at least 4°F

Source: www.energystar.gov

7.1.5 *Insulation*

There are currently 70 manufacturers listed as ENERGY STAR partners that produce insulation. Table 7-2 shows ENERGY STAR recommended insulation levels given climate types and heating systems.[112]

on tests performed in accordance with the Air-Conditioning and Refrigeration Institute (ARI). www.energystar.gov

[109] RLW, 2005

[110] www.energystar.gov

[111] Ibid.

[112] www.energystar.gov

According to the 2005 CLASS study, the average R-value in attics in CA was 18; 14 percent of attics inspected had no insulation at all. As expected, newer homes had better insulated attics. Homes less than 5 years had an average R-value of 29 in the attic, whereas those between 10 and 15 years old averaged 23, and homes built in 1950 or earlier averaged 15.[113]

Table 7-2: ENERGY STAR Recommended Insulation Levels, 2006

Climate	Fuel Type	Insulation Type			
		Ceiling/Attic	Wood-frame wall	Floor	Basement/ crawl space walls
Warm with cooling and minimal heating requirements (i.e., coastal CA)	gas/oil or heat pump	R-22 to R-38	R-11 to R-13	R-11 to R-13	R-11 to R-19
	electric resistance	R-38 to R-49	R-13 to R-25	R-13 to R-19	R-11 to R-19
Mixed with moderate heating and cooling requirements (i.e., inland CA)	gas/oil or heat pump	R-38	R-11 to R-22	R-13 to R-25	R-11 to R-19
	electric resistance	R-49	R-11 to R-26	R-25	R-11 to R-19
Cold (i.e., mountainous areas)	gas/oil	R-38 to R-49	R-11 to R-22	R-25	R-11 to R-19
	heat pump or electric resistance	R-49	R-11 to R-28	R-25	R-13 to R-19

Source: www.energystar.gov.

7.1.6 *Windows*

Energy-efficient windows are well insulated (double or triple-paned and air or gas filled) and allow a minimal amount of solar heat gain. ENERGY STAR recommends that windows in California have U-values and Solar Heat Gain Coefficients (SHGC) of less than or equal to 0.4. Today, there are over 400 manufacturers listed as ENERGY STAR as partners that produce windows.

The 2005 CLASS study found that more than half of all the homes in CA had metal framed, single paned windows. Interestingly, a large majority of "modular/prefabricated" homes had metal framed, *double* paned windows. Nearly 75 percent of one and two story apartment buildings had metal framed, single paned windows. The study also found, unsurprisingly, that a larger percentage of newer homes have double paned windows than the older homes. For example, 62 percent of homes built between the years 2000 and 2005 have wood or vinyl

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[113] RLW, 2005.

framed double paned windows, while only 8 percent of homes built in the years 1981-1985 have the same type of windows.[114]

7.1.7 *Pool Pumps*

In homes that have in-ground or aboveground swimming pools, pool pumps are generally the largest single electrical end-use. According to a 2004 study[115], about 1.2 million California residences have swimming pools. Many of these pumps have older, less efficient motors that present noteworthy potential for increased efficiency.

Pool owners can save energy and maintain a comfortable swimming pool temperature by using a smaller, higher efficiency (two-speed) pump and by running it less. In a study of 120 pools by the Center for Energy Conservation at Florida Atlantic University, some pool owners saved as much as 75 percent of their original pumping bill by using smaller, more efficient pumps and/or running them less; Table 7-3 shows the study's results.[116]

Table 7-3: Options for Increasing Residential Pool Pump Efficiency

Condition	Energy Use (kWh/year)	Cost of Energy ($/year)	Energy Savings
Standard	3,000	240	----
Pump replacement (downsizing)	1,800	140	40%
Reduced time (60%)	1,200	100	60%
Combination of downsizing and reduced time	720	60	75%

Source: www.eere.energy.gov

The 'low' speed of a two-speed pump is generally adequate for most pool filtration needs, operating at half the revolutions per minute (rpm) of the high speed; this results in electricity consumption of approximately one-fifth to one-eighth of the power used on high speed. Pumps with two-speed motors thus offer significant opportunities for energy savings.

As of the 2004, motors such as those used in residential pool pumps were not regulated by state or federal standards. However, pool pumps are now regulated by an amendment to Title 20 of the California Appliance Efficiency Regulations that took effect on January 1, 2006. The amendment requires that any pool pump manufactured after that date and sold in California must feature either a capacitor-start/capacitor-run motor or a two-speed motor.

[114] Ibid.

[115] Davis Energy Group, 2004. Codes and Standards Enhancement Initiative for PY2004: Title 20 Standards Development; Analysis of Standards Options for Residential Pool Pumps, Motors, and Controls. Prepared for Pacific Gas and Electric Company. May 12, 2004.

[116] www.eere.energy.gov

Split-phase and capacitor-start/induction-run motors are no longer allowed for new installations or replacements. Pool pump efficiency will be further increased when new standards take effect on January 1, 2008 requiring that pool pumps with capacities of 1 HP or greater manufactured on or after that date must have a two-speed motor and automatic pump control system capable of controlling both high and low speeds separately.

7.2 Participating Supplier Perspectives

This section summarizes findings from interviews with 26 participating appliance dealers, 32 participating HVAC contractors, and 25 participating pool retailers/contractors. The section covers:

- Standard energy-efficiency practices;
- Reactions to equipment specification changes; and
- Market trends and barriers for emerging HVAC equipment.

The interviews were conducted between November 2006 and January 2007. The respondents came from random samples of contractor/retailer lists that were supplied by the participating utilities. Some of these lists contained only participating contractors/retailers while others contained a mixture of participants and non-participants. In the latter cases, questions were used to screen out non-participants. Participants were defined as those who had sold/installed equipment that had been rebated by the SFEER Program during the 2004/2005 period. No sample stratification was used except for the pool retailers/contractors where it was used to ensure an adequate number of pool retailers.

It is important to note that the evaluators only interviewed participating market actors. While many of the trends and concerns cited by these participants are likely reflective of their markets as a whole, the evaluators cannot be certain because non-participating market actors were not interviewed as part of this Study.

7.2.1 *Standard Energy Efficiency Practices*

This subsection provides detail on participating practices regarding promotion and salesperson training specific to energy-efficient equipment.

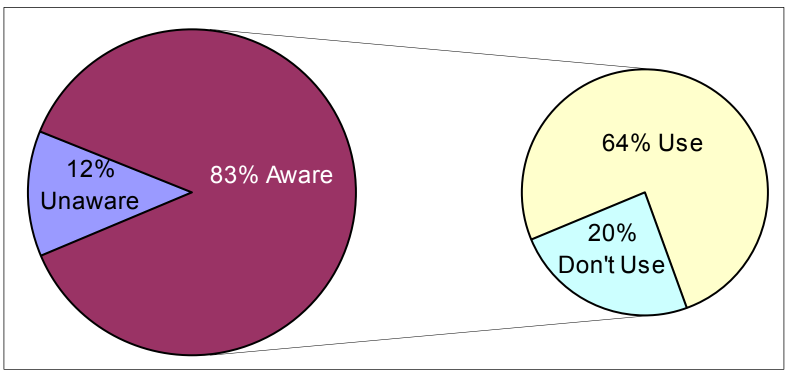
Product Promotion

Appliance Dealers

Fifty-eight percent of participating appliance dealers said their stores actively market or promote ENERGY STAR appliances differently than standard efficiency appliances. These marketing strategies fall into two categories, ENERGY STAR or energy-efficiency related signage (mostly point-of-sale [POS]), and salesperson knowledge. Many respondents thought that salesperson knowledge about the savings associated with energy-efficient equipment is the key to selling these products. Respondents also thought that advertising plays an important role in energy-efficient product sales.

Some utilities provide POS signs or refrigerator magnets to retailers that advertise utility rebates for ENERGY STAR appliances. Most respondents who are aware of these materials use them in their stores, as shown in Figure 7-3. Some retailers do not use the materials because utilities had not sent them any recently, and one dealer, who sells only very high-end appliances, said he does not use the magnets because they do not stick to stainless steel appliances.

Figure 7-3: Appliance Dealer Awareness and Use of Program POS Materials, 2004/2005



n = 25.

HVAC Contractors

The evaluators asked participating HVAC contractors whether they promote their energy-efficient products differently than their standard efficiency products, and 91 percent said that they do. Table 7-4 lists the various ways that the HVAC contractors promote their energy-efficient equipment. It shows that the most common promotional method is to proactively explain the benefits of energy efficiency to customers.

Table 7-4: How HVAC Contractors Promote Their Energy-Efficient Equipment, 2004/2005*

Approach for Promoting Energy-Efficient Equipment	% of Respondents
Proactively explain benefits of energy efficiency to customers	63%
Do mass marketing of energy-efficient products	20%
Do direct mail promotion of energy-efficient products	13%
Market energy-efficient products in-store, company website	13%
Discuss energy efficiency but only if customer asks	7%
Promote energy efficiency primarily when bidding new jobs	7%
Provide own rebates for energy-efficient products	3%
Offer energy efficiency seminars for manufacturers/customers	3%
Manufacturer does mass marketing of energy-efficient products	3%
Try to upsell energy-efficient equipment for custom home projects	3%
n	**29**

* Question allowed multiple responses; total exceeds 100%.

Pool Retailers/Contractors

The evaluators asked the pool contractors who sell products at retail stores whether they promote their energy-efficient products differently than their standard efficiency products. Of the 17 pool contractors who do some retail selling, 10 said that they promote their energy-efficient products differently and the remaining 7 claimed that they sell nothing but energy-efficient products.

The retailing pool contractors were also asked what they considered the most effective strategies for promoting energy-efficient pool pumps. The following strategies were cited by more than one respondent:

- Using utility-supplied marketing materials and information;
- Using manufacturer-supplied marketing materials and information;
- Promoting the utility rebates;
- Telling customers about the long-term energy/cost savings of energy-efficient pool pumps;
- Only selling energy-efficient pool pumps (as opposed to standard-efficiency pumps); and
- Giving the energy-efficient pool pumps more prominent placement in the retail space than lower-efficiency pumps.

The evaluators also asked all 25 pool contractors whether they provide staff with incentives or bonuses tied to energy-efficient product sales. None of them did. Many said it was because they already sell mostly energy-efficient products. In a number of cases the companies were sole proprietorships or there wasn't enough staff to justify bonuses. Other reasons include not wishing to "hard sell" the more energy-efficient equipment and the belief that a bonus should be tied to sales volume ("a sale is a sale").

Training

Appliance Dealers

As stated above, many retailers believe sales staff knowledge about energy efficiency is the key to selling these high-end products. The evaluators asked retailers if they provide on-going training to sales staff regarding energy-efficient products such as ENERGY STAR appliances. Of those that provide training (62 percent), most do so on an “as needed” basis, but some also do it when new staff are hired or on set schedules. At a majority of stores (73 percent), a manager or owner conducts the trainings, but many also rely on manufacturer sales representatives to conduct all or some of the trainings (43 percent).

While salesperson knowledge is key to energy-efficient product sales, all but one of the appliance retailers said they do not provide sales staff with incentives tied to energy-efficient product sales. Many retailers said that sales staff receive sales-based SPIFs (sales performance incentive funds) from manufacturers already, and there is no need to provide additional incentives.

HVAC Contractors

The HVAC contractors were asked whether they provide on-going training to their staff on how to promote more energy-efficient equipment. Sixty-nine percent (n = 32) of them said that they do provide such training. As Table 7-5 shows, over half of companies that providing training get their training from equipment suppliers and manufacturers.

Table 7-5: Sources of HVAC EE Sales Training, 2004/2005*

Source of Training	% of Respondents (n = 22)
Equipment suppliers/manufacturers	55%
Self-provided/in-house	45%
Utilities	27%

* Total exceeds 100% because some companies get training from multiple sources.

The contractors were also asked whether they had heard of California programs that provide training and pay incentives to HVAC contractors for testing refrigerant charges and air flows

(RCA) for central air conditioners (CACs). Fifty-eight percent (n = 29) of the contractors had heard of these California RCA training programs, but only seven of them had actually participated. Six of the seven participants rated their satisfaction with the RCA training Program and the average was rating of 4.2 (using a 5-point satisfaction scale with 5 equaling "very satisfied").

Twenty-one HVAC contractors who had not participated in the RCA training programs were asked if they would be interested in such programs. Seven of them said that they were interested, six said that they were not interested, and the remaining eight said that they were not sure. The two most-cited reasons for not wishing to participate in the RCA training programs included:

- Concern that the Program's financial incentives were insufficient to justify the paperwork and hassle costs of attending the trainings; and
- The belief that testing and maintenance were not important parts of their businesses.

One contractor also criticized the Program for requiring the use of flow hoods, which he claimed were too expensive for most contractors.

Pool Retailers/Contractors

The pool contractors were asked whether they provide training to staff on how to sell more energy-efficient pool pumps. Sixty-percent (n = 25) said that they did, with all but one of these relying on their own internal training programs. Of the 15 pool contractors that provide training, nine of them said that they provide this primarily for new hires.

Only one-third (n = 24) of the pool contractors were aware that the California utilities were offering education training events/demonstrations regarding high-efficiency pool pumps. And of these aware contractors, only one had actually participated in a utility training Program. Reasons (besides unawareness) for not participating in these programs included:

- Not having the time (due to being self-employed or the company undergoing transition);
- Training being handled by their corporate office;
- Training sessions were not at convenient times; and
- Thinking that the knowledge would not be useful for their business.

Ten of the pool contractors who were previously unaware of the training opportunities offered by the utilities were asked whether they would be interested in such training.

- Five contractors said that they probably would not be able to attend -- with four of them saying it was because their company tightly controlled training opportunities;
- Three contractors said that they would be interested in the training; and

- Two contractors said that they would only attend training if rebate levels for energy-efficient pool pumps were increased.

Seven of the pool contractors expressed interest in receiving information about utility training opportunities. Five of these mentioned direct mail as a preferred information channel, two mentioned a visit from a utility rep, and one each mentioned email or demonstrations for wholesalers.[117]

7.2.2 *Reactions to Equipment Specification Changes*

Standards for energy-equipment standards are constantly changing. This is especially true in California where changes in the state's own Title 20 Appliance Efficiency Standards are occurring at the same time as national changes in minimum efficiency standards for residential central air conditioners and ENERGY STAR equipment. These changing standards can have significant impacts on the dealers and installation contractors who sell this energy-efficient equipment. For this reason, the evaluators asked the participating appliance dealers, HVAC contractors, and pool dealers/contractors how these recent and pending changes in equipment efficiency standards have affected their businesses.

Appliance Dealers

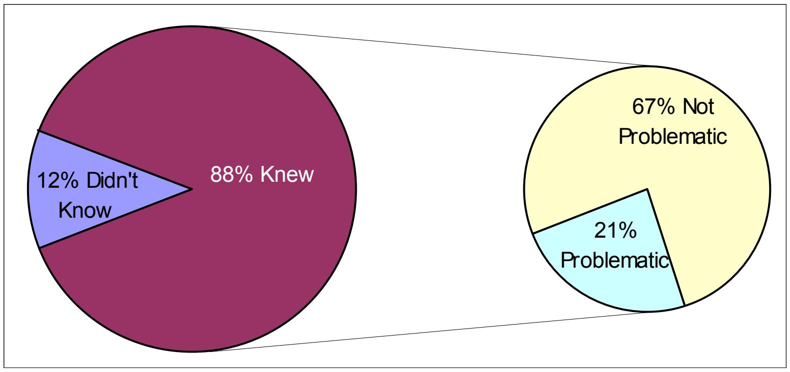
In 2004 ENERGY STAR raised the minimum efficiency levels needed for clothes washers to qualify for the ENERGY STAR label. Consequently, rebates offered by CA electric and gas utilities were only for clothes washers that met these new, higher standards. The evaluators asked respondents whether they were aware of these changes and about any problems the changes caused them or their customers in terms of the clothes washers not qualifying for rebates as they expected.

As illustrated in Figure 7-4, almost all respondents are aware of the changes, and two-thirds said that the changes did not cause any problems. Specific problems reported by the remaining minority of dealers included:

- Did not learn about changes until after they took effect; and
- Still had ENERGY STAR stickers on old appliances that no longer qualified for rebates.

[117] Five of the pool retailers/contractors indicated one preferred information channel each, and two contractors provided two channels each.

Figure 7-4: Appliance Dealer Reactions to Changes in ENERGY STAR Specifications, 2004/2005



Knew/didn't know n=26; Problematic/not problematic n=22.

HVAC Contractors

The evaluators asked the HVAC contractors how the 2006 federal requirements for SEER 13 central air conditioners (CAC) had affected what types of CACs they sell and how they sell them. Table 7-6 shows that the most common response was that these new requirements had little or no effect on their business because they were already selling energy-efficient equipment. A number of contractors also pointed out that the new standards have raised average CAC prices, and some claimed that this had reduced their CAC sales levels.

Table 7-6: HVAC Contractor Assessment of Outcomes of 2006 Federal Minimum SEER Requirements

Assessment of Outcomes	Comments (# of Respondents)
Positive Outcomes	▪ Satisfied with new standard (4). ▪ New standard will help increase sales of energy-efficient equipment (4). ▪ PG&E has done good job of educating about standard change (1).
Neutral Outcomes	▪ New standard has had little/no effect because already promote energy-efficient equipment (12). ▪ Higher metal costs have made price effects of standard change almost unnoticeable (1). ▪ Change didn't affect split systems but did affect packaged systems (1). ▪ Uncertain about effect of standard change on business (1).
Negative Outcomes	▪ New standard has raised CAC prices for consumers (5). ▪ New standard has reduced sales due to higher prices and smaller differential between baseline and high efficiency (2). ▪ New standard has increased paperwork (2). ▪ New standard has made it harder to upsell (1). ▪ New standard has increased installation times (1).

n = 32 (multiple responses allowed).

Pool Contractors

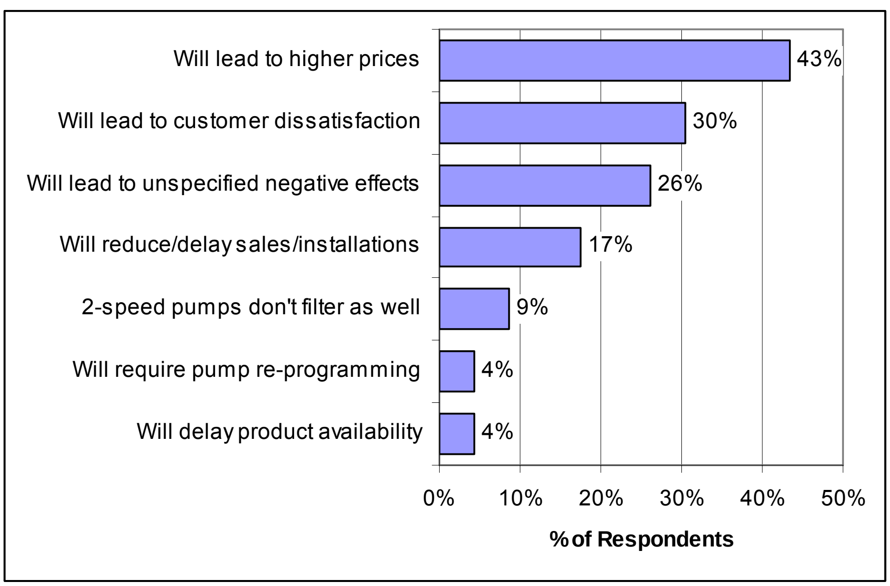
California is undergoing changes in its pool pump requirements under its Title 20 California Appliance Efficiency Regulations (see Section 7.1.7 for details). These changes include:

- The switch to capacitor-start/capacitor-run or two-speed motors for all new pool pump installations or replacements after January 1, 2006;
- Manufacturer requirements to display rated horsepower of the pump and total horsepower of the motor on each unit as of January 1, 2008; and
- Also as of January 1, 2008, all pool pumps with capacities of 1 HP or greater must have a two-speed motor and automatic pump control system capable of controlling both high and low speeds separately.

The evaluators asked the pool contractors whether they had heard of these new pool pump requirements and what they thought the market impacts of these would be. Only 21 percent of the pool contractors (n = 24) were aware of the requirements. Of those who were aware, only one knew any details about the requirements.

Many of the pool contractors were actually quite upset upon hearing of the 2008 requirement that pool pumps with capacities of 1 HP or greater must have two-speed motors. Figure 7-5 shows various concerns and objections that the pool contractors raised about this requirement.

Figure 7-5: Pool Contractor Concerns About 2008 Title 20 Two-Speed Pool Pump Requirements



n = 23.

The pool contractors were more favorably disposed towards the other changes in the Title 20 requirements. Two-thirds (n = 24) of the contractors said that the new labeling requirements would have no effect on their own companies. Some of these said that this was because their suppliers already clearly label the pumps. However, nearly half (42%) of the contractors thought that the requirement would have a positive effect, even if it was small, in reducing confusion and discouraging missing or misleading labeling by some pump manufacturers.

7.2.3 *Market Trends and Barriers for Emerging HVAC Equipment and Programmable Thermostats*

The evaluators asked the HVAC contractors about market trends and barriers for two HVAC technologies that California energy-efficiency programs have been trying to promote in recent years: the use of variable speed drives (VSDs) in HVAC equipment and the use of enhanced evaporative coolers. The evaluators also asked the participating HVAC contractors about standard practices and market trends related to programmable thermostats. This section summarizes their responses.

VSDs for Central Air Conditioners

The HVAC contractors were asked what percentage of the residential central air conditioners (CACs) they install include VSDs. The average percentage was 29 percent, although one of the respondents installed VSDs on all his residential CACs. The HVAC contractors were then asked why they do not install more VSDs on CACs. Table 7-7 shows that the largest barrier to greater use of VSDs is the high initial cost.

Table 7-7: Barriers to Use of VSDs in Residential CACs Identified by HVAC Contractors*

Reasons for Not Installing More VSDs on Residential CACs	% of HVAC Contractors
High initial cost	85%
Past/current problems with VSD reliability	19%
Inadequate rebates	19%
Customers don't understand the benefits	19%
Manufacturer preferences/standards/practices	19%
Some contractors don't know how to install them	4%
n	**27**

* Question allowed multiple responses; total may exceed 100%.

The evaluators also asked the HVAC contractors whether they thought that the California energy-efficiency programs have encouraged greater use of VSDs. Sixty-nine percent (n = 29) of the contractors said that they did, although almost half of these said that the Program effects were small or limited in scope.

Advanced Evaporative Coolers

In 2004 the SFEER Program included a new set of incentives for advanced whole house evaporative coolers including an incentive for the more efficient two-stage evaporative cooler. The evaluators asked the HVAC contractors whether they sold or installed whole house, advanced and ducted evaporative coolers for residential customers. Fifty-eight percent (n = 31) said that they did. However, over half of those who sold them said that they do so only rarely.

The HVAC contractors who sold or installed advanced evaporative coolers were also asked about the advantages and disadvantages of this technology. Twelve of these contractors provided feedback on these questions. The most frequently-cited advantages of this technology were energy efficiency (5 out of 12 respondents) and low upfront costs compared to other cooling technologies (4 out of 12 respondents). The most-cited disadvantage of this technology was its inability to remove humidity in extreme climates (9 out of 12 respondents). Other disadvantages cited included difficult installations, poor aesthetics (on roof), and low profit margin for installers.

Finally the HVAC contractors were asked whether they thought that the California energy-efficiency programs have encouraged greater use of advanced evaporative coolers. Thirty percent (n = 30) said that they had, 10 percent said that they had not, and the remaining 60 percent did not know or were not sure.

Programmable thermostats

The evaluators also asked the participating HVAC contractors about standard practices and market trends related to programmable thermostats. Starting in 2006, rebates for ENERGY STAR programmable thermostats were eliminated from the SFEER Program and other California rebate programs. One reason for this was evidence of free-ridership due to the measure increasingly becoming standard technology. Another reason was evidence that the measure was not being used as designed, with many users overriding energy-saving default settings.

Despite the elimination of this rebate, evaluators chose to ask the participating HVAC contractors about programmable thermostats. First, because programmable thermostats were a nontrivial component of the 2004/2005 SFEER Program – accounting for 37 percent of the claimed non-lighting energy savings – and secondly, because the evaluators were interested in collecting additional evidence to see whether the decision to eliminate the rebate was justified.

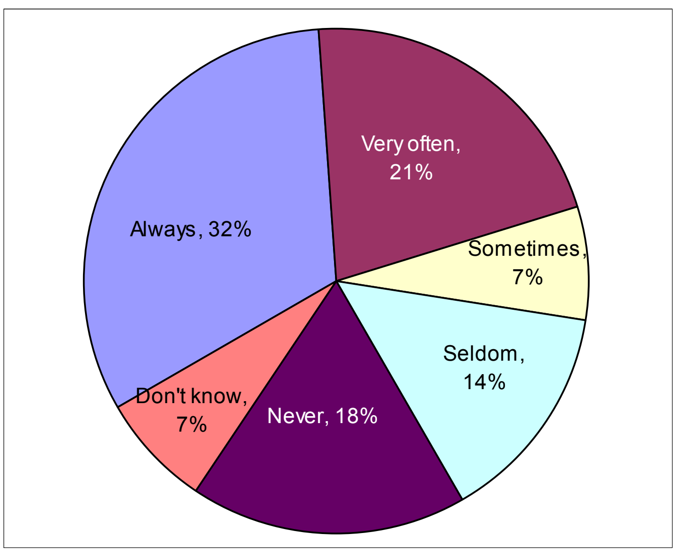
The responses of the HVAC contractors who were surveyed in late 2006 did appear to justify the decision to eliminate the rebate. There was further evidence that the installation of

ENERGY STAR programmable thermostats is becoming standard practice. Of the 28 installation contractors, 93 percent said that they always install a new programmable thermostat with a new central air conditioner or furnace and the remaining two installers said that they do so "almost always" or "very often." All of these 28 installation contractors said that 100 percent of the programmable thermostats that they install are ENERGY STAR thermostats.

The contractors were also asked whether the $20 Program rebate offered by the 2004/2005 SFEER Program had any impact on their sales of the ENERGY STAR programmable thermostats. Only two of the 29 respondents said that it did and even these two said that the effect of the rebate was very small. The other 27 thought that the rebate had no effect either because the rebate amount was too small or because of the maturity and market penetration of the technology.

Finally, the HVAC contractors also confirmed that the default settings of ENERGY STAR programmable thermostats are frequently overridden. Figure 7-6 shows that over half of the HVAC contractors override the default settings "always" or "very often." When asked why they override default settings, most said it was to suit customer preferences and prevent customer callbacks. One contractor claimed that programmable thermostat factory settings only fit the customers schedule about 20 percent of the time.

Figure 7-6: Frequency with Which HVAC Contractors Override or Reprogram a Programmable Thermostat's Default Settings



n = 28.

7.3 Consumer Summary

This section of the report presents a characterization of the general California consumer population's motivations and behaviors with regard to energy efficiency and conservation. To elicit this information, the consumer survey included a battery of questions based on those used in prior California general population surveys fielded in 1998, 2001, 2003. The general population data provide context for interpreting the population's awareness, attitudes, and behaviors regarding energy-efficient products and services – in other words, the general population's willingness to adopt energy-efficiency measures may be explained in part by their concern about energy usage, their general feelings about energy efficiency, and their awareness of energy-efficient products and services.

The results in this section are organized as follows:

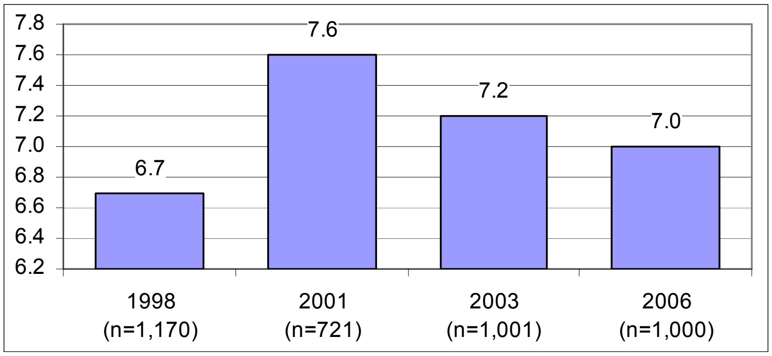
- **Knowledge, Awareness, and Attitudes.** Provides respondent self-assessment of knowledge of ways to save energy in their homes, awareness of energy-efficiency programs, and attitudes regarding energy efficiency and conservation.
- **Energy Efficiency Behaviors.** Discusses respondent self-reported energy conservation activities and purchases of energy-efficient equipment.

7.3.1 *Knowledge, Awareness, and Attitudes*

General Knowledge

General population telephone survey respondents were asked to rate their overall knowledge of the ways in which they could save energy in their homes. Respondents provided ratings on a scale of one to 10, with 1 meaning "not at all knowledgeable" and 10 meaning "extremely knowledgeable." Figure 7-7 shows changes in responses over time. After peaking in 2001 (during the energy crisis), ratings decreased to an average of 7.2 in 2003 and 7.0 in 2006. However, in 2006 consumers still rated their knowledge higher than they did prior to the energy crisis (6.7 in 1998). These differences were not found to be statistically significant.

Figure 7-7: Self-Assessment Regarding Knowledge of Ways to Save Energy at Home, 1998-2006[118]



1998 data source: Hagler Bailly, 1999.
2001 data source: XENERGY Inc., 2002.
2003 data source: KEMA-XENERGY and Quantum Consulting, 2003.
2006 data source: General Population Telephone Survey.

Energy-Efficiency Program Awareness

The US Environmental Protection Agency (EPA) introduced ENERGY STAR in 1992 as a voluntary labeling program designed to identify and promote energy-efficient products, particularly computers and computer monitors. Over the next three years, the EPA expanded the label to include additional office equipment as well as residential heating and cooling equipment. Since then, the EPA has partnered with the US Department of Energy to put the ENERGY STAR label on major household appliances, lighting, home electronics, new homes, and commercial and industrial buildings.[119]

To provide another way to gauge consumer awareness of energy efficiency, evaluators measured consumer awareness of ENERGY STAR by asking (unaided) whether they had seen or heard of ENERGY STAR prior to the telephone survey. As shown in Figure 7-8, 64 percent of 2006 respondents reported that they were aware of ENERGY STAR prior to the survey, a statistically significant increase over the proportion who provided that same response in 2003 (54%) and 2001 (42%). The 2006 results align with those from the 2006

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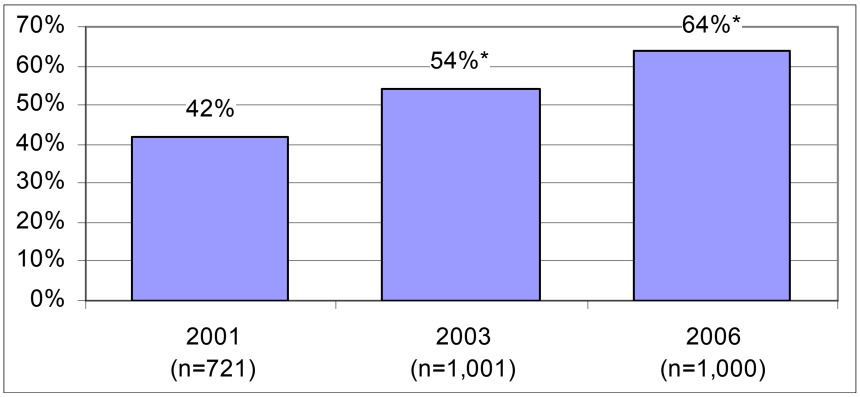
118 Hagler Bailly, 1999. CBEE Baseline Study on Public Awareness and Attitudes Toward Energy Efficiency. Prepared for California Board for Energy Efficiency (CBEE). June 1999.
XENERGY Inc., 2002. Phase 4 Market Effects Study of California Residential Lighting and Appliance Program: Final Report. Prepared for San Diego Gas and Electric Company. April 26, 2002.
KEMA-XENERGY and Quantum Consulting, 2003. Evaluation of the 2002 Statewide Crosscutting Residential Lighting Program: Final Report. Prepared for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison. October 13, 2003.

119 US EPA, (no date). "History of Energy Star" from http://www.energystar.gov/index.cfm?c=about.ab_history.

National Awareness of ENERGY STAR study[120] that showed 63 percent of the population is aware of the ENERGY STAR label in areas in which it is actively promoted by utilities or other entities (as is the case in California).[121]

Figure 7-8: Awareness of ENERGY STAR Over Time



* Difference from prior survey year is statistically significant at the 90 percent level of confidence.
2001 data source: XENERGY Inc., 2002.
2003 data source: KEMA-XENERGY and Quantum Consulting, 2003.
2006 data source: General Population Telephone Survey.

To further gauge consumer awareness of energy efficiency, interviewers asked survey respondents whether they had ever seen or heard of the Flex Your Power campaign. Initiated in 2001, Flex Your Power is the statewide energy efficiency marketing and outreach campaign that includes retail promotions for energy-efficient products, a website, an electronic newsletter, educational materials, and advertising (see Chapter 3 for details).[122] Just over half of the general population survey participants were aware of the Flex Your Power campaign (52%, n=2511). Of those who were aware of the campaign, approximately 38 percent indicated that they had taken some action as a result of their exposure to the campaign.

The evaluators also asked respondents whether they were aware of the California 20/20 Rebate Program. The 20/20 Program provides residential customers with an instant 20 percent rebate on any electricity bill that reflects a 20 percent reduction in energy use when compared to the same month in the prior year. Twenty-four percent of respondents reported that they were aware of the 20/20 Program in the 2006 survey, compared with more than twice that proportion in 2003 (52%; a statistically significant difference). The reason for this

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120 US EPA Office of Air and Radiation, Climate Protection Partnerships Division, 2006. National Awareness of ENERGY STAR® for 2006: Analysis of 2006 CEE Household Survey. U.S. EPA, 2007.

121 The National Survey gauged aided awareness (by showing respondents images of the ENERGY STAR label) and unaided awareness; results shown here are for unaided awareness.

122 Efficiency Partnership, 2007. “About Flex Your Power” from http://www.fypower.org/about/.

decline may be a result of decreasing promotion of the 20/20 Program over time since its inception in 2001.

Attitudes Toward Energy Efficiency and Conservation

Consumers have generally favorable attitudes toward energy efficiency and conservation. The evaluators asked consumers to rate their agreement with four attitudinal questions on a scale of 1 to 10 where 1 means "strongly disagree" and 10 means "strongly agree." As shown in Table 7-8, respondents generally do not feel that their lives are too busy to worry about energy-related improvements in their homes, and feel that it's possible to save energy without sacrificing comfort. The mean rating of agreement with the concept that saving energy is worth it to help preserve the environment has increased from 8.1 in 2003 to 8.8 in 2006, a statistically significant difference. This difference may be at least in part attributable to increased media focus on global warming and greenhouse gas emissions.

New to the 2006 survey, the evaluators asked respondents to indicate their level of agreement with the statement, "When considering purchasing appliances or other equipment, I typically consider both the price and the operating costs, not just the price;" agreement with this statement was high (8.8).

Table 7-8: Agreement with Statements Regarding Energy Efficiency and Conservation

1 = strongly disagree; 10 = strongly agree

Statement	Survey Year			
	1998	**2001**	**2003**	**2006**
My life is too busy to worry about energy-related improvements in my home.	3.7	2.7	2.9	2.7
It is possible to save energy without sacrificing comfort by being energy-efficient.	7.7	7.9	8.3	8.2
It is worth it to me for my household to use less energy in order to help preserve the environment.	7.7	8.2	8.1	8.8†
When considering purchasing appliances or other equipment, I typically consider both the price and the operating costs, not just the price.	*	*	*	8.8
n	**1,170**	**721**	**1,001**	**500****

* New question in 2006 survey.
† Difference from prior survey year is statistically significant at the 90 percent level of confidence.
1998 data source: Hagler Bailly, 1999.
2001 data source: XENERGY Inc., 2002.
2003 data source: KEMA-XENERGY and Quantum Consulting, 2003.
2006 data source: General Population Telephone Survey.
** Statement 1 n=492; Statement 2 n=506; Statement 3 n=492; Statement 4 n=511

7.3.2 *Energy Efficiency Behaviors*

The evaluators asked residential customers to identify any conservation activities they undertake regularly. The evaluators also asked a battery of questions to determine whether they had made any household equipment or appliance purchases since January 2004 and whether the new equipment was more efficient than standard models available at the time of their purchase (i.e., energy-efficient). This subsection presents related findings.

General Actions to Conserve Energy

The vast majority of survey respondents say they regularly take actions to conserve energy other than purchasing new appliances or equipment (94%); this result is statistically unchanged from 2003. Actions cited most commonly include turning off lights when they are not being used (70%), turning down the heat or decreasing heat usage (49%), turning down air conditioning or decreasing air conditioning usage (21%), and turning off appliances when they are not in use (20%).

Energy-Efficient Appliance Purchases

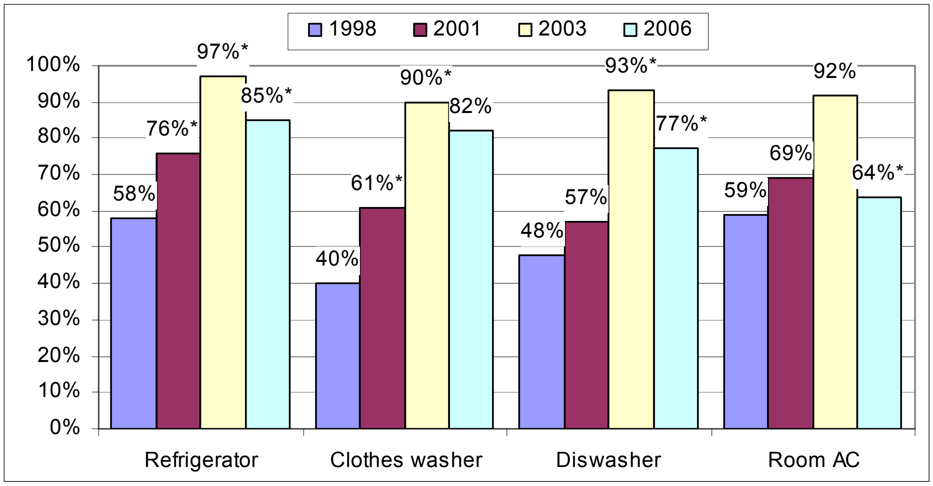
The evaluators asked respondents whether they had purchased a new refrigerator, dishwasher, clothes washer, or room air conditioner since January 2004 without receiving rebates for their purchases, and whether their new appliance was "more energy-efficient than standard models available" at the time of their purchases. Respondent self-reports of energy-efficient appliance purchases have declined by statistically significant margins since 2003 for refrigerators, dishwashers, and room air conditioners, and have declined slightly for clothes washers as well.[123] Figure 7-9 shows the proportion of purchases made outside of the Program that were reportedly energy-efficient.

Interviewers asked a follow-up question for each appliance to determine how respondents knew their appliance was energy-efficient; Figure 7-10 shows the proportion of appliances that reportedly had the ENERGY STAR label out of all purchases made among 2006 survey respondents. The proportions in this figure for refrigerators (39%), clothes washers (34%), and room air conditioners (46%) are roughly similar to the 2005 ENERGY STAR market shares for these appliances in California (43% for refrigerators; 41% for clothes washers; 51% for room air conditioners). For dishwashers, ENERGY STAR market share (86%) is closer to the proportion shown in Figure 7-9.[124]

123 Note: the evaluators did not verify that equipment was energy-efficient; these results are based on telephone survey respondent self-reports.

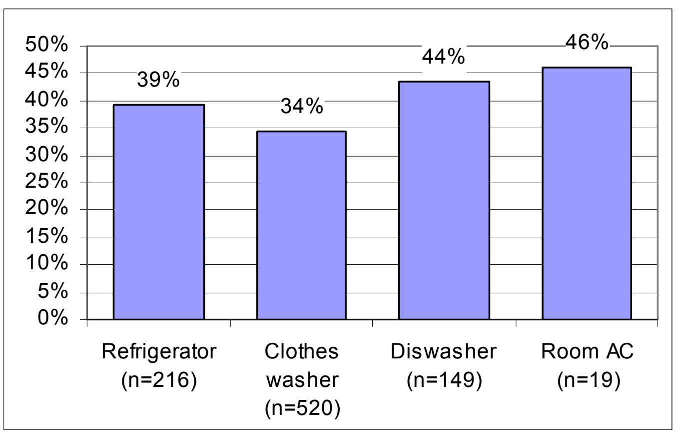
124 2005 California ENERGY STAR market share from D&R International.

Figure 7-9: Self-Reported Energy-Efficient Appliance Purchases Over Time



* Difference from prior survey year is statistically significant at the 90 percent level of confidence.
Refrigerator n: 1998=248; 2001=284; 2003=50; 2006=216. Clothes washer n: 1998=254; 2001=97; 2003=50; 2006=520. Dishwasher n: 1998=186; 2001=75; 2003=49; 2006=149. Room AC n: 1998=66; 2001=19; 2003=21; 2006=19.
1998 data source: Hagler Bailly, 1999.
2001 data source: XENERGY Inc., 2002.
2003 data source: KEMA-XENERGY and Quantum Consulting, 2003.
2006 data source: General Population Telephone Survey.

Figure 7-10: Self-Reported ENERGY STAR Appliance Purchases, 2006 Survey



Data source same as Figure 7-9 (2006 data only).

8

Assessment of HEER Component

This chapter of the report presents findings related to the Home Energy Efficiency Rebates (HEER) component of the 2004/2005 Single Family Energy Efficiency Rebate (SFEER) Program. Recall that the HEER component includes all non-lighting measures in the SFEER Program, most of which involve rebates delivered directly to the customer (although contractors and retailers may be involved in the sale). In addition, the Program provided point of sale (POS) incentives primarily for programmable thermostats and pool pumps but also for other measures (e.g., clothes washers) in limited geographic areas.

The evaluators obtained information for this chapter largely from primary research conducted for this study. Key data sources include the Participant Telephone Survey (n = 2,411) and interviews conducted with representatives of non-lighting suppliers (n = 83) that participated in the HEER component of the Program.

This report chapter is organized as follows:

1. The **Supplier Perspectives** section provides non-lighting suppliers' assessments of Program processes and effects. In this section of the chapter, "participant" refers to suppliers (retailers and contractors) who sold and/or installed equipment rebated by the SFEER Program during the 2004/2005 period.
2. The **Consumer Summary** presents 2004/2005 Program participant findings related to energy-efficiency program awareness, energy-efficient measure purchase experiences, Program satisfaction, and influences on energy-efficient measure purchase decisions. In this section of the chapter, "participant" refers to consumers who received incentives through the HEER Component of the 2004/2005 SFEER Program.

This chapter does not include our assessment of the refrigerator rebates offered by SCE and SDG&E during 2004/2005. The refrigerator rebates were funded using procurement dollars rather than PGC funds and the refrigerator analysis was thus funded as a separate evaluation component. The refrigerator analysis (similar to the measure-related component of the Consumer Summary presented in this chapter) is provided in Appendix I.

8.1 Supplier Perspectives

This section summarizes the findings from interviews with 26 participating appliance dealers, 32 participating HVAC contractors, and 25 participating pool retailers/contractors concerning their satisfaction with various aspects of the SFEER Program as well as other feedback they provided on Program processes.

The interviews were conducted between November 2006 and January 2007. Random samples of respondents were drawn from contractor and retailer lists supplied by the participating utilities. Some of these lists contained only participating contractors and retailers while others contained a mixture of participants and non-participants. In the latter cases, questions were used to screen out non-participants. Recall that for the purposes of this section, "participants" are defined as retailers or contractors who sold or installed equipment that had been rebated by the SFEER Program during the 2004/2005 period. No sample stratification was used except for the pool retailers/contractors, where it was used to ensure an adequate number of pool retailers.

8.1.1 *Assessment of Program Processes*

This section of the chapter provides non-lighting suppliers assessments of Program processes and effects.

Appliance Dealers

Program Satisfaction

The evaluators queried respondents regarding their satisfaction with the 2004/2005 SFEER Program as a whole as well as with other Program elements including utility staff, the way the utilities markets the Program, and Program promotion on utility websites. Satisfaction with the Program as a whole was fairly high among appliance dealers (84% satisfied), but this group was less satisfied with the other Program elements – particularly the way the utilities market the Program on their websites (Figure 8-1).[125]

As stated in Chapter 3, some of the IOUs reduced the number and frequency of their retailer visits (or eliminated them entirely) and decreased general spending on marketing during the 2004/2005 period. These cutbacks may be reflected in the lower satisfaction rates with the Program's marketing efforts among appliance dealers. The lighting manufacturers discussed in Chapters 4 and 5 were more satisfied with Program marketing, but it is likely that they have greater promotional resources available than appliance dealers and are thus more

[125] Using a 5-point satisfaction scale where 5 equaled "very satisfied and 1 equaled "very dissatisfied." A respondent was defined as "satisfied" if they gave a 4 or 5 rating and "dissatisfied" if they gave ratings of 1, 2, or 3.

capable of providing adequate Program marketing in absence of the utilities' financial assistance.

Half the respondents were satisfied with the way utilities market the Program on their websites. Some reasons for dissatisfaction were specific, including:

- Our store's demographic is uneducated, low-income, without web access;
- The utility is slow to make updates; and
- It takes too many steps to get to the webpage you need.

Many retailers were also dissatisfied with the way utilities market the Program. Particular reasons included:

- Our customers come in to the store uneducated about the Program;
- There is inadequate coverage of the Program in the media; and
- The utilities do not send us enough Program literature.

Respondents did not give specific reasons for dissatisfaction with utility staff.

Figure 8-1 also shows that some appliance dealers could not answer some satisfaction questions; and this may speak to these dealers' overall lack of involvement or knowledge of Program processes as well as to utilities' cutbacks on marketing spending. For example, more than a quarter of respondents said they never interacted with Program staff.

Figure 8-1: Appliance Dealer Satisfaction with 2004/2005 Program Processes

Process	n	% Satisfied	% Dissatisfied	% Don't know
Program as a whole	25	84%	16%	0%
Utility staff	25	64%	8%	28%
Way utility markets Program	25	60%	28%	12%
Program promotion on utility websites	26	54%	31%	15%

Appliance dealers who indicated that they serve customers in lower-income areas were less satisfied with the Program than other retailers. This group expressed concern that utilities are not reaching their customers through advertising or other media, and are putting less effort into keeping their stores updated. Often these retailers also served non-English-speaking communities and in general they seemed to think utilities were still not reaching their customers or keeping their stores adequately aware of Program changes.

Recommendations for Program Improvements

The evaluators asked the appliance dealers for recommendations on how the HEER component of the SFEER Program could be improved. Several appliance dealers said utilities need to be more proactive in contacting them about Program changes. These dealers believe they should not have to take the initiative to learn about what's going on with the Program year to year and that it is difficult to stay on top of the list of equipment eligible for rebates.

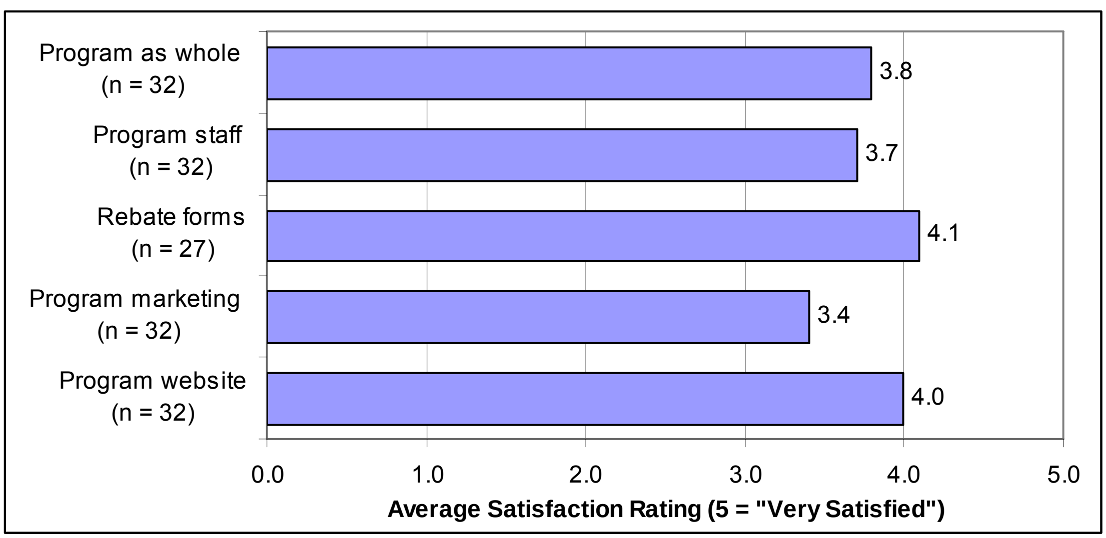
Another recommendation is to make greater efforts to enroll appliance dealers in the POS process. Thirty percent of the appliance dealers interviewed as part of this Study were not enrolled. The main reasons respondents cited for not enrolling were that the process was too complicated or required too much paperwork, that they had never heard about the Program, or that nobody had approached them about it.

<u>HVAC Contractors</u>

Overview of Program Satisfaction

The HVAC contractors were, on average, less than satisfied with the HEER component of the SFEER Program. Using a satisfaction rating scale in which 5 equals "very satisfied," contractors satisfaction ratings were less than 4 for the Program marketing efforts, the Program staff, and the Program as a whole (Figure 8-2). The following subsections discuss some of the reasons for these satisfaction ratings.

Figure 8-2: HVAC Contractor Satisfaction with 2004/2005 Program Processes



Program Marketing and Websites

Almost half (47%) of the HVAC contractors were less than satisfied (rating less than 4) with the Program's efforts to market the rebates. These contractors saw little evidence that the Program was doing any marketing. They reported a low level of awareness of Program rebates among their customers. One contractor also said that the Program has been making rebate decisions too late in the cooling season for contractors to launch effective marketing campaigns of their own.

HVAC contractor satisfaction with the Program websites was higher than Program marketing, although 22 percent of them were dissatisfied with the websites. One contractor said that it was difficult for a customer without technical or Program-specific knowledge to navigate the website. Other dissatisfied contractors described the websites as “unclear,” “confusing,” “complicated,” “disorganized,” and “irritating.”

Rebate Application Forms and Equipment Eligibility

The HVAC contractors were much more satisfied with Program paperwork requirements. Eighteen of the 32 HVAC contractors filled out some Program rebate applications on behalf of their customers. Of these 18 contractors who were familiar with the application forms, 16 of them (89%) though that the forms were reasonable in terms of length and level of detail.

The HVAC contractors reported this high level of satisfaction even though the 2005 Program year forms were made more complicated than 2004 Program year forms due to new SEER/EER level reporting requirements. The evaluators asked the 20 contractors who recalled being asked to report SEER/EER levels whether it was difficult to do this. Only five of the 20 said it was difficult.

The evaluators asked the HVAC contractors whether they were aware of any of their customers’ HEER rebate application forms being rejected. Half of the contractors were aware of this happening with at least one of their customers, but most said this happened rarely. The most common reason for rebate application form rejections was the existence of inaccurate or mismatched numbers for CACs from the American Refrigeration Institute (ARI) website. Contractors said that this was due to either customers misinterpreting or mis-transcribing the numbers or the ARI website not having updated information. Late submission of rebate application forms was another common reason for rejections.

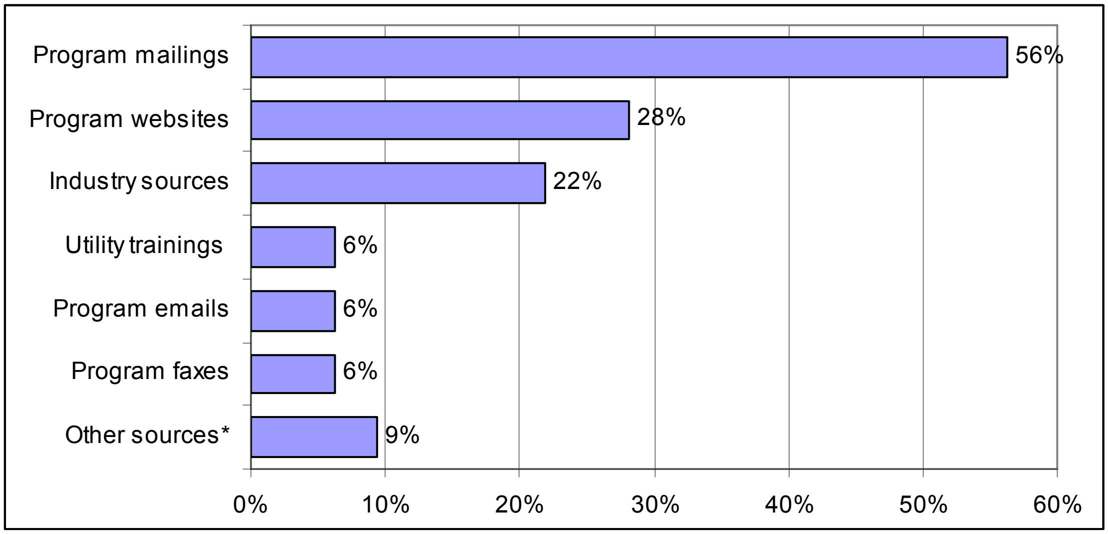
Program Staff and Communications with Trade Allies

About a third (34%) of the HVAC contractors were dissatisfied with the Program staff. Reasons for dissatisfaction that were cited by more than one contractor included:

- Program staff lacking the technical or specific knowledge to answer questions about which HVAC equipment qualified for the rebates;
- Program staff being difficult to get a hold of or not returning phone calls; and
- Program staff being difficult to deal with when contacted regarding rejected rebate applications.

The evaluators asked the contractors how they keep up with changes in the HEER component of the SFEER Program. Figure 8-3 shows that more than half of them rely on Program mailings for this information (56%) with Program websites and industry sources also being used.

Figure 8-3: How HVAC Contractors Keep Track of Program Changes (2004/2005)



* Other sources include calls from utility representatives, customers, and unspecified word-of-mouth. n=32.

The HVAC contractors were also asked how difficult it was to keep up with the changes in Program requirements. Using a scale of 1 to 5 where 5 equaled "very easy" and 1 equaled "very difficult," the average contractor "easiness" rating was 3.4. Those who had difficulty keeping up with Program changes cited general lack of communication from Program staff. A number of respondents said that they used to get "packets" or mailings from the utility but no longer receive these.

Comparing Satisfaction Ratings Across IOU Service Territories

Evaluators examined whether the HVAC contractors' responses differed by utility service territory in terms of their satisfaction with the Program and related Program processes. Contractors were asked to rate their satisfaction on a 5-point scale where 5 equaled "very satisfied." Table 8-1 shows the average contractor satisfaction ratings by utility. There were no statistically significant differences (at the 80% confidence level) among HVAC contractors by IOU service territory for mean satisfaction ratings.[126] However, there are a

[126] Note that differences in satisfaction by IOU service territory are shown at the 80 percent level of confidence. For the consumer surveys, significance testing was not conducted at levels below the 90 percent confidence

few statistically significant differences among the utility service territories when the proportion of *dissatisfied* HVAC contractors is measured (Table 8-2); most notably, a significantly greater proportion of contractors in PG&E and SDG&E service territories reported dissatisfaction with the overall Program than in the combined SCE and SCG territories (these differences are statistically significant at the 95% level of confidence).

Table 8-1: Average HVAC Contractor Satisfaction Ratings by Utility Service Territory*

Utility	Mean Satisfaction Rating				n
	Utility Websites	Utility Marketing Efforts	Program Staff	Program (Overall)	
PG&E	4.0	3.4	4.0	3.6	15
SCE/SCG	4.3	3.8	3.7	4.4	7
SDG&E	3.7	3.4	3.7	3.7	10

* Contractors were asked to rate their satisfaction on a 5-point scale where 5 equaled "very satisfied."
Note: None of the average satisfaction ratings in a given column are significantly different from any of the others in the same column at the 80% level of confidence level.

Table 8-2: Proportion of HVAC Contractors Dissatisfied with Program and Related Processes by Utility Service Territory*

Utility	Percent of Dissatisfied Contractors				n
	Utility Websites	Utility Marketing Efforts	Program Staff	Program (Overall)	
PG&E	27%	53%	13%^{C}	47%^{E}	15
SCE/SCG	29%	29%^{A}	43%^{D}	0%^{F}	7
SDG&E	20%	70%^{B}	30%	50%^{E}	10

* Contractors were asked to rate their satisfaction on a 5-point scale where 5 equaled "very satisfied." For the purposes of this table, "dissatisfied" contractors are those who provided ratings of 3 or lower.
Note: Rating A is statistically different from rating B at the 80% confidence level.
Rating C is statistically different from rating D at the 80% confidence level.
Ratings E are both statistically different from rating F at the 95% confidence level.

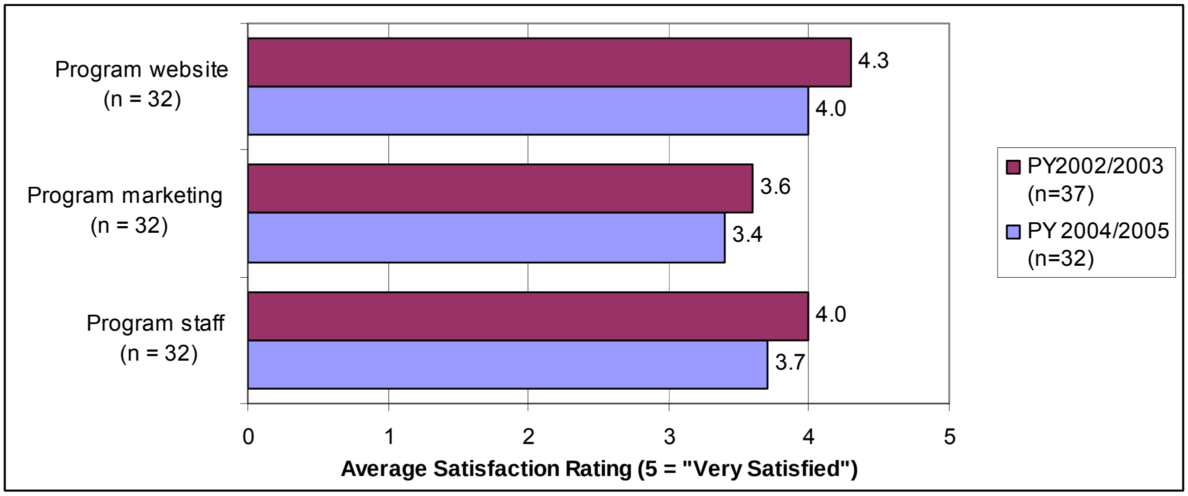
Comparing Satisfaction Ratings Over Time

The evaluators also compared the satisfaction ratings from the 2004/2005 participating HVAC contractors with those of the HVAC contractors who participated in the 2002/2003 Program. Figure 8-4 shows that contractor satisfaction has declined slightly for all the Program process categories that were covered in both surveys. Some of this decline is likely

level. The evaluators believe 80 percent to be an appropriate level for the HVAC contractor results based upon the small number of respondents (n=32 HVAC contractors).

related to the cutback in 2004/2005 Program marketing efforts discussed in Chapter 3 and in the previous section of this chapter. These differences are not statistically significant.

Figure 8-4: HVAC Contractor Program Satisfaction Ratings Over Time[127]



2002/2003 data source: KEMA-XENERGY and Quantum Consulting, 2003.
Note that this evaluation also covered PY 2003 indirectly (respondents were asked about PY 2002 and then were asked whether anything was different for PY 2003).

Recommendations for Program Improvements

The evaluators asked the HVAC contractors for recommendations on how the HEER component of the SFEER Program could be improved. The most common recommendations included:

- *Improve communications about Program changes:* Suggestions for improving communications included creation of a rebate notification email list, more frequent Program rollout meetings with contractors, and more frequent personal contact/calls from utility representatives.
- *Improve Program marketing efforts:* As noted, HVAC contractors were dissatisfied with the extent of current Program marketing efforts. However, they had few suggestions on where this marketing should be done except that it should target both suppliers and consumers.
- *Increase/restore rebate levels:* One contractor termed current rebates as "very limited and ineffective." Another contractor said that increasing rebate levels would increase customer "responsiveness" to the Program. Higher rebates levels were recommended in particular for evaporative coolers, thermal expansion valves, duct testing, and testing refrigerant charges and air flows (RCA).

[127] KEMA-XENERGY and Quantum Consulting, 2003. Evaluation of the 2002 Statewide Crosscutting Residential Lighting Program: Final Report. Prepared for San Diego Gas and Electric Company, Pacific Gas and Electric Company, and Southern California Edison. October 13, 2003.

Other recommendations for Program improvements that were made by at least two contractors included:

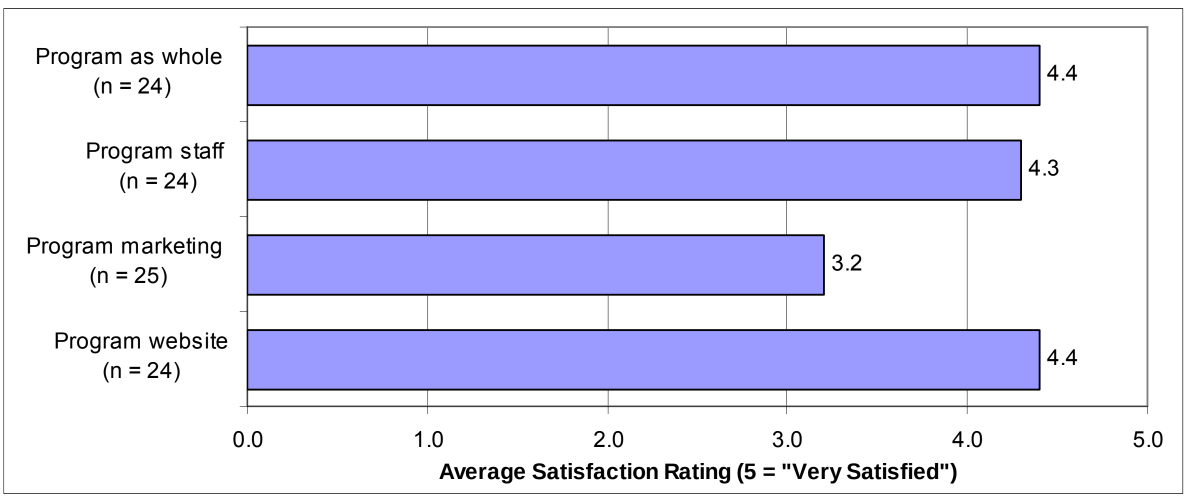
- Process rebate applications more quickly (consumers were also relatively dissatisfied with rebate turnaround time; see Section 8.2.4 for details);
- Ensure that up-to-date equipment eligibility information is available;
- Ensure that rebate funds do not run out;
- Broaden rebate offerings;
- Create simpler rebate application forms; and
- Restore the central air conditioner rebates that were eliminated in 2006.

Pool Contractors/Retailers

Overview of Program Satisfaction

The pool contractors/retailers were generally satisfied with the HEER component of the SFEER Program. Figure 8-5 shows that they were, on average, least satisfied with the Program's marketing efforts. The following subsections discuss some of the reasons for these satisfaction ratings.

Figure 8-5: Pool Contractor Satisfaction with Program Processes



Program Marketing and Websites

Over half (58%) of the pool contractors/retailers were less than satisfied with the Program's efforts to market the rebates (ratings < 4). Inadequate marketing effort was the most frequently cited reason for low levels of satisfaction; "marketing efforts are not strong enough or extensive enough," one pool contractor complained. "Rebates are not in the news enough," another contractor claimed. One contractor thought that the Program had not done any serious marketing of energy-efficient pool pumps in 5-6 years. A few insisted that more marketing to pool installers needs to be done.

Half of the contractors/retailers did not provide satisfaction ratings for the Program website because they were not familiar with it. Ten of the 12 pool contractors/retailers who were familiar with the Program websites were satisfied with them.

Rebate Application Forms and Equipment Eligibility

Unlike the HVAC contractors, few of the pool contractors/retailers filled out rebate applications on behalf of their customers. Only six of the 25 pool contractors/retailers said that they had done so. The evaluators asked these six contractors whether they thought that the rebate application forms were reasonable in terms of length and level of detail. Five of the six said they were reasonable.

The pool contractors/retailers were also asked whether any of their customers' rebate applications had been rejected by the Program. Nine of the 25 respondents said that this had happened although most said that it had only happened once. None of the respondents identified any particular type of pool pump that was more subject to rejection.

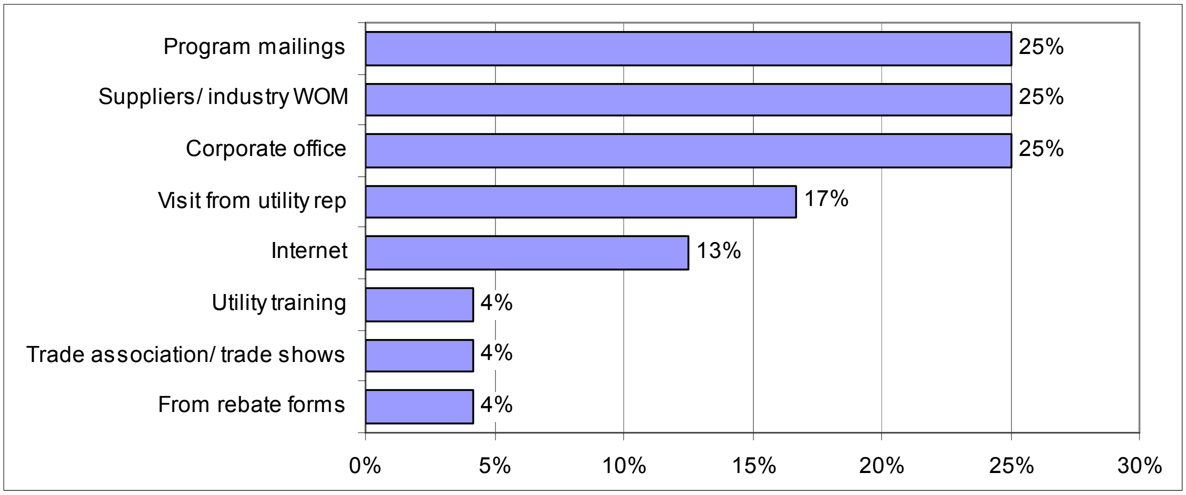
Program Staff and Communications with Trade Allies

Nine of the 12 pool contractors/retailers who had contact with the Program staff were satisfied with them. However, half of the contractors/retailers did not provide satisfaction ratings, mostly because they had no dealings with them.

The evaluators asked the contractors/retailers how they keep up with changes to the HEER component of the Program. Figure 8-6 shows that the three most-cited ways of tracking Program changes included Program mailings, industry word-of-mouth, and information from their corporate offices.

The pool contractors/retailers were also asked how difficult it was to keep up with the changes in Program requirements. Using a scale of 1 to 5 where 5 means "very easy" and 1 means "very difficult," the average contractor "easiness" rating was 4.2. Those who had difficulty keeping up with Program changes cited not receiving Program mailings as well as a general lack of communication from Program staff. One pool retailer said that when Program representatives came into his store he wished that they would explain the Program changes to him rather than just dropping off the forms.

Figure 8-6: How Pool Contractors/Retailers Keep Track of Program Changes (2004/2005)*



* Multiple responses allowed; total may exceed 100 percent.
n = 24.

Recommendations for Program improvements

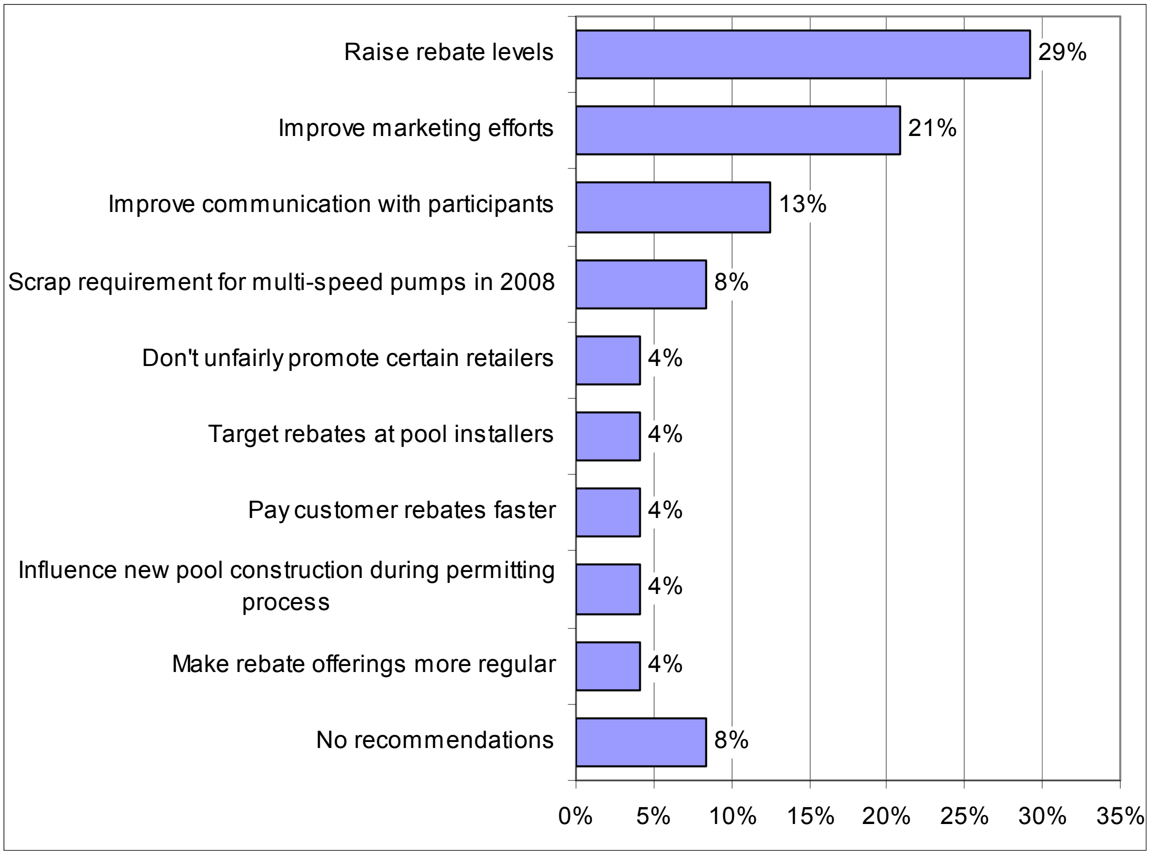
The evaluators asked the pool contractors/retailers for recommendations on how the HEER component of the SFEER Program could be improved. The most common recommendations included:

- *Raise rebate levels:* Almost a third of the pool contractors thought that current rebate levels were inadequate.[128]
- *Improve Program marketing efforts:* Like the HVAC contractors, the pool contractors were dissatisfied with the extent of current marketing efforts, but did not have specific suggestions on where this marketing should be done, except that it should target pool owners.

Figure 8-7 shows all of their recommendations.

[128] Two-speed motor rebates were $300 in 2005; as of June 2007, rebates for 2-speed pool pumps decreased to $200 in PG&E service territory and $100 in SCE and SDG&E territories (according to the utilities' websites). The decreased rebate may be attributable (at least in part) to the Title 20 changes affecting pool pump specifications as detailed in Section 7.1.7.

Figure 8-7: Pool Contractor/Retailer Recommendations for Program Improvements*



* Multiple responses allowed; total may exceed 100 percent.
n = 25.

8.1.2 *Assessment of Program Effects*

The evaluators asked HVAC contractors, appliance dealers, and pool contractors/retailers to estimate their sales of energy-efficient equipment that qualified for Program rebates and then estimate what the sales of this equipment would have been without the rebates. Figure 8-8 shows the supplier free-ridership estimates for non-lighting energy efficiency equipment rebated by the Program. It is important to note that these supplier free-ridership estimates will not be used for calculating net savings for the HEER component of the Program.[129]

[129] Two methods were used to estimate non-lighting free-ridership. These methods include participant self-report for all measures and discrete choice models for four of the 14 non-lighting measures. These methods are described in detail in Chapter 9 and Appendix G.

Figure 8-8: Supplier Estimates of Free-Ridership Rates for Non-Lighting Equipment Rebated by the Program

Rebated Equipment Type	Sales-Weighted[130] Average Free-Ridership Rate	Sample Size[131]
HVAC Equipment		
Tier III Central Air Conditioner	56%	19
Tier II Central Air Conditioner	54%	21
ENERGY STAR Central Air Conditioner	64%	20
ENERGY STAR Furnace	68%	25
Appliances		
Tier I or Tier II Clothes Washers	77%	19
ENERGY STAR Dishwashers	93%	19
Pool Pumps		
Energy-Efficient 1-Speed Pool Pumps	67%	22
Multi-Speed Pool Pumps	17%	3

These free-ridership estimates are much higher than those that lighting suppliers provided for compact fluorescent bulbs and fixtures. These non-lighting free-ridership rates are somewhat surprising when one considers the California data for the market penetration of energy-efficient equipment. For example, a 2006 Itron study estimated that ENERGY STAR products accounted for only 20 percent of central air conditioning sales and 23 percent of gas furnace sales at the end of 2005.[132]

However, factors to consider, beyond the normal methodological considerations (social desirability bias, etc.) for self-report-based free-ridership estimates, include:

- The free-ridership estimates were provided by participating contractors. It is reasonable to assume that such participating contractors would be more likely to install high-efficiency equipment than the average contractor (measured by the Itron market share study), even if no rebates were available.
- Even though the respondents were asked to estimate the effect of taking away the rebates on their 2005 sales of energy-efficient equipment, it is likely that some respondents based their estimates on their present experiences (most were interviewed

130 All weights are based on estimated annual equipment sales/installations except for clothes washers and dishwashers which are based on the appliance dealer's # of employees.

131 Sample size is the number of respondents who were able to provide not only free-ridership estimates but also estimates of annual sales/installations that would allow sales-weighted estimates. For the multi-speed pool pump estimate the sample size is the number of pool contractors who were actually selling/installing multi-speed pool pumps in 2005 and who had provided estimates of annual pool pump sales/installations.

132 Itron, 2006. California Residential Efficiency Market Share Tracking, HVAC 2005. Prepared for Southern California Edison. August 1, 2006.

in late 2006). Increasing federal and state minimum equipment standards have likely increased market penetration of these energy-efficient products compared to the end of 2005. For example, the January 2006 increase in minimum federal efficiency standards for central air conditioners (CACs) not only increased the market penetration of efficient CACs in 2006 but also likely reduced their natural market penetration in 2005. This is because the pending January 2006 federal standard may have caused HVAC distributors to discount their less efficient products in 2005.

However, these caveats aside, all of these estimates (with the exception of the multi-speed pool pump estimate) are based on reasonably robust sample sizes. In addition, these free-ridership estimates are consistent in the sense that free-ridership levels go down as the energy efficiency of the rebated equipment goes up.

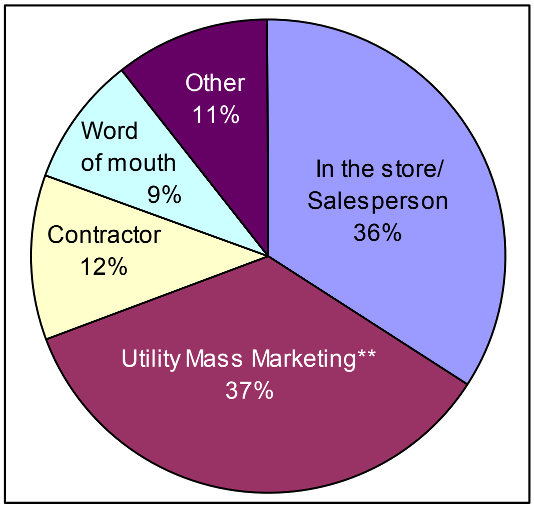
8.2 Consumer Summary

This section of the chapter presents 2004/2005 Program participant findings related to energy-efficiency program awareness, energy-efficient measure purchase experiences, Program satisfaction, and influences on energy-efficient measure purchase decisions. Recall that in this section, "participant" refers to consumers who received incentives through the HEER Component of the 2004/2005 SFEER Program.

8.2.1 *Program Awareness*

The IOUs and participating suppliers conducted Program marketing to consumers through in-store point-of-purchase (POP) signage and displays, brochures, direct mail (e.g., bill inserts), utility websites, press releases, and other approaches. Figure 8-9 shows the ways in which 2004/2005 HEER participants first heard about the Program. Overall, 37 percent of participants first became aware of the Program through utility sources (e.g., brochures; bill inserts; IOU websites; television, radio, and newspaper advertisements). A similar proportion first became aware in stores (36%).

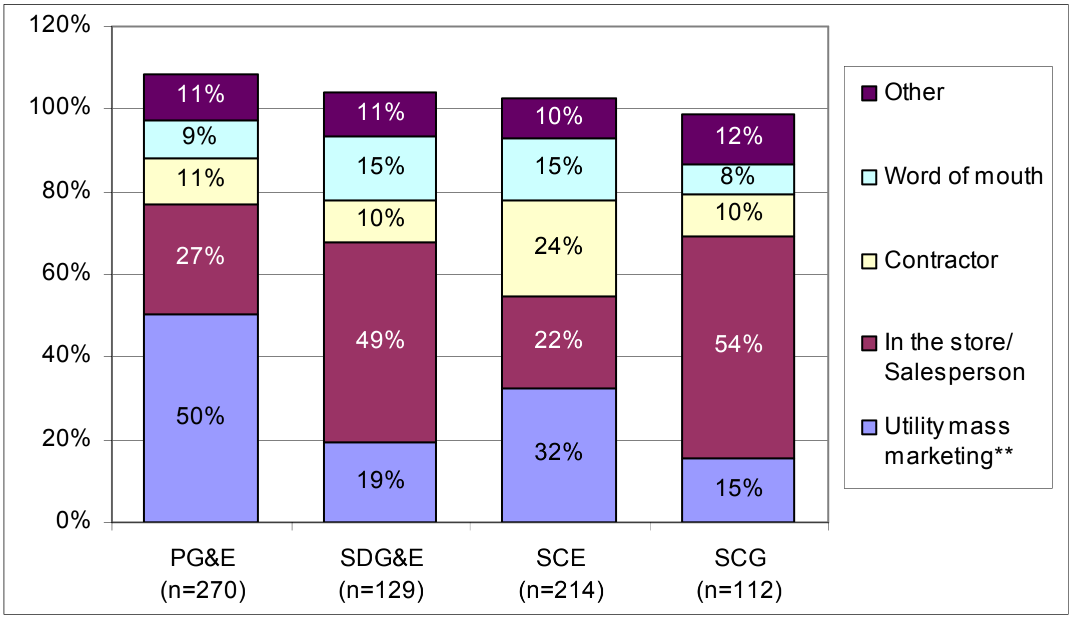
Figure 8-9: Sources of Program Awareness Among HEER Participants, 2004/2005*



* Multiple responses allowed; total exceeds 100 percent
** "Utility mass marketing" includes brochures; bill inserts; IOU websites; and television, radio, and newspaper advertisements.
n = 775.
Data source: HEER Participant Telephone Survey, 2006.

Sources of Program awareness varied by utility (Figure 8-10). Fifty percent of PG&E customers cited an in-store display or retail store salesperson as their source of awareness, compared with 19 percent of SDG&E participants, 32 percent of SCE participants, and 15 percent of SCG participants.

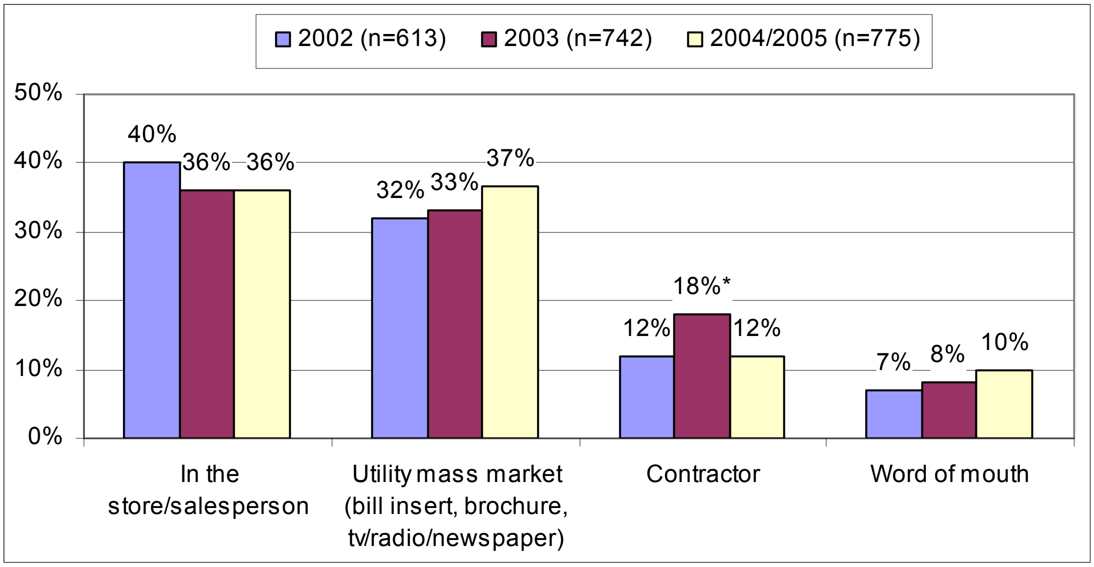
Figure 8-10: Sources of Program Awareness Among HEER Participants by Utility, 2004/2005*



* Multiple responses allowed; total may exceed 100 percent.
** Utility mass marketing includes brochures; bill inserts; IOU websites; and television, radio, and newspaper advertisements.
Data source: HEER Participant Telephone Survey, 2006.

Figure 8-11 shows a comparison of major sources of program awareness among HEER participants during the 2002, 2003, and 2004/2005 Program periods. Sources of Program awareness have not changed dramatically across the program periods. During all three periods, retailers played a significant role in making HEER participants aware of rebates. In 2004/2005, more than one-third of the respondents indicated that they learned about the program through utility mass marketing (bill inserts, mailings, TV/radio/newspaper advertisements; 37%) or in a retail store from a salesperson or in-store display (36%).

Figure 8-11: Sources of Program Awareness Among HEER Participants Over Time[133]



* Difference from other years (within source) is statistically significant at the 90 percent level of confidence.
2002 data source: Quantum Consulting and KEMA-XENERGY, 2003.
2003 data source: Quantum Consulting and KEMA-XENERGY, 2004.
2004/2005 data source: HEER Participant Telephone Survey, 2006.

8.2.2 *Where Participants Get Rebate Applications*

The utilities provide rebates applications for HEER measures on their websites, through the mail (by request through the utilities' customer hotlines), through retailers, and through contractors. Figure 8-12 shows the distribution of where HEER participants obtained their rebate application across the four primary distribution methods. Overall, 42 percent of participants reported receiving their rebate applications from retail stores, statistically unchanged from 2003. Retailers played the most prominent role in SCE territory (58%) where as significantly fewer customers relied on retailers in PG&E and SDG&E territories (38% and 41%, respectively).

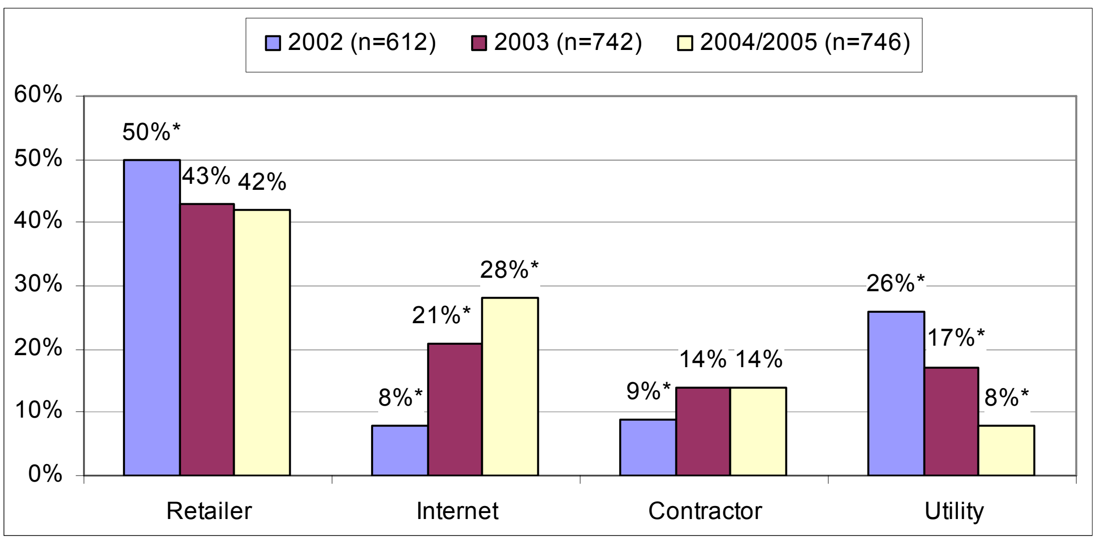
Participants who obtained rebate applications from the Internet (including utility websites) have increased by statistically significant proportions from 2002 to 2003 and from 2003 to 2004/2005, while at the same time the proportion of participants who obtained applications

[133] 2002 data source: Quantum Consulting and KEMA-XENERGY, 2003. 2002 Statewide Residential Retrofit Single-Family Home Energy Efficiency Rebate Program Evaluation. Prepared for Pacific Gas and Electric Company. Study ID# PSE-SW-069. December 23, 2003.
2003 data source: Quantum Consulting and KEMA-XENERGY, 2004. 2003 Statewide Residential Retrofit Single-Family Home Energy Efficiency Rebate Program Evaluation. Prepared for Pacific Gas and Electric Company, San Diego Gas and Electric Company, Southern California Edison, and Southern California Gas Company. Study ID# PGE0204. December 29, 2004.

directly from the utilities has decreased by statistically similar proportions. It is possible that participants who reported obtaining their applications from the utility may have gotten them from the utility website and vice-versa. Combining these two channels of application delivery (internet and utility) the survey results show that 36 percent of 2004/2005 participants obtained their applications via the utility or the internet, compared with 38 percent in 2003 and 34 percent in 2002. There is no statistically significant difference between these results.

Retailers play a dominant role in distributing appliance rebate applications; approximately 55 percent of participants reported getting their appliance rebate application from a retailer, compared with 25 percent of rebate applications for home improvement measures and 10 percent for AC/heating measures. Home improvement and AC/heating measure participants tended to obtain their applications from contractors (34% and 37%, respectively).

Figure 8-12: Where HEER Participants Get Rebate Applications, 2002, 2003, and 2004/2005



* Difference from other years (within source) is statistically significant.
2002 data source: Quantum Consulting and KEMA-XENERGY, 2003.
2003 data source: Quantum Consulting and KEMA-XENERGY, 2004.
2004/2005 data source: HEER Participant Telephone Survey, 2006.

8.2.3 *Energy-Efficiency Measure Purchase Experience*

The telephone surveys asked HEER participants several questions regarding Program purchases. For participants who purchased their measure at a retail store, interviewers asked about their recall of in-store advertising materials, as well as their interactions with retail salespeople. Interviewers also queried participants who purchased their measure from a contractor about the contractor's sales pitch. Interviewers asked all participants about their satisfaction with the Program and its influence on their decision to purchase the measure.

The evaluators discovered that often participants response to questions differed based on the type of measure the participant purchased. Measure categories include home improvement measures, HVAC measures, and appliances. In many cases, pstat results differ from the remaining home improvement measures and thus pstat results are presented separately. Figure 8-13 shows the specific measures included in each measure category for the purposes of these analyses.

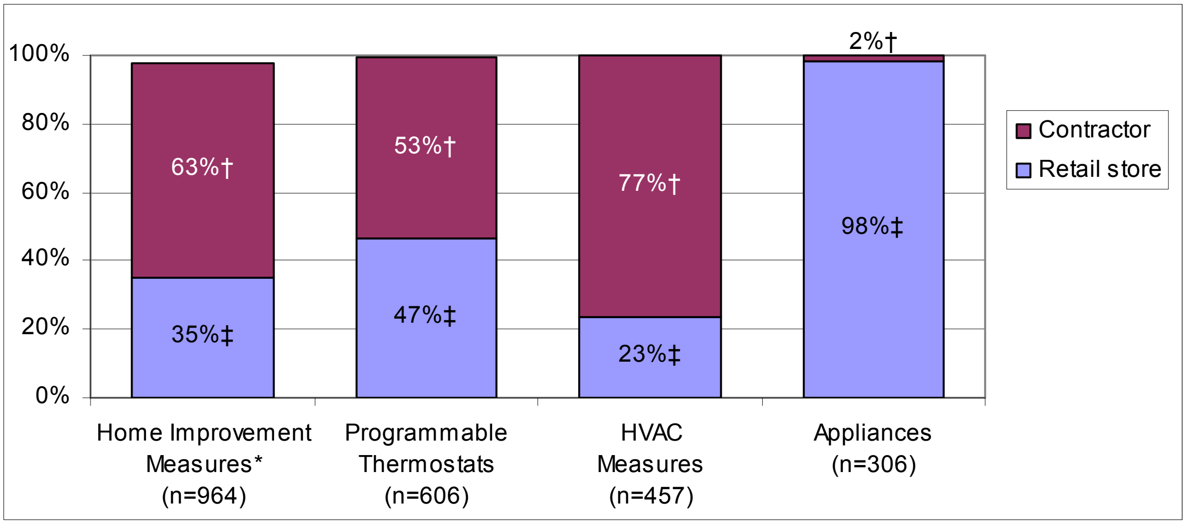
Figure 8-13: Measure Categories and Included Measures

Measure Category	Measures Included
Home improvement measures	Pool pump Insulation Water heater Windows Programmable thermostat (pstat)
HVAC measures	Central air conditioner Evaporative cooler Whole house fan Gas furnace Room air conditioner
Appliances	Clothes washer Dishwasher

8.2.4 *Where Participants Obtain Program Measures*

The evaluators asked participants whether they purchased their HEER measures from retail stores, contractors, or other sources (Figure 8-14). Results differed by measure category; as expected, a statistically higher proportion of appliance purchasers bought their equipment in retail stores (98%) than participants who purchased programmable thermostats (47%), other home improvement measures (35%), or HVAC equipment (23%).

Figure 8-14: Measure Purchase Location Among HEER Participants by Measure Category, 2004/2005**



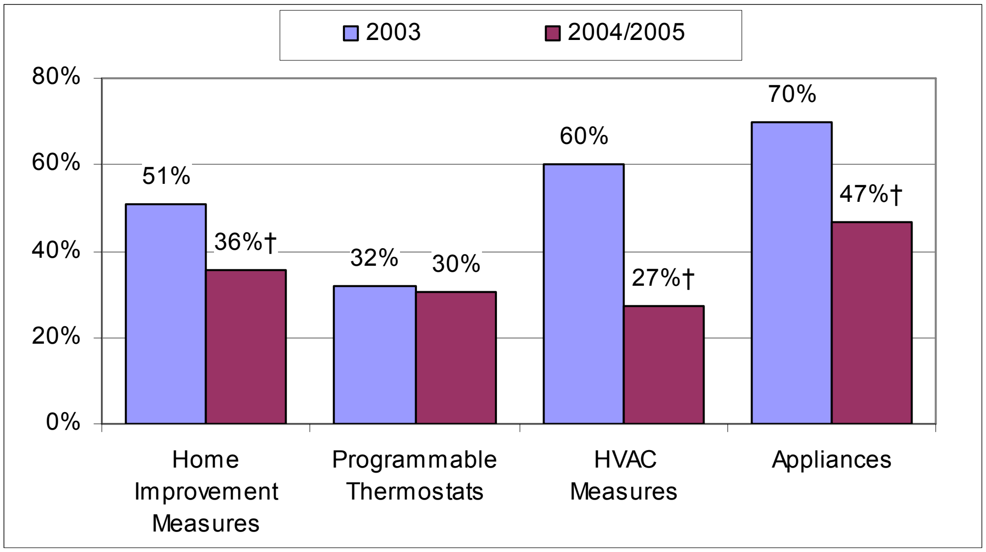
** 2003 Program data not available for comparison because survey question was asked differently.
* "Home Improvement Measures" category excludes programmable thermostats; total does not equal 100% because 1% responded, "Don't Know."
† Differences between measure categories are statistically significant at the 90 percent level of confidence.
‡ Differences between measure categories are statistically significant at the 90 percent level of confidence.
Data source: HEER Participant Telephone Survey, 2006.

The In-Store Purchase Experience

Program Promotions

The IOUs and participating suppliers placed Program POP materials in retail stores in the form of signage, literature, and displays. About half of the 2004/2005 participants who purchased their equipment in retail stores indicated that they recalled seeing in-store promotional materials that provided information about the energy efficiency of the equipment they purchased (45%). This is a statistically significant decrease from 2003 in which two out of three participants who shopped in retail stores recalled seeing literature or displays. This decline was apparent within all measure categories except programmable thermostats (Figure 8-15). The decreased recall of in-store materials between 2003 and 2004/2005 may be related to the timing of the 2004/2005 surveys (late 2006 through early 2007 – more than a year after the Program period ended).

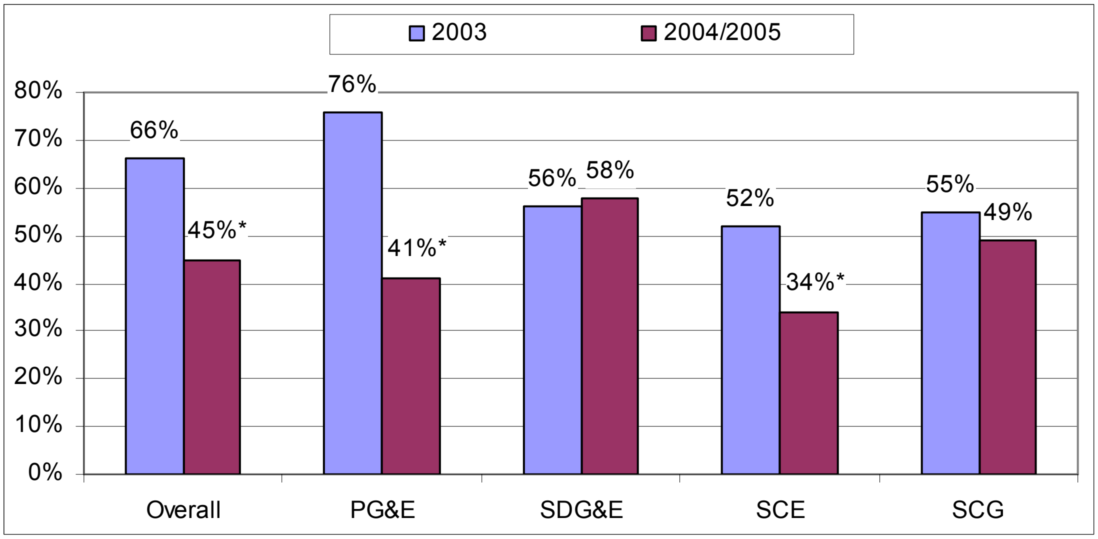
Figure 8-15: HEER Participant Recall of In-Store Promotional Materials by Measure Category, 2003 and 2004/2005



† Difference from prior Program period is statistically significant at the 90 percent level of confidence.
2003 n: home improvement=158; pstat=25; HVAC=54; appliances=113.
2004/2005 n: home improvement=361; pstat=168; HVAC=145; appliances=301.
2003 data source: Quantum Consulting and KEMA-XENERGY, 2004.
2004/2005 data source: HEER Participant Telephone Survey.

Recall of in-store promotional materials also differed by utility service territory between 2003 and 2004/2005 (see Figure 8-16). Participants in PG&E service territory exhibited the most significant drop in recall of in-store materials between 2003 and 2004/2005 (76% to 41%, respectively), followed participants in SCE territory (52% to 34%). Again, this decline may be at least partially attributable to the timing of the 2004/2005 surveys.

Figure 8-16: HEER Participant Recall of In-Store Promotional Materials by Utility, 2003 and 2004/2005



* Difference from prior Program period is statistically significant at the 90 percent level of confidence.
2003 n: Overall=325; PG&E=114; SDG&E=75; SCE=72; SCG=66.
2004/2005 n: Overall=813; PG&E=305; SDG&E=151; SCE=200; SCG=157.
2003 data source: Quantum Consulting and KEMA-XENERGY, 2004.
2004/2005 data source: HEER participant Telephone Survey, 2006.

Retail Salespeople

Eighty-three percent HEER participants who purchased their Program measure in a retail store recall speaking with salespeople while shopping for their equipment. The majority of participants who received appliance rebates talked with a salesperson (86%), compared with statistically smaller proportions of participants who received rebates for home improvement measures (63%), heating and cooling measures (58%), or pstats (49%).

Nearly three-quarters of HEER participants who spoke with retail salespeople indicated that the salesperson told them about the rebate program (73%) and/or about the energy-efficiency benefits of the new equipment (74%), suggesting that retailers are training salespeople to promote energy-efficient products. Figure 8-17 provides additional detail.

Figure 8-17: In-Store Purchase Experience Among HEER Participants, 2004/2005

In-Store Experience	Measure Category				Overall*
	Home Improvement Measures	Pstats	HVAC Measures	Appliances	
Purchased in store	35%‡	47%‡	23%‡	98%‡	77%
Talked w/salesperson (of in-store purchasers)	63%†	49%†	58%	86%‡	83%
Salesperson told about rebate program	63%†	76%	67%	74%†	73%
Salesperson told about EE benefits	74%	69%†	81%‡	74%†	74%

† Difference between measure categories is statistically significant at the 90 percent level of confidence.
‡ Difference from other measure categories is statistically significant at the 90 percent level of confidence.
Purchased in store n: home imprvmt=964; pstat=606; HVAC=457; appl=306; overall=1782.
Talked w/salesperson n: home imprvmt=308; pstat=168; HVAC=117; appl=262; overall=691.
Salesperson told about rebate program n: home imprvmt=222; pstat=61; HVAC=61; appl=240; overall=527.
Salesperson told about EE benefits n: home imprvmt=282; pstat=75; HVAC=110; appl=279; overall=680.
Data source: HEER Participant Telephone Survey, 2006.

Participant Experience with Contractors

Twenty-two percent of 2004/2005 HEER participants purchased their measure from a contractor. As expected, the proportion of HVAC measure participants who purchased their equipment from a contractor (77%) is significantly higher than among participants in all other measure categories (see Figure 8-18).

The majority of participants who purchased their Program measure from their contractor indicated that their contractor discussed the energy-efficiency benefits of this new equipment (87%). The proportion of HVAC participants who discussed energy efficiency benefits with their contractor is higher than among home improvement measure participants (93%) and pstat participants (66%).[134]

Seventy-two percent of home improvement and HVAC measure participants who purchased their measure from a contractor indicated that the contractor told them about the Home Energy Efficiency Rebate Program. By measure type, the proportion of HVAC participants is again higher than participants in the other measure categories. Two-thirds of participants who purchased their measure from a contractor indicated that the contractor recommended a high-efficiency model. Among pstat participants, 58 percent indicated that the contractor recommended an ENERGY STAR model.

[134] These differences are statistically significant at the 90 percent level of confidence. Sample size for Other Appliance participants is too small for valid comparison (n=5).

Figure 8-18: Contractor Purchase Experience Among HEER Participants, 2004/2005

Contractor Experience	Measure Category				Overall
	Home Improvement Measures	Pstats	HVAC Measures	Appliances	
Purchased from contractor	63%‡	53%‡	77%‡	2%‡	22%
Contractor told about rebate program	69%	65%	81%‡	*	72%
Contractor told about EE benefits	85%‡	66%‡	93%‡	*	87%
Contractor recommended high efficiency model (for pstats: ENERGY STAR model)	65%	58%†	71%†	*	67%

* Results excluded; invalid due to small sample size (n=5).
† Difference between measure categories is statistically significant at the 90 percent level of confidence.
‡ Difference from other measure categories is statistically significant at the 90 percent level of confidence.
Purchased from contractor n: home improvement=964; pstat=606; HVAC=457; appliance=306; overall=1,782.
All other n: home improvement=556; pstat=425; HVAC=300; appliance=5; overall=909.
Data source: HEER Participant Telephone Survey, 2006.

8.2.5 *Participant Satisfaction*

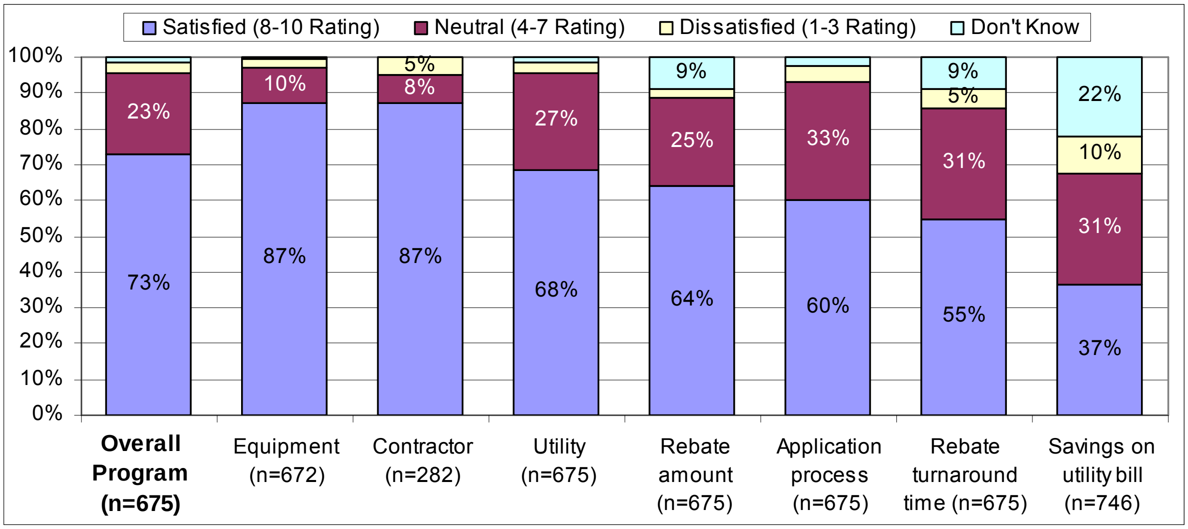
All HEER participants were asked to rate their satisfaction with the Program and various Program components on a scale of 1 to 10 where 1 means, "not at all satisfied" and 10 means "very satisfied." Figure 8-19 presents reported satisfaction with the 2004/2005 Program and various components. "Satisfied" customers were defined as those who ranked their satisfaction between 8 and 10 on the 10-point scale, "Neutral" customers ranked their satisfaction between 4 and 7, and "Dissatisfied" customers provided rankings between 1 and 3. Overall, 73 percent of HEER participants reported being satisfied with the HEER Program in general. Utility bill savings produced the greatest proportions of Neutral and Dissatisfied participants (41% total), while fewer than 5 percent of Participants reported being dissatisfied with the overall Program or other program components.

There were few differences in satisfaction by measure type. Participants who received a rebate for insulation were less satisfied with their measure and its performance than participants who received a rebate for other measure types.[135] Participants who received a rebate for windows were less satisfied with the rebate amount than participants who received a rebate for other measures.[136] There were no other statistically significant differences in satisfaction by measure type.

[135] The question was phrased as follows, "Using a scale of 1 to 10 where 1 is NOT AT ALL SATISFIED and 10 is EXTREMELY SATISFIED, how satisfied are you with the [measure] and its performance?" The mean satisfaction rating for insulation participants (8.4) was lower than for windows participants and central air conditioner participants (both 9.2, a statistically significant difference at the 90 percent level of confidence).

[136] The mean satisfaction ratings for rebate amount among windows participants was 7.3, much lower than among clothes washer participants and pool pump participants (8.3 and 8.4, respectively; a statistically significant difference).

Figure 8-19: Levels of Satisfaction Among HEER Participants, 2004/2005

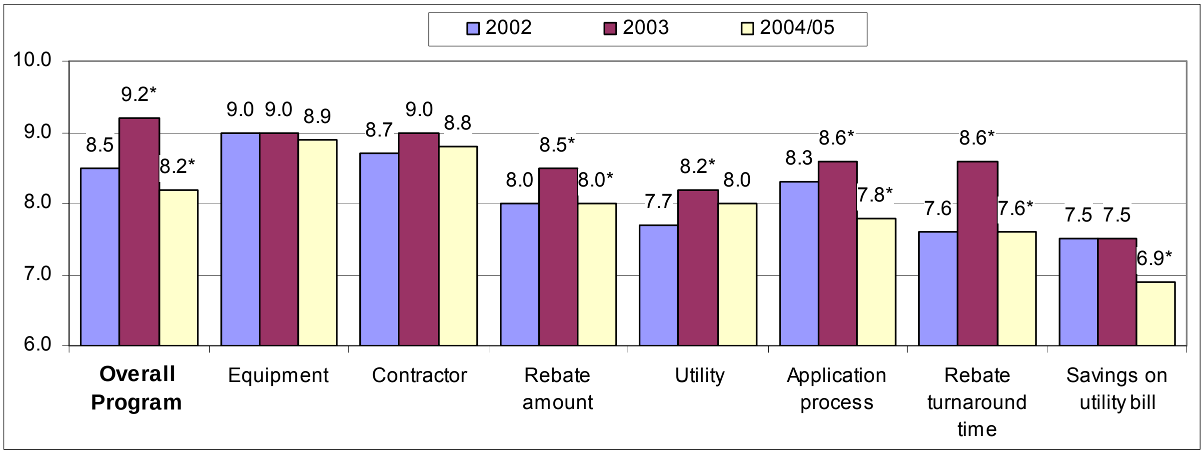


Data source: HEER Participant Telephone Survey, 2006.

General satisfaction with the rebate program increased by a statistically significant margin between the 2002 and 2003 Program periods, and in 2004/2005 returned to levels similar to those reported in 2002 (with the exception of satisfaction with utility bill savings and the application process). Five key measures of participant satisfaction (including satisfaction with the Program, rebate amount, application process, rebate turnaround time, and utility bill savings) declined by statistically significant margins between the 2003 and 2004/2005 Program periods. Lower satisfaction during the 2004/2005 Program period may be a result of early measure close-outs in some utility service territories, midstream changes to rebate levels (e.g., for clothes washers) and slow rebate processing times in 2004 (see Chapter 3 for details).

Half of the HEER participants (49%) believed that the savings on their monthly electric bills were close to what they expected and 42 percent of gas measure participants responded the same for their gas bills. Approximately one in 10 HEER participants reported their electric or gas savings exceeded their expectations.

Figure 8-20: Satisfaction with Rebate Program and Attributes Among HEER Participants



* Difference from prior Program period is statistically significant at the 90 percent level of confidence.
2002 n: equip=607; contractor=244; prog=612; rebate=594; util=603; app=605; turnaround=588; savings=499.
2003 n: equip=735; contractor= 481; prog=739; rebate=718; util=735; app=722; turnaround=703; savings=510.
2004/2005 n: equip=672; contractor=282; prog=718; rebate=685; util=717; app=695; turnaround=668; savings=637.
Data source: HEER Participant Telephone Survey, 2006.

8.2.6 *Influences on Consumer Purchase Decisions*

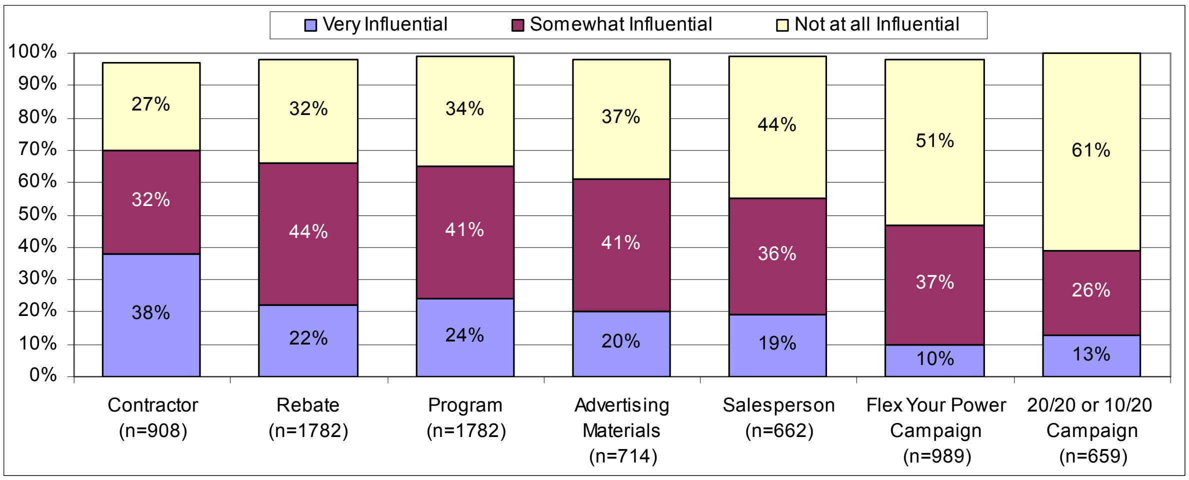
Influences on Overall Energy-Efficient Measure Purchase Decision

The HEER participant phone surveys asked participants to indicate the influence of the rebate Program and other factors on their decision to purchase their new measure. As shown in Figure 8-21, roughly two-thirds of HEER participants indicated that the Program, the rebate, or the contractor had some influence on their measure purchase decision. Thirty-eight percent of participants who purchased their measure from a contractor said the contractor was very influential, compared with half that proportion (19%) who shopped in retail stores and indicated that the salesperson was very influential.

Overall, the Program had at least some influence on 65 percent of HEER participants. Influence of the rebate Program did not differ significantly by measure type or utility, but statistically significantly larger proportions of low-income participants indicated that the Program was "very influential" on their decision to make the purchase than non low-income participants (32% and 23%, respectively). These populations showed similar trends with regard to influence of the rebate on purchasing decisions (30% of low-income participants indicated that the rebate was "very influential" compared with 20% of non low-income participants) as well as with regard to program advertising material (35% versus 17%, respectively).

These results are not surprising, as low-income participants may be more influenced by cost savings (and information regarding cost savings) than other groups within the population. It is also possible that low-income residents are less likely to buy energy-efficient equipment because of the higher initial cost, so the rebate is likely to be more influential than for non-low-income customers (who may be more able to afford the higher cost).

Figure 8-21: Influence of Various Factors on Energy-Efficient Measure Purchase Decisions Among HEER Participants, 2004/2005*



* Totals may be less than 100% as some participants could not provide an assessment of influence (i.e., responded "don't know").
Data source: HEER Participant Telephone Survey, 2006.

Influences on Other Elements of Energy-Efficient Measure Purchase Decision

All participants were asked what actions they would have taken had the rebate not existed. Results for pstat measures and all other measures are presented separately because pstats required a slightly different question battery due to the unique nature of the measure.

The evaluators asked pstat participants what they would have done regarding their measure purchase in absence of the rebate; 79 percent indicated that they would have purchased the same ENERGY STAR programmable thermostat in absence of the rebate. Eight percent said they would have purchased a non-ENERGY STAR programmable thermostat, and 1 percent said they would have purchased a manual thermostat. Seven percent said they would not have purchased a thermostat at all, and the remaining 4 percent said they did not know what they would have done in absence of the rebate. More than 9 out of 10 pstat participants said they would have purchased their pstat at the same time if the Program incentives were not available.

Figure 8-22 shows that 91 percent of participants in other measure categories indicated that they still would have purchased an energy-efficient measure in absence of the rebate.[137] The proportion of participants who say they would have purchased an energy-efficient appliance in absence of the rebate is significantly higher than the proportion of home improvement measure participants (92% and 86%, respectively; a statistically significant difference at the 90 percent level of confidence). The proportion of HVAC participants that reported feeling this way fell directly in-between these two reports (88%).

Eighty-five percent of HEER participants indicated that they would have purchased the same model in absence of the rebate, while 11 percent speculated that they would have purchased a less expensive and less efficient model. Ten percent of HEER participants indicated that they would have delayed their purchase in absence of the rebate, while 90 percent said they would have purchased the measure at the same time in the absence of the rebate. There were no noteworthy differences in these hypothetical activities by measure type.

Figure 8-22: Hypothetical HEER Participant Measure Purchase Actions in Absence of Rebate, 2004/2005

Action	Measure Category			Overall
	Home Improvement Measures	HVAC Measures	Appliances	
We would not have purchased a new [measure]	3%	4%†	1%†	2%
We would have purchased a standard efficiency [measure]	8%†	6%	4%†	5%
We would have bought an energy-efficient [measure]	86%†	88%	92%†	91%
Don’t know	3%	2%	2%	2%
n	**711**	**457**	**306**	**1,529**

† Difference between measure categories is statistically significant at the 90 percent level of confidence.
Data source: HEER participant Telephone Survey, 2006.

All HEER participants were asked to indicate whether they became aware of the rebate before or after they decided to purchase their new equipment. Forty-one percent of participants reported being aware of the rebate before they decided to make the equipment purchase, 25 percent stated they became aware at the same time, and 30 percent said it was after they decided to purchase the new equipment (Figure 8-23).[138] These data indicate that just under one-third of HEER rebate recipients learned about the rebate *after* they had already

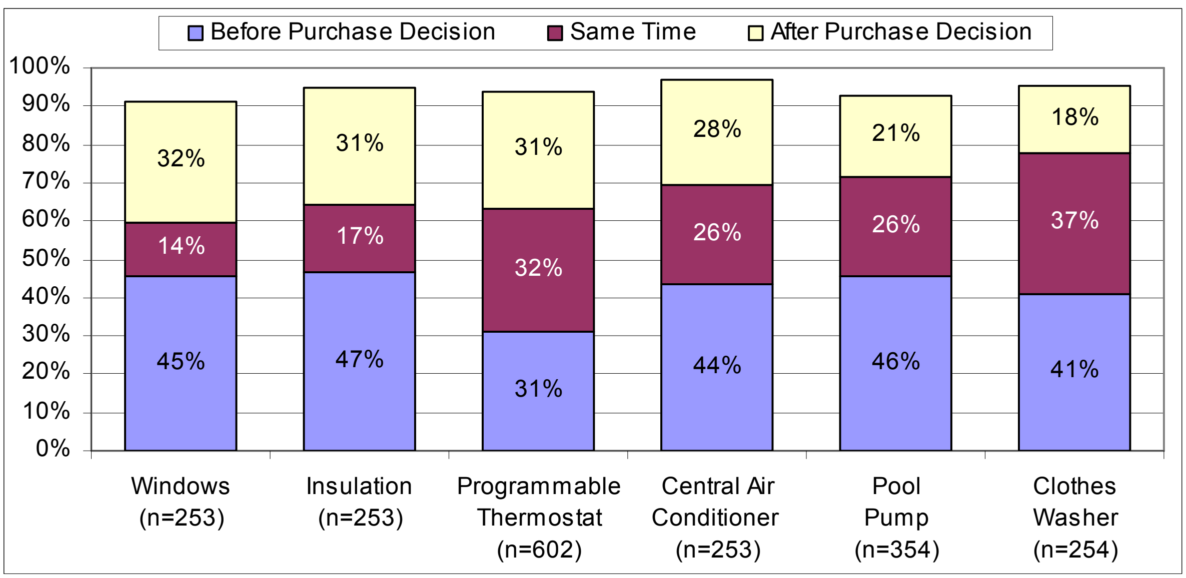
[137] This battery of questions was NOT asked of insulation and pstat participants. The concept of (e.g.) “an energy efficient insulation” is meaningless, so the battery was skipped. For pstat participants, a slightly different battery of questions was asked to clarify purchasing intentions for manual versus programmable and (among programmable) ENERGY STAR versus non-ENERGY STAR as described above

[138] An additional 4 percent did not know.

decided to purchase the equipment. However, the data make no indication as to whether or not these individuals changed their decisions regarding which *model* to purchase after becoming aware of the rebate.

There are no noteworthy differences by measure category in terms of the proportion of participants who learned about the rebates *after* making their measure purchase decision. However, some differences were revealed when six key measures were examined individually. The proportion of HEER participants who became aware of the rebates *after* making their purchase decision is highest among windows rebate participants (32%) when compared with other key measure types. This proportion is significantly higher than among pool pump or clothes washer participants (21% and 18%, respectively). This finding underscores the soundness of the utilities' decisions to discontinue windows rebates in 2006.

Figure 8-23: Timing of Rebate Awareness and Measure Purchase Decision Among HEER Participants, 2004/2005*



* Totals are less than 100% as some participants could not recall when they became aware of the rebates.
Data source: HEER Participant Telephone Survey, 2006.

9

Non-Lighting Impact Assessment

This chapter presents the results of the non-lighting impact assessment activities conducted for energy saving measures offered through the 2004/2005 California Statewide Home Energy Efficiency Rebate (HEER) Program. The objective of this study component is to verify Program performance and estimate ex post energy and demand savings and net-to-gross ratios for key measures of the program. These results are used to calculate Program level estimates of net savings and the corresponding realization rates on the ex ante savings estimates.

This section begins with a discussion of data sources and an overview of the methodology used to calculate net and gross impacts. It is followed by a detailed discussion of the three primary impact assessment areas: verification of Program performance; gross savings estimation, using billing analyses and engineering model calibration; and net savings estimation, using self-report net-to-gross analysis and discrete choice modeling. These discussions cover the details of analysis completed within each of these assessment areas and the final analysis results.

9.1 Data Sources

The impact assessment for the 2004/2005 HEER Program evaluation relies on data from four primary sources: utility billing data, Program tracking data, participant and non-participant telephone surveys, and weather data.

Participant tracking system data for the HEER Programs were provided by each of the IOUs involved in this evaluation (PG&E, SCE, SDG&E and SCG) in support of this evaluation. Data were provided for Program years 2004 and 2005. The tracking system contains dates of participation, Program measure descriptions, quantity installed, incentive amounts, estimated gross kWh, kW and Therm savings per unit, and the net-to-gross ratios currently applied for each measure to calculate the net kWh, kW and Therm savings. The tracking database is linked to the utility billing databases via customer account numbers.

Utility monthly billing data was also provided by each of the California IOUs. This billing data included customer account numbers, addresses, kWh and Therm usage, and bill read dates. Billing data was provided for all 2004/2005 HEER participants and a sample of 40,000 non-participants at each utility and spanned the period from January 2003 through late 2006.

As part of this evaluation telephone survey data was collected from more than 2,200 participants and 2,500 non-participants. This data was used to support all of the gross and net impact analyses.

Weather data files were provided to the Itron team from PG&E, SCE and SDG&E. Since weather data was not received for SCG it was necessary to apply the weather data from SCE and SDG&E by zip code to customers in the SCG service territory. Daily heating and cooling degree days (HDD and CDD) were calculated based on the hourly temperature data from January 2003 through October 2006. HDD and CDD were chosen to represent weather patterns, as these have the most direct relationship with energy needs and consumption. Cumulative HDD over a billing period are generally well correlated with space heating demand over that period. Similarly, CDD are proportional to cooling needs, for those with air conditioning.

9.2 Overview of Methodology

As mentioned above there were three primary impact assessment areas: verification of Program performance, gross savings estimation and net savings estimation. Because of the number of measures eligible under the 2004/2005 HEER Program, it was not feasible to conduct a complete savings analysis for each measure. Table 9-1 below shows the analysis methods undertaken for each of the 2004/2005 rebated measures. This analysis plan was developed based on a number of factors, primarily the current Program accomplishment and the estimated future active potential of each measure. The methods in this table were proposed and approved in a research plan submitted to the CPUC in September 2006.

Table 9-1: Verification, Gross, and Net Savings Methods for 2004/2005 HEER Measures

Measure Type	Technology Type	Verification	Gross Savings Methods		Net Savings Methods	
		Various Methods	Billing Analysis	Engineering Model	Self-Report	Discrete Choice
Clothes Washer	Clothes Washer	X		X	X	X
Dishwasher	Dishwasher	X			X	
HVAC	Central AC	X		X	X	X
	Evaporative Cooler	X			X	
	Gas Furnace	X			X	
	Heat Pump	X			X	
	Room AC	X			X	
	Whole House Fan	X			X	
Insulation	Insulation	X	X		X	X
Pool Pumps	Single and Two Speed	X	X	X	X	
Programmable Thermostat	Programmable Thermostat	X	X		X	X
Water Heater	Electric	X			X	
	Gas	X			X	
Windows	Windows	X	X		X	

9.2.1 *Gross Impact Analysis Methods*

The objective of the ex post gross savings analyses was to develop measure-level estimates of gross energy and demand savings for measures installed by the Program. The purpose of conducting ex post analysis is to develop more precise and more accurate (i.e., less biased) estimates of both individual measure savings and overall Program savings and future potential savings. The analysis approaches used to estimate ex post energy and demand savings include billing analyses (used to estimate energy savings only), and the calibration of existing DEER and/or other engineering models. Each of these approaches resulted in per unit ex post gross energy savings estimates (gas and/or electric) and a realization rate on the current ex ante estimate.

The section below describes at a high level each of the gross approaches utilized and provides the overall gross impact results for each of the non-lighting measures analyzed. A comprehensive explanation of the methodologies employed and a complete presentation of the analysis results are included in Appendix G.

Billing Analysis

For four of the high priority measures that had sufficient savings, we conducted billing analyses. The objective of these billing analyses was to determine the energy savings resulting from the installation of Program measures. Statistical regression techniques were used to model energy use with actual customer billing data. The models are specified using billing data, weather data and other independent variables that explain changes in customers' energy usage. The latter includes information gathered during the participant and non-participant telephone surveys, as well as engineering estimates of energy impact from the Program tracking database.

The results of the billing regression analysis are ratios, termed "realization rates," of the energy savings detected by the billing model to the impact estimates found in the tracking data. These realization rates are the fraction of engineering estimates actually "observed" or "detected" in the statistical analysis of the billing data.

Billing analyses were conducted for the following measures: windows and insulation (ceiling and wall), pool pumps, and programmable thermostats.

The billing analysis presented here uses a basic statistical regression approach to model the differences in customers' energy usage between pre- and post-installation periods with actual customer billing data. The models are specified using billing data, tracking data, weather data and other explanatory variables gathered during the telephone surveys, as described above. In general, post-installation consumption is modeled as a function of pre-installation consumption, changes in the weather, other changes in the home, and the installation of Program measures. Both post- and pre-installation consumption data comprise 12 valid months of usage (either kWh or Therms).

Each of the billing models discussed below predicts annual energy (either kWh or Therms) usage as a function of relevant independent variables, including pre-installation energy usage. Each of the models includes both non-participants and participants. The non-participants serve as a control group for participant usage patterns, essentially representing usage patterns in the absence of Program measures. The general model specification of each billing model is shown below.

$$Energy_{post,i} = \beta_1 Energy_{pre,i} + \Sigma_N \beta_N x_i + e_i$$

Where,

> $Energy_{post,i}$ = Energy consumed by customer i over the 12 month period after studied Program measure installations have occurred
>
> $Energy_{pre,i}$ = Energy consumed over a 12 month period before studied Program measure installations have occurred
>
> β_N = Vector of independent variable coefficients
>
> x_i = Vector of independent variables associated with customer i
>
> e_i = Error term for customer i

The results of the billing analysis are presented for each of the four measures in Section 9.4.1 below.

<u>Calibrated DEER or Engineering Models</u>

For some measures, instead of calculating an entirely new ex post estimate, we updated or calibrated the current DEER values or other engineering models. A value in DEER may be based on an engineering model that is a function of a number of parameters. For some of the measures, the DEER team has provided us with a number of key parameters that drive the DEER results and are in need of updating. In these instances we attempted to estimate these parameters using primary and secondary data sources to provide a more accurate and precise overall estimate of the measures' savings.

Measure by measure approaches and the results of the engineering models are presented in Section 9.4.2 below.

9.2.2 *Net Impact Analysis Methods*

The primary objective of the net savings analyses for the non-lighting measures is to determine the Program's net effect on customers' electric and gas usage. This requires estimating what would have happened in the absence of the Program. This estimation hinges on estimating the level of free-ridership that exists for each measure. Participant and non-participant spillover effects were also estimated but were not used to calculate a measure's net-to-gross (NTG) ratio. The analysis approaches used to estimate ex post net energy and demand savings for the non-lighting measures included a self-report data analysis and discrete choice modeling. Both of these approaches resulted in the estimation of a NTG ratio that, when applied to the gross Program savings estimates, calculated the ex post net Program impacts.

As shown in Table 9-1 above a self-report net-to-gross analysis was conducted for each of the non-lighting measures which resulted in measure-level estimates of free-ridership. Discrete choice analyses were conducted for a subset of the non-lighting measures based on the measure prioritization described above.

The section below describes at a high-level each of the net-to-gross approaches utilized. The overall net impact analysis results for each of the non-lighting measures analyzed are included in Section 9.5.3 . A comprehensive explanation of the methodologies employed and a complete presentation of the net analysis results are included in Appendix G.

Self-Report Net-to-Gross Analyses

Self-report net-to-gross analyses were conducted on data collected during the participant and non-participant surveys to estimate free-ridership and spillover for each measure.

Free-ridership

The calculation of free-ridership is a multi-step process that considers a variety of ways in which the Program may influence a customer to adopt an energy efficient measure. Generally, free-ridership was analyzed from four separate perspectives, as follows:

1. Did the *Program* influence the customer to make a purchase?
2. Did the *Program* influence the customer to accelerate a purchase?
3. Did the *Program* influence the customer to make a more efficient purchase than they otherwise would have?
4. Did the *incentive* influence the customer's decision to purchase a Program qualifying measure?

The Program and the incentive were differentiated since the Program can influence a customer in more ways than a financial incentive can (e.g., information used to make a decision, or increasing awareness and knowledge of energy efficient options).

Probability scores of a customer being a free-rider were developed separately for each of these four criteria. Each probability score was based on survey responses to a specific set of questions. The product of these probability scores forms the probability the participant was a free-rider. A free-ridership score was assigned to each participant in the survey sample, and the average of the scores represents the Program result. The four probability scores included:

a) Probability that respondent would have purchased the same type of measure in the absence of the Program (e.g., an air conditioner),
b) Probability that respondent would have purchased the measure at the same time,
c) Probability that the measure purchased in the absence of the Program would be as efficient as that purchased through the Program (e.g., would have purchased an air conditioner with a program-qualifying level of efficiency),
d) Probability that the respondent was *not*[139] influenced by the cash incentive in making the decision to purchase a Program qualifying measure.

The results of the free-ridership analysis are presented in Section 9.5.1 below.

Participant Spillover

Participant spillover includes all participant adoptions of energy saving measures that are influenced by the Program, but are not done through the Program (i.e., are not rebated, since the HEER program claims savings only for rebated measures). It is reasonable to expect that the Program, by providing information on and experience with energy efficient measures, motivated customers to install Program qualifying measures without the Program rebate. As per the CPUC's requirements for 2004-2005 evaluations, participant spillover is estimated for informational purposes only; it is not used to calculate the final NTG ratios.

The participant survey fielded in support of this evaluation gathered information on additional equipment installations and measure adoptions that were made by Program participants for which they did not receive a Program rebate. The information collected included:

a) The efficiency of the installed equipment or measure which was not rebated,
b) The degree of self-reported influence of the Program on the decision to purchase the equipment, and

[139] The probability of *not* being influenced, rather than being influenced, by the cash incentive is estimated so that all three probabilities have the same relationship with the likelihood of free-ridership.

c) Whether the customer received any rebates whatsoever for the installation or purchase of high efficiency equipment or measure (to confirm the measure was not rebated).

A participant's additional measure adoption was considered a spillover adoption if the following three conditions were met:

a) The measure was program-qualifying.

b) The degree of self-reported influence of the Program on the purchase of the Program-qualifying measure was sufficient to reasonably conclude that the adoption would not have occurred in the absence of the Program.

c) The customer did not receive any rebates whatsoever for the measure adoption.

The spillover rate was calculated by dividing the number of spillover adoptions by the number of surveyed participants. The spillover rate was then applied to the appropriate population of participating customers. The issue of what is the 'appropriate' participant population revolves around who is a reasonable candidate for additional measure adoptions. Consider the air conditioning measure for example. Since it is unlikely that an air conditioner participant would adopt an additional air conditioner, the 'appropriate' participant population used for the calculation of air conditioner spillover was the total participant population less the number of air conditioner participants in the Program[140].

Annual participant spillover adoptions were divided by program-year participation to yield an estimate of participant spillover expressed as a percent of Program savings.

Non-participant Spillover

Non-participant spillover was calculated in the same manner as participant spillover with a couple of exceptions. First, a screening criterion was added to ensure the non-participant was aware of the HEER Program prior to making their program-qualifying purchase. Second, the calculation of the spillover rate (which was calculated as the number of spillover adoptions divided by the number of surveyed customers) was applied to the appropriate population of non-participating customers to estimate the number of spillover adoptions occurring in the population. As California IOUs are not able to include non-participant spillover in net savings claims, estimates of non-participant spillover were calculated for informational purposes only and the results are presented in Section 9.5.1 below.

[140] This adjustment gets us close to the relevant participant population, but in some cases that eligible participant population may still be overstated due to the fact that not all participants are eligible able to buy certain measures (i.e. participants without swimming pools would not likely purchase a pool pump).

Discrete Choice Analysis

A second approach used to assess net Program impacts was discrete choice modeling, which relies on large samples of telephone survey data, and is used for measures that are commonly installed outside of the Program and are homogenous in nature. This approach was recommended in the research plan for four HEER measures: clothes washers, central air conditioning, insulation and programmable thermostats. It was used in conjunction with the self-report approach for these four measures, however, the final NTG ratios used to calculate the net Program impacts are based on the discrete choice results since they are generally thought to be more robust than the self-report methods.

Discrete choice modeling combines customers' responses about their equipment choices and their purchase decision process with customer demographic information and details on their previous or existing equipment in order to estimate the probability that alternative equipment options will be chosen. It also provides a method for estimating the importance of various equipment and Program factors on the equipment choice decision.

A two-stage discrete choice model is typically used to simulate the decision to purchase energy efficient equipment. The probability of purchasing any given equipment option A can be expressed as the product of two separate probabilities: the probability that a purchase is made multiplied by the probability that equipment option A is chosen given that a purchase has been made. This can be written as:

$$Prob(Purchase \,\&\, Equipment\ A) = Prob(Purchase) \times Prob(Equipment\ A \mid Purchase)$$

The two-stage model adopted for this analysis estimated both of the right hand side probabilities separately. The first stage of the model estimated the probability that a customer made an equipment purchase and is referred to as the **purchase probability**. The second stage of the model estimated the type of equipment chosen, given that the decision to purchase equipment has already been made. This is referred to as the **equipment choice probability**. The product of the purchase probability and the equipment choice probability is the **total probability,** and reflects the probability that any one equipment option is purchased. Once estimated, the model was also used to determine the probability of purchasing high-efficiency equipment in the absence of the program. This was simulated by setting all Program related variables to zero in both stages of the model.

The purchase decision was specified as a logit model with a dependent variable having a value of either zero or one. Customers were given a value of one if they made an equipment purchase either in or outside the Program and a zero if they did not purchase any equipment. The purchase decision model specification is defined as:

$$PURCHASE = \alpha_i + \beta' X_i + \varepsilon_i$$

Where α_i is a constant, β represents a vector of variable coefficients, and X_i represents a vector of explanatory variables for customer *i* such as information on their homes' characteristics (square footage, age, changes such as remodeling), the age and condition of their current/previous equipment, the customer's predisposition to energy efficiency and various Program awareness variables that capture the effect Program has had on them. The error term ε_i is assumed to be distributed logistic, consistent with the logit model specification.

The second stage of the model is similar to the first except that it is devoted to estimating the probability that a specific equipment option is chosen given that the decision to purchase equipment has already been made. This second stage of the model is specified as a conditional logit, and is used to estimate the equipment choice decision. The equipment choice model specification is:

$$EQUIPMENT\ CHOICE = \alpha_i + \beta' X_i + \varepsilon_i$$

Where α_i again is a constant, β represents a vector of variable coefficients. X_i continues to represent a vector of explanatory variables for customer *i,* however in the second stage of the model the explanatory variables also include influence variables, such as the influence of the program, a contractor, or Program marketing materials, and variables representing how the customer was informed of the program, in addition to the variables included in the first stage of the model. The error term ε_i is again assumed to take on a logistic distribution, consistent with the logit model specification. Once estimated, the model is used to determine the probability of purchasing high-efficiency equipment in the absence of the program. This is simulated by setting all rebate and Program awareness variables to zero in both stages of the model.

The final net-to-gross ratio for each of the measures evaluated was calculated using the total probability of purchasing high-efficiency equipment (that is the product of the purchase and equipment choice probabilities) both with and without the existence of the program. It is calculated as the difference between the estimated probability with the Program minus the estimated probability without the Program divided by the estimated probability with the Program ($Prob_w$ – $Prob_{wo}/Prob_w$). Segmenting the final results by population (participants versus non-participants) allows for the calculation free-ridership rates and spillover, by disaggregating the total net-to-gross ratio into the individual components.

The two-stage model was used for three of the four measures evaluated. The exception was for insulation, for where a one-stage discrete choice model was used to estimate the probability of installing insulation. The second stage of the model was unnecessary since insulation installations are considered high-efficiency actions and the equipment selection portion of the model is not needed. The results of the discrete choice modeling efforts are presented in Section 9.5.2 below.

9.3 Verification Results

9.3.1 *Overview of Verification Activities*

Verifying energy and peak demand savings was a key objective of this study, to be met through primary research. Five separate verification activities were conducted to verify various aspects of the Program accomplishments. The specific activities that were conducted are as follows:

1. **Application Verification** - Verify that applications were correctly entered into the Program tracking systems, for a sample of applications. Also verify that the rebated equipment was Program qualifying by comparing the vendor invoices attached to the applications with the HEER Program qualifying requirements for each measure (Products Lists for 2004 and 2005 were not provided).
2. **Measure Accomplishments Verification** - Verify that the total number of units rebated through the Program by measure type, as reported by each IOU[141], match the Program tracking systems.
3. **HTR Accomplishments Verification** - Verify that the percent of participants that received incentives in HTR segments (based on geographic location and income for non-lighting measures) as reported by each IOU, match the Program tracking systems.
4. **Measure Installation Verification** – Conduct telephone surveys to verify that the rebated equipment actually installed match the Program tracking system, for a sample of participants.
5. **Onsite Equipment Verification** – Conduct onsite audits to verify that the rebated equipment actually installed match the Program tracking system, and collect measure specific information to verify that the equipment installed was Program qualifying, for a sample of participants.

[141] Source for the final number of rebated units varied by Utility. PG&E was based upon the *Residential Summary Database*, SCE was based upon the *Annual Energy Efficiency Reports* (May 2005/May 2006), and SDG&E and SCG were based on the *December 2005 Statewide Residential Single Family Rebate Workbooks.*

9.3.2 *Approach*

In order to conduct these activities, the Itron/KEMA Team obtained the following detailed information from each IOU:

- A sample of 250 participant applications distributed across the four IOUs, along with the corresponding vendor invoices for non-lighting measures,
- The Program tracking systems,
- Definitions and data sources used to classify participants as hard-to-reach,
- Reports of final HEER Program performance. The reports received varied by utility (PG&E provided figures from the *Residential Summary Database*, SCE provided the *Annual Energy Efficiency Reports* (May 2005/May 2006), and SDG&E and SCG provided the *December 2005 Statewide Residential Single Family Rebate Workbooks.)*

Where appropriate, we integrated the results of the verification activities listed above into our calculations of the ex post energy savings estimates developed as part of this Study to develop final ex post savings estimates.

9.3.3 *Findings*

The results of the five verification activities for the HEER Program are presented in this section.

Application Verification

To ensure that all key parameters were entered correctly into the Program tracking system a total of 355 customer applications were verified across the four IOUs. This verification also ensured that all rebated equipment was Program qualifying. 250 of the 355 applications reviewed focused on the 14 non-lighting measures installed across the state (69 within PG&E territory, 79 within SCE territory (of which 25 were Refrigerators and the results are included in Appendix I), 33 within SCG territory and 69 within SDG&E territory. The remaining 105 applications were for Lighting measures and the results are included in Chapter 6.

PG&E: Itron randomly selected 69 of PG&E's non-lighting end-user rebated measures for verification. For each of these measures, the rebate applications and corresponding vendor invoices were obtained for verification. The payee, measure description, quantity, and rebate amounts were compared with the entries in PG&E's tracking database. All available invoices were correctly entered in the tracking database, with the exceptions noted below. The rebated measures were then evaluated to determine whether or not they met the HEER Program qualifying requirements. Most of these measures were found to be Program qualifying, with exceptions noted below.

Verification Exceptions:

- Itron noted that one of the rebated ENERGY STAR programmable thermostats did not include the proper paperwork (a work proposal, rather than an invoice, was provided.) This unit still was Program qualifying.
- Itron was unable to verify the Tier of the evaporative cooler measures. The list of qualifying products is no longer available.
- Itron noted that there did not appear to be a consistent approach to calculating the window area for the high performance windows measure. Some window area estimates included on the application forms were adjusted by PG&E, although Itron could not identify if the approach to making the adjustments was consistent.

SCE: Itron randomly selected 79 of SCE's non-lighting end-user rebated measures for verification (25 of these were for rebated refrigerators and thus the verification results are included in Appendix I). For each of these measures, the rebate applications and corresponding vendor invoices were obtained from SCE for verification. The payee, measure description, quantity, and rebate amounts were compared with the entries in SCE's tracking database. All available invoices were correctly entered in the tracking database, with the exceptions noted below. The rebated measures were then matched up with the list of qualifying products. Most of these measures were found to be included in the Program qualifying list, with exceptions noted below.

Verification Exceptions:

- Itron was unable to verify the Tier of the evaporative cooler measures. The list of qualifying products is no longer available.
- Itron noted that there did not appear to be a consistent approach to calculating the window area for the high performance windows measure. Some of the installed window area estimates provided on the applications were adjusted down a few square feet by SCE and thus the tracking data and the applications did not match exactly. Itron could not identify if the approach to making the adjustments was consistent.
- Itron noted that one air conditioning unit was rebated as a Tier 1 unit, however the application contained conflicting information on the actual SEER level (12 versus 13 SEER). Tier 1 Split Systems require a 13 SEER rating.

SDG&E: Itron randomly selected 69 of SDG&E's non-lighting end-user rebated measures for verification. For each of these measures, the rebate applications and corresponding vendor invoices were obtained for verification. The payee, measure description, quantity, and rebate amounts were compared with the entries in SDG&E's tracking database. All available invoices were correctly entered in the tracking database, with the exceptions noted below. The rebated measures were then matched up with the list of qualifying products. Most of these measures were found to be included in the Program qualifying list, with exceptions noted below.

Verification Exceptions:

- Itron was unable to verify the Tier of the evaporative cooler measures. The list of qualifying products is no longer available.
- Itron noted that eight of the non-lighting measures had inconsistencies with the invoices provided. These issues included illegible invoices, invoices missing installed equipment information, and invoices for the wrong items. For these we were able to verify the equipment was purchased, but unable to verify whether or not it was Program qualifying.

SCG: Itron randomly selected 33 of SCG's non-lighting end-user rebated measures for verification. For each of these measures, the rebate applications and corresponding vendor invoices were obtained for verification. The payee, measure description, quantity, and rebate amounts were compared with the entries in SCG's tracking database. All available invoices were correctly entered in the tracking database, with the exceptions noted below. The rebated measures were then matched up with the list of qualifying products. Most of these measures were found to be included in the Program qualifying list, with the exception noted below.

Verification Exception:

- Itron was unable to verify that four of the 10 clothes washers and one of the five dishwashers were qualifying products. The list of qualifying products is no longer available and so manual model number lookups had to be done, but not all units could be found.

Measure Accomplishments Verification

To verify measure accomplishments the Itron team calculated the total number of units rebated through the Program by measure type, based on each IOU's tracking data. These figures were compared to the final reports provided by each of the IOUs (the reports varied by IOU – for PG&E the figures are based on the *Residential Summary Database*, for SCE they are based on the *Annual Energy Efficiency Reports* (May 2005/May 2006), and for SDG&E and SCG they are based on the *December 2005 Statewide Residential Single Family Rebate Workbooks.* Table 9-2 summarizes the findings of the measure accomplishments verification task by measure and IOU.

Table 9-2: Comparison of Non- Lighting Measure Accomplishments, by IOU Tracking Database vs. Final Report[142][143]

Measure Description	PG&E		SCE		SCG		SDG&E	
	Database	Reported	Database	Reported	Database	Reported	Database	Reported
Attic Insulation (installations)	6,491	7,335	6	6	6,689	6,689	480	480
Central Air Conditioners	7,536	9,631	5,111	5,161	0	0	932	932
Central Heat Pump	385	499	279	281	0	0	92	92
Clothes Washer	85,477	89,582	0	0	49,640	49,640	13,319	13,319
Dishwasher	51,066	53,134	0	0	30,312	30,312	9,994	9,994
Evaporative Cooler	139	153	1,219	1,230	0	0	8	8
Gas Furnace	12,735	15,186	0	0	4,417	4,417	515	515
Pool Pump/Motor	4,094	4,372	5,558	5,576	0	0	480	480
Programmable Thermostats	44,500	46,066	25,363	25,461	30,965	30,965	4,355	4,355
Room Air Conditioner	983	995	2,431	2,450	0	0	597	597
Wall Insulation (installations)	2,523	2,828	1	1	2,835	2,835	202	202
Water Heater	7,480	9,016	75	75	6,024	6,024	308	308
Whole House Fan	1,080	1,188	2,937	2,226	0	0	1,380	1,380
Windows (installations)	19,826	20,402	2,191	2,192	0	0	6,328	6,328
Total	**244,314**	**260,388**	**45,171**	**44,659**	**130,881**	**130,881**	**38,990**	**38,990**
Percent Difference	**-6.17%**		**1.15%**		**0.00%**		**0.00%**	

PG&E: The quantity of measures sold through the Program reported by PG&E in was higher than the quantity observed in their tracking databases. The reported quantity was higher because it included 2005 committed rebates, whereas the database did not include these accounts.

SCE: The quantity of measures sold through the Program reported by SCE in their final reports was slightly lower than the quantity observed in their tracking databases. However, the difference between the actual quantity and the reported quantity was just over one percent.

SCG & SDG&E: The reported quantity of every measure sold through the Program in both SDG&E's and SCG's final reports matched the actual quantity in their tracking databases.

Hard-to-Reach (HTR) Accomplishments Verification

The HTR accomplishments for the non-lighting measures were verified based on a zip code mapping which flagged participants who resided in areas that were considered rural and/or of moderate income. The percentage of applications (or incentives for PG&E) that fell into any

[142] The number of insulation and window installations was estimated by dividing the total number of square feet installed by the size of an average installations (1,272 sq/ft per insulation installation and 187 sq/ft per window installation).

of these HTR areas was then calculated based on these flags for the non-lighting measures. The percent of the total non-lighting applications classified as HTR were then compared to the final IOU reported numbers to determine if the values matched[144].

Table 9-3 below summarizes the non-lighting findings of the HTR accomplishment verification task. Presented are the percentages of the Program that was utilized by customers in HTR areas that were (1) set as goals for the program, (2) found in their Program tracking database and (3) reported by each IOU in their final reports. PG&E used percent of rebate dollars, while the other utilities used applications to calculate the hard-to-reach accomplishment percentages.

Table 9-3: Comparison of Non-Lighting HTR Goal and Accomplishment, by IOU - Tracking Database vs. Final IOU Reported Values[145]

Hard-to-Reach	PG&E	SCE	SDG&E	SCG
Goal	35%	34%	60%	23%
Database	37%	36%	57%	26%
Reported	36%	41%	60%	28%

PG&E: PG&E slightly under-reported their HTR accomplishments relative to what was found in the database. PG&E reported that 36 percent of the incentives went to HTR areas, compared to 37 percent found in the database. This value beats their HTR goal of 35 percent. It should be noted that these percents represent amount of rebate dollars from rural areas only (excluding those from low-income areas).

SCE & SCG: SCE and SCG slightly over-reported their HTR accomplishments relative to what was found in the database. However, both still exceeded their HTR goals.

SDG&E: SDG&E's HTR accomplishments were slightly higher than what was found in the tracking database. SDG&E reported that 60 percent of the participants that received incentives were in HTR areas, compared to the 57 percent that were found in the tracking database.

SCE, SCG, and PG&E reached their HTR goals of 34 percent 23 percent, and 35 percent respectively. SDG&E, which had the highest amount of HTR participation, did not reach their HTR goal of 60 percent. All of these tracking data based HTR estimates are slightly different from what the utilities reported which could be a result of the how multiple measure

[144] Since no May final reports were filed for SCE and PG&E the database estimates were compared to the HTR estimates reported in the December 2005 Program narratives (which may not be final).

[145] PG&E results do not include PY2005 committed units. The final report will be updated to include these committed results.

installations were handled at a single address, slight changes to the list of HTR zip codes between the 2003 and 2004/2005 Programs (no new zip code lists were provided), or because the IOU numbers being compared to were not the final HTR estimates.

Measure Installation Verification

The participant survey conducted included a component to verify that IOU customers had installed the measures specified in the IOU's tracking databases. The survey asked a sample of 2,414 participants if they recall receiving a mail-in or point-of-sale (POS) rebate for one or more of the measures that were included in these tracking databases. The results are presented in Table 9-4. Out of 2,561 measures asked about during the survey, participants were unable to verify 151 of the measures. And an additional 112 participants spoken with responded that they were unable to answer the question (i.e., they were unsure about their participation in the Program).

Of 2,414 participants spoken with, a total of 2,316 participants were asked about cash incentives distributed via mail-in rebates. As shown in Table 9-4, a large majority of these surveyed participants remember receiving a rebate for the measures inquired about. Nearly every participant surveyed who had installed a whole house fan reported remembering receiving the utility rebate (97%). However, only two-thirds of the sample of dishwasher participants surveyed remembered receiving a rebate as part of the HEER Program. These figures were not used to adjust gross impacts since it is not unreasonable that participants may have forgotten a rebate they received almost three years after their program participation.

The other 98 participants spoken with during the surveys were asked about POS rebates they received for pool pumps or programmable thermostats.[146] Nearly 70 percent of the respondents whom had received a POS pool pump rebate recalled the instant rebate. More than 80 percent of the respondents surveyed recalled receiving a POS rebate for the programmable thermostat they purchased.

[146] Data for these customers was captured in SCE service territory only for a handful of customers who received pool pump or programmable thermostat instant rebates. SCE captured this pool pump data by requesting one of the stores who sold pool pumps to record the contact information of those receiving the pool pump rebates. To capture the programmable thermostat data they offered $5 Starbucks giftcards for any customer who would provide their contact information.

Table 9-4: Survey Self-Reported Measure Installation Verification

Measure	TOTAL	PG&E	EDISON	SCG	SDG&E	N
Central Air Conditioner	92%	93%	90%		91%	276
Central Heat Pump	95%	96%	91%		100%	58
Clothes Washer	93%	94%		91%	88%	277
Dishwasher	66%	73%		61%	56%	81
Evaporative Cooler	95%	92%	95%			54
Gas Furnace	89%	87%		95%	100%	54
Insulation	91%	92%		90%	93%	277
Pool Pump/Motor	93%	94%	90%		91%	385
Programmable Thermostat	90%	92%	86%	90%	95%	545
Room Air Conditioner	84%	87%	91%		71%	59
Water Heater	79%	85%		75%	83%	66
Whole House Fan	97%	96%	95%		100%	55
Windows	92%	91%	94%		92%	276
Pool Pump/Motor (instant rebate)	69%		69%			72
Programmable Thermostat (instant rebate)	81%		81%			26

Those that recalled receiving a rebate through the Program were also asked if that measure was currently installed. A summary of the responses to this question are presented in Table 9-5. Only 11 respondents reported that their rebated measure was not currently installed. One respondent reported they never installed the pool pump they purchased through the Program (a POS rebate) and ten respondents across four different measures reported they had removed the rebated measure. One additional respondent reported being unsure if the measure was still installed.

Table 9-5: Survey Self-Reported Results of Measure Installation and Retention

Measure	Measure is Still Installed	Measure was Installed and Removed	Measure was Never Installed	Don't know	N
Central Air Conditioner	100%				253
Central Heat Pump	100%				55
Clothes Washer	100%	0%			254
Dishwasher	100%				52
Evaporative Cooler	100%				51
Gas Furnace	100%				50
Insulation	100%				253
Pool Pump/Motor	98%	1%		0%	354
Programmable Thermostat	99%	1%			495
Room Air Conditioner	96%	4%			50
Water Heater	100%				53
Whole House Fan	100%				53
Windows	100%				254
Pool Pump/Motor (instant rebate)	98%		2%		50
Programmable Thermostat (instant rebate)	100%				21

Onsite Verification

A total of 267 onsite surveys were conducted to verify that the rebated non-lighting equipment installed matched the Program tracking system, and to collect additional measure specific information to verify that the equipment installed was indeed Program qualifying (26 of these were refrigerators and the results are presented in Appendix I). The sample for the onsite verification surveys was recruited from the sample of participants who had completed the telephone survey. The methods used to determine whether or not equipment was Program qualifying are included in Table 9-6 below.

Table 9-6: Description of Methods Used to Verify Qualifying Equipment

Measure	Tier	Requirements	Method	Comments
Central AC	General	• Some Climate zone restriction	Looked up by Zip code	Only verified PG&E Climate Zones
	Tier1	• Energy Star (Optional TXV)	Make & Model look up from onsite visit data	
	Tier 2	• Factory TXV • Split System: 14 SEER, 12 EER • Package System: 13 SEER, 11 EER		
	Tier 3	• Factory TXV • Split System: 15 SEER, 12.5 EER • Package System: 14 SEER, 12 EER		
Clothes Washer	General	• Rebate provided by water heating utility	Verified from site visit	
	Energy Star	• Energy Star	Make & Model look up from onsite visit data	
	Tier 1	• MEF 1.42- 1.59 • WF 8.5 or lower		
	Tier 2	• MEF 1.6 or greater • WF 8.5 or lower		
Energy Star Dishwasher	Energy Star	• Energy Qualifying	Make & Model look up from onsite visit data	
Evaporative Cooler	General	• 2,500 CFM (0.1 in static pressure) • 2 fan speeds • Single or multi ducted • Multi-function manual control switch	Make & Model look up from onsite visit data	Could not verify Evaporative effectiveness on all models.
	Tier 1	• Evaporating effectiveness of 0.85		
	Tier 2	• Evaporating effectiveness of 0.85 • Pressure relief dampers		
Furnace	General	• Annual Fuel used efficiency of 90 or greater	Make & Model look up from onsite visit data	
Insulation	Attic	• Existing insulation of R-11 or less • Between conditioned and unconditioned space • Final insulation of R-30 or greater • 24 inch clearance between bottom rafter and ceiling joists at peak	Verified while on site	Only verified insulation characteristics, could not confirm area.
	Wall	• No existing insulation • Between conditioned and unconditioned space • Final insulation of R-13 or greater		
Single speed pool pumps	Horse power reduction	• Existing pump > 1 hp, min ½ hp reduction • Existing pump between ¾-1 hp, min ¼ hp reduction • If existing pump < ¾ hp, no reduction required	Verified while on site, and self reported data	Many of the existing pump hp values were unknown. Runtime and Peak time requirements not included in % qualifying, these factors already reflected in gross savings.
	Time reduction/ Peak Time	• Reduce pump runtime a minimum of 2 hours a day • Cannot run pump during peak time (noon to 6pm) • Exempt from time reduction/ if existing pump runs less than 4 hours a day or pool has solar heating • Exempt from Peak time requirement if pool has solar heating		
P-Stat	Energy Star	• Energy Star	Make & Model look up from onsite visit data	
Whole House Fan	General	• Rated at 1,000 CFM • Permanently installed	Make & Model look up from onsite visit data	
Windows	General	• Between Conditioned and Unconditioned Spaces • U factor < 0.4 • SHGC < 0.4 (spectrally selective low E glass)	Make & Model look up from onsite visit data	Only verified window characteristics

Table 9-7 shows the distribution of the 241 measures that were audited and indicates whether or not the equipment was found to be Program qualifying. All measures were found to be installed, but 3 percent were not Program qualifying and 14 percent were classified as unable to determine (UTD) since it was impossible to determine if the measure was Program qualifying. The seven measures that were not Program qualifying failed for the following reasons:

- A gas furnace had an AFUE of 80%, Program requires a minimum of 90%,
- Two of the insulation installations were less than R30 (minimum Program qualifying insulation level was R30) and one had R19 previously (prior maximum level was R11),
- Two of the pool pumps did not meet hp reduction (participant reported to have purchased a pool pump with the same horsepower as the one they removed), and
- One programmable thermostat model was not Program qualifying.

The majority of the measures classified as UTD may be Program qualifying, however since a 2004/2005 Program Qualifying Products List was not provided and many of the models are now discontinued, we had to rely on lookups by model number and manufacturer to get product information. In cases where this product information was not available we were unable to ensure the measure passed the Program qualifying requirements. The 21 UTD pool pumps were classified as such due to the participant being unsure of hp of previous unit and thus it was impossible to determine if the participant met the hp reduction requirement that was set for pool pumps.

Table 9-7: Measures Found to be Program Qualifying based on Onsite Audits

Measure Description	Number of Measures Audited	Is Measure Program Qualifying?		
		Yes	No	UTD
Air Conditioning	25	24	0	1
Clothes Washer	27	22	0	5
Dishwasher	12	12	0	0
Whole House Evaporative Cooler	10	7	0	3
Whole House Fan	11	11	0	0
Gas Furnace	13	11	1	1
Heat Pump	0	0	0	0
Insulation	34	29	3	0
Pool Pump	48	25	2	21
Programmable Thermostat	32	29	1	2
Room Ac	0	0	0	0
Water Heater	0	0	0	0
Windows	29	29	0	0
Total Across All Measures	241	199	7	33

Based on the results of these onsite verification activities the ex ante gross savings estimates were adjusted. Table 9-8 below provides the measure level adjustment factors based on these onsite activities. These adjustment factors were used for all measures for the calculation of the estimates of gross kW savings. However, since billing analyses were completed for insulation, pool pumps and programmable thermostats (results provided below), the kWh and Therm realization rates that resulted from these billing analyses were used in place of the onsite adjustment estimates since they are thought to be more robust.

Table 9-8: Verification Adjustment Factor Used for Ex Post Estimates of Gross Program Savings

Measure Description	Verification Adjustment Factor
Air Conditioning	100%
Clothes Washer	100%
Dishwasher	100%
Whole House Evaporative Cooler	100%
Whole House Fan	100%
Gas Furnace	92%
Heat Pump	100%
Insulation	91%
Pool Pump	96%
Programmable Thermostat	97%
Room Ac	100%
Water Heater	100%
Windows	100%
Total Across All Measures	97%

9.4 Gross Savings Results

A summary of the results of the billing analysis and the calibrated DEER/engineering models for the subset of the non-lighting measures these gross savings methods were used for is presented in the section below. A full presentation of results is included in Appendix G.

9.4.1 *Billing Analysis*

The billing analysis was conducted on four distinct non-lighting measures: insulation (wall and ceiling), pool pumps (single and two-speed), programmable thermostats and windows. The results for each of these analyses are provided in the sections below.

Pool Pump Model Specification and Results

The vector of independent variables included in the pool pump billing model are defined in Table 9-9 below. Cooling degree days and heating degree days are included to capture variations in energy consumption due to changes in the weather. Cooling degree days are interacted with a flag indicating the presence of air conditioning equipment, and heating degree days are interacted with a flag indicating the presence of electric heating equipment. 'NON_PGM_INSTLL' represents the installation of new electric equipment in the home between the pre- and post-periods that was not rebated through the program. PRG_SAVE represents the gross savings estimates of measures other than pool pump that were installed through the program. The final variable, 'ADD_NEW_AC' indicates that a new air conditioner was installed at the premise where none existed before. This variable is interacted with square footage of the home to allow expected increase in energy consumption to vary with the size of the home. Installation of a pool pump is indicated by a flag for Program participants. The coefficients on this variable will represent average kWh savings per year associated with the installation of an efficient pool pump.

Table 9-9: Independent Variables Used in Pool Pump Billing Model

Dependent Variable	Description
E_PRE	Total kWh Consumption for 2003
POOL_PUMP	A flag indicating installation of a pool pump
CH_CDD	Post period cooling degree days minus pre-period cooling degree days, interacted with a flag indicating air conditioning equipment
CH_HDD	Post period heating degree days minus pre-period heating degree days, interacted with a flag indicating electric heating equipment
NON_PGM_INSTLL	Flag for self-reported Installation of energy saving equipment outside the program interacted with pre-period
PRG_SAVE	Gross savings estimates for other measures installed through the program.
ADD_NEW_AC	Flag indicating the installation of an air conditioner where none existed before, interacted with square feet of the home

A series of data censoring steps was taken to remove customers from the pool pump model if they had recently completed home renovations, reported trying to reduce their usage to receive the 20/20 Program incentive, had a large fluctuation in usage between the pre- and the post-periods (greater than 40 percent change), had made significant changes to their home, had very low usage or had incomplete survey data. Ultimately, there were 123 participants and 808 non-participants included the final pool pump billing model.

Pool Pump Billing Model Results

Table 9-10 below summarizes the results of the pool pump model. With the exceptions of the change in heating degree days (CH_HDD) and the addition of a new air conditioner (ADD_NEW_AC) the independent variables are significant at the 90 percent level. The pool pump coefficient estimate is also significant at the 99 percent confidence level, and indicates an average savings of 602 kWh per year. This value is 67 percent of the updated engineering estimates of savings presented below in section 9.4.2 and 46 percent of the ex ante savings estimates.

Table 9-10: Summary of Results, Pool Pump Billing Model

Dependent Variable	Parameter Estimate	Standard Error	T-Value	T-Statistic	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
E_PRE	1.05	0.002	455.97	<.0001	1.06	1.05
POOL_PUMP	602.46	168.260	-3.58	0.0004	879.25	325.67
CH_CDD	1.36	0.708	1.93	0.055	2.53	0.20
CH_HDD	0.10	0.998	0.10	0.920	1.74	-1.54
NON_PGM_INSTLL	-0.12	0.049	-2.51	0.0122	-0.04	-0.20
PRG_SAVE	-0.31	0.168	-1.85	0.0648	-0.03	-0.59
ADD_NEW_AC	0.17	0.130	1.30	0.1941	0.38	-0.04

<u>Insulation Gas Model Specification and Results</u>

The vector of independent variables included in the insulation gas model[147] are defined in Table 9-11 below. The installation of windows and insulation through the Program is represented by a flag, interacted with pre-period gas usage. This representation provides a relatively consistent relationship to realized impacts, and removes the confounding effects of utilizing varying engineering algorithms across the IOUs.

Heating degree days are included to absorb variations in energy consumption due to changes in the weather. The installation of Program measures besides windows and insulation are controlled for with the variable 'PGM_GAS_SAVE'. This variable takes on the value of the combined ex-ante gross savings estimates from all other Program installations except insulation. As is discussed below, nonparticipants that installed Program measures were removed from the analysis dataset, so this variable capturing the effect of Program changes applies to insulation participants only. 'SR_THM_SAVE' represents the installation of new gas equipment in the home between the pre- and post-periods that was not rebated through the Program. The final variable, 'INC_PERSON' indicates that there was an increase in the number of people residing in the home during the analysis period[148].

[147] The draft report modeled windows and insulation impacts together in a combined value. However, subsequent to the draft report substantial additional windows participants were added to the model, as valid installation dates were uncovered. These additional windows participants available for the model produced greater distinction in the behavior of the windows and insulation coefficients. Thus, separate models are used to estimate the impacts of these measures.

[148] A variable representing a decrease in the number of people residing in the home was tried in the model, but found to have an unexpected sign and not to be statistically significant.

Table 9-11: Independent Variables Used in Insulation and Window Gas Billing Model

Dependent Variable	Description
G_PRE	Total Gas Consumption for 2003
ATTWINWALL	A flag indicating installation windows or insulation, interacted with pre-period gas usage
CH_HDD	Post period heating degree days minus pre-period heating degree days
PGM_GAS_SAVE	Gross savings estimates for other measaures installed through the program
SR_THM_SAVE	Flag for self-reported Installation of energy saving equipment outside the program
INC_PERSON	Increased number of people living full time in the home

Data censoring steps similar to those described above for the pool pump model were taken for the insulation models. An additional screening was added to remove customers without gas heating from the model. Ultimately there were 67 participants and 764 non-participants in the final insulation gas billing model.

Insulation Gas Billing Model Results

The insulation gas billing model coefficient estimates are presented in Table 9-12 below. With the exception of 'SR_THM_SAVE' the coefficients are significant at the 90 percent confidence level. The estimated coefficients on the pre-period usage and the insulation variable are significant at the 99 percent confidence level. The r-squared statistic for the model is 0.975.

The estimated coefficient for pre-period usage of 94 percent indicates a general decline in gas usage between the pre- and post-periods among both participants and non-participants. This could be a result of socioeconomic trends, or it could be that some of the effects of weather differences are being absorbed by this value. Those that reported some changes to the gas appliances in their home had, on average, a small increase in their annual usage.

The insulation gas billing model detected a decrease in gas usage resulting from Program-rebated insulation equal to 10 percent of the customer's pre-period annual bill. This corresponds to an average savings of 55 Therms for the 67 participants included in the model. The 2004 California Statewide Residential Appliance Saturation Study[149] reports the statewide UEC for primary heaters to be 242 Therms per year. Thus, a savings of 55 Therms per year represents a savings of 23 percent. Readers should keep in mind that the Program standards allow for some insulation to be present at the time the Program insulation is installed. No more than R-11 can be present, and a minimum of R-30 must be installed. (Insulation savings are non-linearly related to pre-existing R- values.) Over half of insulation participants surveyed (55%) indicate the Program insulation was installed where there was already some existing insulation.

[149] RLW Analytics, 2005. 2005 California Statewide Residential Lighting and Appliance Efficiency Saturation Study. Prepared for California's Investor Owned Utilities. August 23, 2005.

The average ex-ante savings of the 67 participants included in the model is 118 Therms, which yields an overall realization rate of 47 percent. However, we note that the engineering models utilized across the utilities are not similar. The average ex-ante Therm savings per square foot of installed insulation is 2.4 times higher for SCG customers than non-SCG customers (0.097 versus 0.041 Therms). For this reason, we break out the results and realization rate for SCG customers. Among customers included in the model, 44 are non-SCG customers and 23 are SCG customers. The non-SCG customers have a mean detected savings of 59 Therms per year, and a mean ex ante savings of 82 Therms per year, resulting in a realization rate of 72 percent. SCG customers have a mean savings detected in the model of 49 therms per year and an average ex ante savings value of 188 Therms per year, yielding a realization rate of 26 percent. The 2005 California RASS UEC estimates for gas furnaces is 252 Therms for primary heaters. Thus savings of 49 and 59 Therms, for SCG and non-SCG customers respectively, represent between 19 and 23 percent of the customers total gas heating usage.

Table 9-12: Summary of Results, Insulation Gas Billing Model

Dependent Variable	Parameter Estimate	Standard Error	T-Value	T-Statistic	95% Confidence Interval	
					Lower Bound	Upper Bound
G_PRE	0.94	0.006	145.24	<.0001	0.93	0.95
ATTWALL_PRE	-0.10	0.019	-5.19	<.0001	-0.13	-0.07
CH_HDD	0.05	0.015	3.01	0.0027	0.02	0.07
PGM_GAS_SAVE	-0.52	0.198	-2.55	0.0110	-0.84	-0.19
SR_THM_SAVE	8.92	9.150	0.98	0.3300	-6.13	23.97
INC_PERSON	23.68	13.090	1.81	0.0708	2.15	45.21

As mentioned above the insulation gas billing model is run only for those participants that had gas heat. However, since the tracking system assigns a positive Therm savings value to every insulation participant, regardless of appliance holdings, an adjustment was made to account for the portion of insulation customers that are assigned Therm savings, but have no gas heat. The same method is used to apply therm savings to windows participants, i.e. all windows participants are also assigned a positive therm savings value. There is no compelling reason to believe that the distribution of gas heat is systematically different among insulation participants versus windows participants. Thus, to improve the precision of the estimate, we combine windows and insulation participant in calculating this tracking system adjustment.

The survey data and tracking data indicate that 91 percent of Therm savings claimed for windows and insulation measures are associated with a home that has gas heat and so a “tracking system adjustment” of 0.91 was applied to the realization rates to calculate the final recommended adjustments.

Table 9-13 below summarizes the insulation gas billing model results and recommendations. The first two rows display the mean value of ex-post and ex-ante gross savings estimates for insulation for SCG and non-SCG customers. The ratio of these figures is shown in row 3, "Billing Model Realization Rate". The tracking system adjustment discussed above is applied to the billing model realization rates, yielding the final recommended adjustments.

Table 9-13: Insulation Gas Billing Analysis Findings Summary

Insulation Gas Billing Analysis Findings Summary	Non-SCG	SCG
Mean Ex-Ante Therm Savings (customers included in billing model)	82.40	188.57
Mean Therm Savings Value Resulting from Model	59.05	48.78
Billing Model Realization Rate	0.72	0.26
Tracking System Adjustment (based on all surveyed customers)	0.91	0.91
Final Recommended Adjustment	0.65	0.23

<u>Windows Gas Model Specification and Results</u>

The approach used in the windows gas model is analogous to the insulation gas model approach described above. The vectors of independent variables included in the windows gas model[150] are defined in Table 9-14 below. The installation of windows through the Program is represented by a flag interacted with pre-period gas usage. This representation provides a relatively consistent relationship to realized impacts, and removes the confounding effects of utilizing varying engineering algorithms across the IOUs.

Heating degree days are included to absorb variations in energy consumption due to changes in the weather. The installation of Program measures other than windows is controlled for with the variable 'PGM_GAS_SAVE'. This variable takes on the value of the combined ex-ante gross savings estimates from all other Program installations except windows. As discussed below, nonparticipants that had installed Program measures are removed from the analysis dataset, so 'PGM_GAS_SAVE' variable capturing the effect of Program changes applies to windows participants only. 'SR_THM_SAVE' represents the installation of new gas equipment in the home between the pre- and post-periods that was not rebated through the Program. The final variable, 'INC_PERSON' indicates that there was an increase in the number of people residing in the home during the analysis period.

[150] As mentioned above the draft report modeled windows and insulation impacts together in a combined value. However, subsequent to the draft report additional analysis was completed resulting in separate models being created to estimate the impacts of these measures.

Table 9-14: Independent Variables Used in Window Gas Billing Model

Dependent Variable	Description
G_PRE	Total Gas Consumption for 2003
WIN_PRE	A flag indicating installation of windows interacted with pre-period gas usage
CH_HDD	Post period heating degree days minus pre-period heating degree days
PGM_GAS_SAVE	Gross savings estimates for other measaures installed through the program
SR_THM_SAVE	Flag for self-reported Installation of energy saving equipment outside the program
INC_PERSON	Increased number of people living full time in the home

Data censoring steps similar to those described above for the pool pump model were taken for the gas windows model. Similarly to the insulation model above an additional screening was added to remove customers without gas heating from the model. Ultimately there were 40 participants and 791 non-participants in the final windows gas billing model.

<u>Windows Gas Billing Model Results</u>

The windows gas billing model coefficient estimates are presented in Table 9-15 below. With the exception of 'SR_THM_SAVE' the coefficients are significant at the 90 percent confidence level. The estimated coefficients on the windows variable are significant at the 99 percent confidence level. The r-squared statistic for the model is 0.975.

The windows gas billing model detected a decrease in gas usage resulting from Program-rebated windows equal to 6 percent of the customer's pre-period annual bill. This corresponds to an average savings of 34 Therms for the 40 participants included in the model. The average ex-ante savings of the participants included in the model is 58 Therms, which yields an overall realization rate of 58 percent.

Table 9-15: Summary of Results Windows Gas Billing Model

Dependent Variable	Parameter Estimate	Standard Error	T-Value	T-Statistic	95% Confidence Interval	
					Lower Bound	Upper Bound
G_PRE	0.94	0.006	143.80	<.0001	0.92	0.95
WIN_PRE	-0.06	0.023	-2.45	0.0145	-0.094	-0.018
CH_HDD	0.05	0.015	3.06	0.0023	0.022	0.072
PGM_GAS_SAVE	-0.24	0.072	-3.33	0.0009	-0.36	-0.12
SR_THM_SAVE	8.52	9.270	0.92	0.3579	-6.73	23.77
INC_PERSON	23.58	13.250	1.78	0.0756	1.79	45.38

As mentioned above the windows gas billing model is run only for those participants that had gas heat, however, the tracking system assigns a positive Therm savings value to every window participant, regardless of appliance holdings. Therefore, an adjustment needed to be applied to account for the portion of window customers that are assigned Therm savings, but have no gas heat. The method used to calculate the "tracking system adjustment" was described above and resulted in an adjustment of 0.91 being applied to the realization rates resulting from the billing model.

Table 9-16 below summarizes the windows gas billing model results and recommendations. The first two rows display the mean value of ex-post and ex-ante gross savings estimates for windows. The ratio of these figures is shown in row 3, "Billing Model Realization Rate". The tracking system adjustment discussed above is applied to the billing model realization rates, yielding the final recommended adjustments.

Table 9-16: Windows Gas Billing Analysis Findings Summary

Windows Gas Billing Analysis Findings Summary	
Mean Ex-Ante Therm Savings (customers included in billing model)	58.00
Mean Therm Savings Value Resulting from Model	33.75
Billing Model Realization Rate	0.58
Tracking System Adjustment (based on all surveyed customers)	0.91
Final Recommended Adjustment	0.53

<u>Insulation Electric Model Specification and Results</u>

The vector of independent variables included in the insulation electric billing model are defined in Table 9-17 below. The variable "ATTWALL" is equal to the ex ante gross savings from Program-rebated insulation installations. The coefficient on this independent variable represents the percent of ex ante savings detected in the bills. As in all the billing models presented here, pre-period usage is one of the independent variables. In addition, cooling degree days and heating degree days are included to absorb variations in energy consumption due to changes in the weather. Cooling degree days are interacted with a flag indicating the presence of air conditioning equipment, and heating degree days are interacted with a flag indicating the presence of electric heating equipment. Those that self-reported replacing their AC equipment are controlled for using an indicator variable interacted with pre-period usage. This variable is named 'SR_AC_PRE'. Interacting with pre-period usage allows the model to vary predicted savings by the intensity of pre-period usage. Those that installed an air conditioner in their home where none existed before are controlled for with a flag interacted with square feet of the home. This variable is called 'ADD_AC_SQFT'. Variables indicating that the number of people living full time in the home increased or decreased during the analysis period are also included in the model. These are called 'INC_PERSON' and 'DEC_PERSON'. Other measure installations through the Program are controlled for by including a variable (PGM_SAVE_KWH) equal to the ex ante gross savings estimates of other installed measures besides insulation. Finally, the variable SR_KWH indicates other changes have occurred in the home, such as the purchase of a new dishwasher or electric clothes dryer.

Table 9-17: Independent Variables Used in Insulation Electric Billing Model

Dependent Variable	Description
E_PRE	Total kWh Consumption for 2003
ATTWALL	Ex-ante gross savings estimates associated with the installation of insulation through the program
SR_AC_PRE	Self reported installation of new air conditioner, interacted with pre-period kWh usage
ADD_AC_SQFT	Self reported installation of new air conditioner where none existed before, interacted with square feet of the home
DEC_PERSON	Decrease in number of people living full time in the home
INC_PERSON	Increase in number of people living full time in the home
CH_CDD	Post period cooling degree days minus pre-period cooling degree days, interacted with a flag indicating air conditioning equipment and square feet of conditioned space
CH_HDD	Post period heating degree days minus pre-period heating degree days, interacted with a flag indicating electric heating equipment and square feet of conditioned space
PGM_KWH_SAVE	Gross savings estimates for other measures installed through the program
SR_KWH	Self reported changes to the home that would impact kWh usage

Data censoring steps similar to those described above for the gas insulation and windows models were taken for this electric model. However, this model specification does not screen out participants with no air conditioning or electric heat, and thus the results may be applied to all participants and no “tracking system adjustment” needs to be made. Ultimately there were 47 participants and 1,133 non-participants in the final insulation electric billing model.

Insulation Electric Billing Model Results

The insulation electric billing model coefficient estimates are presented in Table 9-18 below. The estimated coefficients on the pre-period usage and the insulation/windows variable are significant at the 95 percent confidence level. The r-squared statistic for the model is 0.997.

The average ex-ante kWh savings per square-foot of installed insulation is 3.5 times higher for SCG customers than non-SCG customers (0.362 versus 0.099 kWh). For this reason, we break out the results and realization rate for SCG customers. It is also important to note that all customers included in the model are non-SCG customers since SCG customer did not have kWh data. The insulation electric billing model detected a decrease in electric usage resulting from Program-rebated insulation installations equal to 201 percent of ex ante gross estimates for non-SCG customers. To calculate the realization rate for SCG customers we multiplied the savings for the SCG customers by used the ratio of the ex ante gross estimates (0.099/0.36) and the resulting savings is 55 percent of the ex ante gross estimates for SCG customers. The impact of a reduced number of people residing in the home is significant and large, at 447 kWh per year. The effect of installing electric appliances (SR_KWH) is very modest and not significant, likely due to some variation in the types of installations occurring.

Table 9-18: Summary of Results, Insulation Electric Billing Model

Dependent Variable	Parameter Estimate	Standard Error	T-Value	T-Statistic	95% Confidence Interval	
					Lower Bound	Upper Bound
E_PRE	1.06	0.002	582.93	<.0001	1.05	1.06
ATTWALL	-2.01	0.949	-2.12	0.0343	-3.571	-0.449
SR_AC_PRE	-0.07	0.015	-4.45	<.0001	-0.092	-0.042
ADD_AC_SQFT	0.22	0.095	2.34	0.0195	0.066	0.380
DEC_PERSON	-447.06	119.290	-3.75	0.0002	-643.290	-250.826
INC_PERSON	308.46	185.170	1.67	0.0960	3.85	613.06
CH_CDD (per 1000 sqft)	0.19	0.242	0.77	0.4423	-0.212	0.584
CH_HDD (per 1000 sqft)	0.27	0.377	0.71	0.4788	-0.353	0.886
PGM_KWH_SAVE	-0.21	0.109	-1.93	0.0544	-0.39	-0.03
SR_KWH	-17.01	85.796	-0.20	0.8429	-158.14	124.13

Table 9-19 below summarizes the insulation electric billing model results and recommendations for SCG and non-SCG customers. The final ex post kWh savings per square-foot is estimated to be 0.20. The average installed square feet of insulation through the Program is 1,200, corresponding to an annual savings of 240 kWh. Assuming a fairly typical consumption of 500 kWh per ton of cooling capacity, annual air conditioner consumption would be 1,750 kWh. Thus, a savings of 240 kWh corresponds to roughly 14 percent of typical annual air conditioner consumption. DEER estimates of savings from insulation range from 24 to 58 percent of the HVAC end use consumption, depending upon the climate and vintage of the home[151]. Results here are expected to be lower due to the inclusion of customers without air conditioners or electric heat in the model as well as a significant portion of insulation participants reporting pre-existing levels of insulation[152].

Table 9-19: Insulation Electric Billing Analysis Findings Summary

Insulation Electric Billing Analysis Findings Summary	Value
Billing Model Realization Rate - Based on Non-SCG customers	2.01
Ex-Ante kWh per Square Foot - Non-SCG	0.10
Ex-Ante kWh per Square Foot - SCG	0.36
Recommended Adjustment - Non-SCG	2.01
Recommended Adjustment -SCG	0.55
Ex-post kWh per square foot - all IOUs	0.20

[151] These figures assume the insulation levels increase from R-0 to R-30.

[152] Program standards allow up to R-11 at the time of installation. Sixty-six percent of insulation participants included in the model report having pre-existing insulation.

Windows Electric Model Specification and Results

The vectors of independent variables included in the windows electric billing model[153] are defined in Table 9-20 below. The variable "WINDOW" is equal to the ex ante gross savings from Program–rebated windows installations. The coefficient on this independent variable represents the percent of ex ante savings detected in the bills. As in all the billing models presented here, pre-period usage is one of the independent variables. In addition, changes between the pre- and post-period cooling degree days and heating degree days are included to absorb variations in energy consumption due to changes in the weather. Both cooling and heating degree days are interacted with the square feet of conditioned space and the presence of electric cooling/heating equipment.

Those that self-reported replacing their AC equipment are controlled for using an indicator variable interacted with pre-period usage. This variable is named 'SR_AC_PRE'. Interacting with pre-period usage allows the model to vary predicted savings by the intensity of pre-period usage. Those that installed an air conditioner in their home where none existed before are controlled for with a flag interacted with square feet of the home. This variable is called 'ADD_AC_SQFT'. Variables are also included in the model indicating that the number of people living full time in the home increased or decreased during the analysis period. These are called 'INC_PERSON' and 'DEC_PERSON'. Other measure installations through the Program are controlled for by including a variable (PGM_SAVE_KWH) equal to the ex ante gross savings estimates of other installed measures besides window. Finally, the variable SR_KWH indicates other changes have occurred in the home, such as the purchase of a new dishwasher or electric clothes dryer.

Table 9-20: Independent Variables Used in Windows Electric Billing Model

Dependent Variable	Description
E_PRE	Total kWh Consumption for 2003
WINDOW	Ex-ante gross savings estimates associated with the installation of windows
SR_AC_PRE	Self reported installation of new air conditioner, interacted with pre-period kWh usage
ADD_AC_SQFT	Self reported installation of new air conditioner where none existed before, interacted with square feet of the home
DEC_PERSON	Decrease in number of people living full time in the home
INC_PERSON	Increase in number of people living full time in the home
CH_CDD	Post period cooling degree days minus pre-period cooling degree days, interacted with a flag indicating air conditioning equipment and square feet of conditioned space
CH_HDD	Post period heating degree days minus pre-period heating degree days, interacted with a flag indicating electric heating equipment and square feet of conditioned space
PGM_KWH_SAVE	Gross savings estimates for other measures installed through the program
SR_KWH	Self reported changes to the home that would impact kWh usage

[153] As mentioned above the for the insulation electric model, the draft report modeled windows and insulation impacts together in a combined value. However, subsequent to the draft report additional analysis was completed resulting in separate electric models being created to estimate the impacts of these measures.

Data censoring steps similar to those described above for the gas insulation and windows models were taken for this electric model. However, this model specification does not screen out participants with no air conditioning or electric heat, and thus the results may be applied to all participants and no "tracking system adjustment" needs to be made. Ultimately there were 96 participants and 1,309 non-participants in the final windows electric billing model.

Windows Electric Billing Model Results

The window electric billing model coefficient estimates are presented in Table 9-21 below. The estimated coefficient on the windows variable has a t-statistic of 0.45, which is significant only at the 55 percent confidence level. Many specifications were tried to improve the significance of this coefficient, including removing customers with no electric heat or air conditioning. With these customers removed from the model, the realization rate is estimated to be 7 percent, and the t-value is just -0.09 – almost completely insignificant.

A possible explanation for the low level of statistical significance relates to the size of the expected impacts relative to overall energy usage. Half of the windows participants have an expected ex-ante electricity savings from windows installations equal to less than 2.5 percent of their bill. Changes of this small a magnitude can be masked or obscured by other, unreported changes in the home. However, a model run with participants whose ex-ante savings was between 3.5 and 7 percent of their pre-period bill results in a lower significance level than the selected model. With this alternative specification the realization rate is estimated to be 63 percent, and the t-value is -0.62.

Table 9-21: Summary of Results Windows Electric Billing Model

Dependent Variable	Parameter Estimate	Standard Error	T-Value	T-Statistic	95% Confidence Interval	
					Lower Bound	Upper Bound
E_PRE	1.06	0.002	577.79	<.0001	1.05	1.06
WINDOW	-0.51	0.676	-0.75	0.4539	-1.619	0.606
SR_AC_PRE	-0.07	0.014	-4.67	<.0001	-0.088	-0.042
ADD_AC_SQFT	0.16	0.093	1.69	0.0907	0.004	0.311
DEC_PERSON	-548.50	112.341	-4.88	<.0001	-733.304	-363.702
INC_PERSON	108.88	190.669	0.57	0.5681	-204.77	422.53
CH_CDD (per 1000 sqft)	0.39	0.226	1.71	0.0879	0.014	0.756
PGM_KWH_SAVE	-0.18	0.068	-2.64	0.0084	-0.29	-0.07
SR_KWH	17.44	82.245	0.21	0.8321	-117.85	152.73

Table 9-22 below summarizes the windows electric billing model results and recommendations. The final ex post kWh savings per square-foot is estimated to be 0.51.

Table 9-22: Windows Electric Billing Analysis Findings Summary

Windows Electric Billing Analysis Findings Summary	Value
Billing Model Realization Rate	0.51
Ex-Ante kWh per Square Foot	1.00
Recommended Adjustment	0.51
Ex-post kWh per square foot - all IOUs	0.51

Programmable Thermostat Gas Model Specification and Results

The vector of independent variables included in the programmable thermostat gas model is defined in Table 9-23 below. Five variables are included in the model. The change in heating degree days between the post-period and the pre-period is included to control for changes in weather between the two periods. ‘PGM_GAS_SAVE’ represents the Therm savings of measures other than programmable thermostats. The variable ‘PSTAT’ indicates the installation of an ENERGY STAR programmable thermostat, either with a point-of-sale rebate, or with an application. PSTAT takes on a value equal to pre-period usage for programmable thermostat participants. The final variable, ‘OTHER_CHANGE’ indicates other changes made in the home that would affect gas usage, such as a new gas water heater, stove or furnace. ‘OTHER_CHANGE’ takes on a value equal to pre-period gas usage for those that made a change and is zero otherwise.

Table 9-23: Independent Variables Used in Programmable Thermostat Gas Billing Model

Dependent Variable	Description
G_PRE	Total kWh Consumption for 2003
PGM_GAS_SAVE	Gross savings estimates for other measures installed through the program
PSTAT	Flag indicating the installation of programmable thermostat, interacted with pre-period usage
OTHER_CHANGE	Flag indicating other changes made to the home effecting gas usage, interacted with pre-period usage
CH_HDD	Post period heating degree days minus pre-period heating degree days

Data censoring for the gas programmable thermostat model was similar to the pool pump model described above. Ultimately, there were 178 participants and 1,149 non-participants in the final gas programmable thermostat billing model.

Programmable Thermostat Gas Billing Model Results

The programmable thermostat gas billing model coefficient estimates are presented in Table 9-24 below. Many specifications were attempted for this model, utilizing information about how the customer uses the thermostat and what type of thermostat was removed. However, only a small portion of the participants removed a manual thermostat and use the programmable thermostat as it is intended to be used. The percent of people that removed a manual thermostat and reported not overriding the thermostat settings are less than 12 percent of participants. This is supported by the findings from the contractor interviews presented in Chapter 7 (Figure 7-6) which showed that more than 50 percent of contractors reported overriding the ENERGY STAR pre-programmed programmable thermostats settings “Always” or “Very Often”. Statistically significant results could not be detected among these subgroups, nor could the effects be parceled out across composite variables designed to capture degree of expected savings. We deduce from these data and analysis of the bills that gas heating savings associated with the installation of programmable thermostats in the IOU territories is small and difficult to detect.

With the exception of the ‘OTHER_CHANGE’ variable, the independent variables in the model are significant at the 95 percent confidence level. The estimated coefficient on the programmable thermostat variable (PSTAT) indicates a savings of two percent of annual gas usage and has an associated T-statistic of 0.097. A two percent savings gas bill savings represents an average of 10 Therms per year among the customers included in the bill analysis. The mean ex ante gross savings estimates associated with these thermostat installations is 87 Therms. The ratio of the mean savings detected in the bill model to the mean ex ante savings yields a realization rate of 12 percent.

Table 9-24: Summary of Results, Programmable Thermostat Gas Billing Model

Dependent Variable	Parameter Estimate	Standard Error	T-Value	T-Statistic	95% Confidence Interval	
					Lower Bound	Upper Bound
G_PRE	0.95	0.006	154.23	<.0001	0.96	0.94
PGM_GAS_SAVE	-0.16	0.057	-2.86	0.0051	-0.070	-0.258
PSTAT	-0.02	0.012	-1.66	0.0974	0.000	-0.038
OTHER_CHANGE	-0.01	0.009	-1.51	0.1303	0.001	-0.027
CH_HDD	0.03	0.012	2.92	0.0036	0.05	0.64

The programmable thermostat gas billing model was run only for those participants that had gas heat. Since the tracking system assigns a positive Therm savings value to every thermostat participant, regardless of appliance holdings, an adjustment was made to account for the portion of thermostat customers that were assigned Therm savings, but have no gas heat. The survey and tracking data indicate that 83 percent of Therm savings claimed for programmable thermostats is associated with homes that have gas heat, and thus a “tracking system adjustment” of 0.82 was applied to the realization rates resulting from the billing model discussed above. The final recommended adjustment to ex ante Therm savings estimates for programmable thermostats is 10 percent.

Programmable Thermostat Electric Model Specification and Results

The vector of independent variables included in the programmable thermostat electric model is defined in Table 9-25 below. Eight variables are included in the model. The change in cooling and heating degree days between the post-period and the pre-period is included to control for changes in weather. The weather variables are interacted with flags indicating electric heating or cooling equipment. 'PGM_KWH_SAVE' represents the kWh savings of measures other than programmable thermostats. The variable 'PSTAT' indicates the installation of an ENERGY STAR programmable thermostat, either with a point-of-sale rebate, or with an application. PSTAT takes on a value equal to pre-period usage for programmable thermostat participants. 'INC_PERSON' and 'DEC_PERSON' indicate changes in the number of people living full time in the home. Customers that self-report replacing their AC equipment are controlled for with an indicator variable 'SR_AC_PRE' that takes on a value equal to pre-period usage in order to allow the model to vary predicted savings by the intensity of pre-period usage.

Table 9-25: Independent Variables Used in Programmable Thermostat Electric Billing Model

Dependent Variable	Description
E_PRE	Total kWh Consumption for 2003
PSTAT	Flag indicating the installation of programmable thermostat, interacted with pre-period usage
PGM_KWH_SAVE	Gross savings estimates for other measures installed through the program
SR_AC_PRE	Self reported installation of new air conditioner, interacted with pre-period kWh usage
INC_PERSON	Increase in number of people living full time in the home
DEC_PERSON	Decrease in number of people living full time in the home
CH_CDD	Post period cooling degree days minus pre-period cooling degree days, interacted with a flag indicating air
CH_HDD	Post period cooling degree days minus pre-period cooling degree days, interacted with a flag indicating electric

Data censoring for the electric programmable thermostat model was similar to the pool pump model described above. Ultimately, there were 164 participants and 915 non-participants in the final programmable thermostat electric billing model.

Programmable Thermostat Electric Billing Model Results

The programmable thermostat electric billing model coefficient estimates are presented in Table 9-26 below. Similar to the programmable thermostat gas billing model, many specifications were attempted incorporating information about how a customer uses the thermostat and what type of thermostat was removed. However, as mentioned above, only a small portion of the participants removed a manual thermostat and use the programmable thermostat as it is intended to be used. Statistically significant results could not be detected among these subgroups, nor could the effects be parceled out across composite variables designed to capture degree of expected savings. We deduce from these data and analysis of the bills that savings associated with the installation of programmable thermostats is small and difficult to detect.

The estimated coefficient on the programmable thermostat variable (PSTAT) indicates a savings of two percent of annual kWh usage and has an associated T-statistic of 0.0827. A two percent kWh bill savings represents an average of 166 kWh per year among the customers included in the bill analysis. The mean ex ante gross savings estimates associated with these thermostat installations is 325 kWh. The ratio of the mean savings detected in the bill model to the mean ex ante savings yields a realization rate of 51 percent.

Table 9-26: Summary of Results, Programmable Thermostat Electric Billing Model

Dependent Variable	Parameter Estimate	Standard Error	T-Value	T-Statistic	95% Confidence Interval	
					Lower Bound	Upper Bound
E_PRE	1.03	0.002	658.69	<.0001	1.04	1.03
PSTAT	-0.02	0.011	-1.74	0.0827	-0.001	-0.038
PGM_KWH_SAVE	-0.29	0.152	-1.89	0.0593	-0.037	-0.537
SR_AC_PRE	-0.06	0.014	-4.22	<.0001	-0.04	0.64
INC_PERSON	290.58	156.100	1.86	0.0630	547.36	33.79
DEC_PERSON	-351.88	110.068	-3.20	0.0014	-170.82	-532.94
CH_CDD	0.19	0.347	0.56	0.5763	0.77	-0.38
CH_HDD	0.68	0.598	1.13	0.2586	1.66	-0.31

The programmable thermostat electric billing model was run only for those participants that had electric heat or air conditioning. Since the tracking system assigns a positive kWh savings value to every thermostat participant, regardless of appliance holdings, an adjustment was made to account for the portion of thermostat customers that were assigned kWh savings, but have no electric heat or AC. The survey and tracking data indicate that 91 percent of kWh savings claimed for programmable thermostats is associated with homes that have electric heat or AC, and thus a “tracking system adjustment” of 0.91 was applied to the realization rates resulting from the billing model discussed above. The final recommended adjustment to ex ante kWh savings estimates for programmable thermostats is 46 percent (that is 46% of the ex ante value).

Final Statistically Adjusted Engineering Billing Analysis Results Summary

Table 9-27 below summarizes the finding of the billing analyses described in this section. Realization rates range from a low of 0.10 for the Therm savings from programmable thermostats to a high of 2.01 for the kWh savings from insulation installations.

Table 9-27: Billing Analysis Results and Recommended Adjustments to Ex-Ante Gross Savings

Technology Type	Billing Analysis Result		Recommended Adjustment	
	kWh	Therm	kWh	Therm
Insulation - SCG	0.55	0.26	0.55	0.23
Insulation - Non SCG	2.01	0.72	2.01	0.65
Windows	0.51	0.58	0.51	0.53
Efficient Pool Pump	0.67	n/a	0.67	n/a
Programmable Thermostat*	0.51	0.12	0.46	0.10

9.4.2 *Adjusted Engineering Models*

Engineering models were used to assess the gross Program savings for four non-lighting measures: central air conditioning, clothes washers, pool pumps and refrigerators. The results for first three of these measures are provided below; the refrigerator results are included with the remainder of the refrigerator impact analysis in Appendix I.

<u>Clothes Washers</u>

Energy use savings from the retrofit of clothes washers under the HEER Program was calculated as the difference between the estimated energy consumption of a baseline unit and the newly installed high-efficiency unit. The consumption of a baseline and high-efficiency unit were estimated using engineering models[154] that relied on a number of factors such as the size of the clothes washer, the type (gas or electric) of water heater and clothes dryer, the water heater efficiency level (energy factor), the number of loads a household washes per year and the average Modified Energy Factor (MEF) associated with a baseline and HEER Program installation. Since MEF was used for this analysis, the percentage of time clothes are dried in a gas or electric dryer (versus being lined dried without the use of an electric or gas dryer) was also required. The MEF is preferred for this analysis since it also takes into account the reduced energy required for drying due to the lower residual moisture content (RMC) of high-efficiency clothes washers.

The data and assumptions used to estimate each of the factors listed above for this analysis are included in Appendix G.

Estimated gross savings estimates were segmented by the fuel type used for hot water and for clothes drying (gas or electric). The engineering model assumes high energy factors for both gas hot water heaters and electric hot water heaters, and assumes a new MEF consistent with Federal Energy Standards. The estimation also includes an adjustment for the amount of time

[154] The engineering models used for this analysis are consistent with the 2007 DEER models that are currently under development.

the dryer is used. A demand factor of 0.219 watts/kWh was used for the demand estimation, consistent with the Residential Single Family Rebate Program PY 2004/2005 workpapers. We are comfortable with this estimate because it is consistent with the results of PG&E's End-Use Metering Study.[155]

The energy savings is the difference between the consumption of the baseline units and the high-efficiency ENERGY STAR units, calculated as follows:

Annual Energy Use = (Volume*Cycles)/MEF*Usage$_i$/EF$_i$ * DryerUse$_i$

Where:

> Volume = Average Capacity of Clothes Washer (in cubic/feet),
> Cycles = Average Number of Washer Cycles Completed per year,
> MEF = Modified Energy Factor,
> Usage$_i$ = Usage Allocation for energy source *i* (water heater, dryer or motor),
> EF$_i$ = Efficiency level for energy source *i*, and
> DryerUse$_i$ = Dryer Usage Factor, 87.5% when energy source = dryer, 0 otherwise.

Using this formula, if the participant had a 3.11 capacity washer, an electric water heater with an EF of 0.88, an electric dryer with an EF of 0.92, washed 7.46 loads/week[156], and a washer MEF of 1.97, the total electric energy savings would be 366 kWh/yr. Since MEF is expressed in kWh, the gas savings are derived from the kWh savings, using 3,413 btu/kWh and 100,000 btu / therm.

Table 9-28 below provides the ex post gross energy savings estimates for clothes washers based on this engineering analysis. As this exhibit shows, the engineering analysis realized 102 percent of the ex ante kWh savings, 175 percent of the kW savings and 65 percent of the Therm savings[157]**.**

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[155] Quantum Consulting, 2001. Residential Load Database Development and Analysis of Residential Load Data Study, prepared for Pacific Gas and Electric. December, 2001.

[156] This estimate is higher than the estimate of 5.7 loads/week from 2004 RASS.

[157] The kWh and kW gross RR are different since the engineering model assumed a demand factor of 0.000219 for both PG&E and SDG&E (as reported in the workpapers) although in practice a much lower demand factor was applied for SDG&E.

Table 9-28: Estimated Ex Post Gross Energy Savings for Clothes Washers

Energy Source		Survey	Participant	kWh Savings		kW Savings		Therm Savings	
Water Heater	Clothes Dryer	Distribution	Distribution	Per Unit	Total	Per Unit	Total	Per Unit	Total
Electric	Electric	2%	2,687	581	1,560,996	0.127	342	0	0
Electric	Gas	0%	0	447	0	0.000	0	5	0
Gas	Electric	26%	38,285	136	5,209,398	0.030	1,141	22	852,717
Gas	Gas	72%	107,466	2	235,407	0.000	52	27	2,927,334
Total		**100%**	**148,438**	**47**	**7,005,801**	**0.010**	**1,534**	**25**	**3,780,051**
Ex Ante Gross Savings Estimates		-	-	**46**	**6,863,520**	**0.006**	**876**	**39**	**5,859,879**
Gross Realization Rates		-	-	**102%**		**175%**		**65%**	

Central Air Conditioning

A summary of the approach used to estimate air conditioner (AC) retrofit impacts and the resulting impacts are presented in this section[158]. A complete presentation of approach and intermediary results are included in Appendix G.

The impact calculations utilized to estimate AC retrofit impacts are based on AC usage estimates from DEER, code-based baseline equipment efficiency, characteristics of the participant population, and characteristics of the equipment installed through the Program. For this analysis Program participants were segmented by home vintage, climate zone, equipment efficiency and type.

The general form of the impact equation applied to estimate both annual energy and summer peak demand AC impacts is:

$$IMPACT = (USE_B - USE_N) \times CAP_N$$

Where:

USE_B = DEER-based AC usage per-ton for baseline system efficiency, by climate zone and home vintage

USE_N = DEER-based AC usage per-ton for new (program) system efficiency, by climate zone and home vintage

CAP_N = Capacity of new (program) system in cooling tons

For the purposes of this evaluation is was decided to develop DEER-based usage per-ton response curves using DEER estimates for the "baseline" efficiency level, in conjunction with DEER estimates for the 15 SEER case[159]. A linear relationship was established using

[158] The approach and impact estimation presented in this section excludes any heat pump or room air conditioner participation. The impacts associated with those measures are addressed separately in this evaluation.

[159] Inspection of the impact shapes as a function of SEER rating demonstrated that some outliers exist in the DEER model results. The DEER simulation team acknowledges these outliers (especially with respect to

those two anchor points, as a function of the inverse of SEER (that is, 1/SEER). Assuming the same underlying performance curves, it is well established that usage is linear with respect to the inverse of SEER. These usage response curves were developed for each of 4 DEER home vintages and each of 16 CEC climate zones. For each participating AC unit in the Program, home vintage was estimated using meter reset date from the utilities CIS systems. Baseline impact estimates for split system AC's are derived using the Title 24 baseline of 10 SEER, while package system AC's use the applicable 9.7 SEER baseline.

The tracking systems that were delivered to the evaluation team by each of the utilities did not initially include any variables for AC unit SEER rating and cooling capacity rating and so a variety of methods (alternate data sources, hard-copy sample application review, and make and model number lookups) were used to estimate the capacity of the new AC system for each of the IOUs.

Air Conditioner Impact Results

Table 9-29 below provides the ex post gross energy and demand impacts estimates for air conditioners based on the analysis approach described above. As this table shows, the engineering analysis realized 112 percent of the ex ante kWh impact for SDG&E, 120 percent for SCE and 136 percent for PG&E. Realization rates on demand impacts ranged from 0.80 for SCE to 1.10 for PG&E and 1.38 for SDG&E.

Table 9-29: Estimated Ex Post Gross Impacts for Air Conditioners

Utility	AC Units Installed	Annual Energy Impact (kWh)	Summer Peak Demand Impact (kW)	Average Per-Unit Impact (kWh)	Average Per-Unit Impact (kW)
PG&E Ex-Post	7,706	3,658,050	5,250	475	0.68
PG&E Ex-Ante		2,687,197	4,782		
PG&E Realization Rate		**1.36**	**1.10**		
SCE Ex-Post	5,161	2,937,649	3,673	569	0.71
SCE Ex-Ante		2,449,525	4,607		
SCE Realization Rate		**1.20**	**0.80**		
SDG&E Ex-Post	932	378,983	647	407	0.69
SDG&E Ex-Ante		337,845	469		
SDG&E Realization Rate		**1.12**	**1.38**		

Pool Pumps

The gross ex post savings analysis for pool pumps focused on single speed pool pumps since they made up 92 percent of the overall rebated pool pumps. Additionally, onsite audits were only completed in a small number of homes where two speed pool pumps were installed, and thus there was not an adequate sample of data for this analysis. The gross ex post savings analysis for single speed pool pumps follows a basic engineering calculation approach. The

DEER results for 16+ SEER equipment) and is planning to update those results using more robust performance data sources.

baseline equipment energy and peak demand was calculated and compared to the rebated equipment operation. The savings calculation inputs are summarized in Table 9-30 below.

Table 9-30: Pool Pump Savings Calculation Inputs

	Values	Sample size, n
Prior Motor Power (hp)	1.49	27
Rebated Motor Power (hp)	0.95	45
Rebated Motor Runtime (hrs/day)	3.89	40
Rebated Motor Peak Runtime (hrs/day)	1.24	40
Prior Motor Runtime (hrs/day)	4.68	39
Prior Motor Peak Runtime (hrs/day)	2.99	39

The pool pump data for this analysis came from onsite equipment observation and participant self-report during telephone and onsite surveys.
Table 9-31 summarizes the average energy consumption and peak demand of the previously installed pool pumps, the newly rebated units and the resulting engineering estimated gross energy savings. Table 9-32 provides the ex ante versus the engineering estimated gross savings estimates, as well as the resulting engineering gross savings realization rates. These rates were used as ex ante estimates of savings in our billing analysis to come up with final ex post energy savings estimates.

Table 9-31: Comparison of Prior Pool Pump to Rebated Pool Pump Savings Estimates

Prior Pump Annual Energy Consumption (kWh/unit)	1,905 kWh/unit
Rebated Pump Annual Energy Consumption (kWh/unit)	1,006 kWh/unit
Engineering Estimated Gross Unit Energy Savings (kWh/unit)	899 kWh/unit
Prior Peak Demand (kW/unit)	0.48 kW/unit
Rebated Pump Annual Peak Demand (kW/unit)	0.13 kW/unit
Engineering Estimated Gross Unit Peak Demand Reduction (kW/unit)	0.35 kW/unit

These Estimates were calculated as follows:

- Prior kWh = (prior power, hp)*(0.746 kW/hp)*(pre runtime, hrs/day)*(365 days/yr)
- Rebated kWh = (rebated power, hp)*(0.746 kW/hp)*(rebated runtime, hrs/day)*(365 days/yr)
- kWh savings = (prior kWh) – (rebated kWh)
- Prior peak demand = (pre power, hp)*(0.746 kW/hp)*(prior peak runtime, hrs/day)/(7 total peak hours/day)
- Rebated peak demand = (rebated power, hp)*(0.746 kW/hp)*(rebated peak runtime, hrs/day)/(7 total peak hours/day)

- Peak reduction = (prior peak) – (rebated peak)

Table 9-32: Ex Ante versus Engineering Estimates of Gross Pool Pump Savings

	Annual Energy Savings (kWh/unit)	Peak Demand Savings (kW/unit)
Ex Ante Gross Savings	1,305	1.07
Engineering Estimated Gross Savings	899	0.35
Engineering Gross Savings Realization Rate	**69 percent**	**33 percent**

Savings for this measure resulted from runtime reduction and reduced power. The largest discrepancy between ex ante and ex post savings is with peak demand reduction. The ex ante peak reduction of 1.07 kW/unit is high compared to the average prior power collected onsite (1.11 kW). The peak demand was calculated by the kWh during peak period, divided by the peak period (noon-7 PM). Even if all of the baseline pool pumps were running throughout peak period, it would be difficult to achieve such a demand reduction given the size of the baseline pumps.

9.4.3 *Gross Savings Results*

Based on the gross savings analyses described above (billing analysis, engineering analysis and onsite measure verification) adjustment factors were created for each of the 14 measures to calculate ex post gross savings estimates. These adjustment factors for each measure, IOU and energy source (kWh, kW and Therms) are included in Table 9-33 below. Multiplying these adjustments factors by the ex ante gross energy savings estimates results in the ex post gross savings estimates. Appendix G3 contains a series of tables that contain all of assumptions and calculations made to go from the ex ante gross savings estimates to the ex post net savings estimates and realization rates.

Table 9-33: Gross Savings Adjustments by Measure

Utility	Technology	Gross Savings Adjustment kWh	kW	Therms
PG&E	Air Conditioners	1.36	1.10	1.00
	Heat Pumps	1.00	1.00	1.00
	Room AC	1.00	1.00	1.00
	Insulation	2.01	2.01	0.65
	Clothes Washer - Energy Star	1.02	1.75	0.65
	Dishwasher - Energy Star	1.00	1.00	1.00
	Furnace - Gas	0.92	0.92	0.92
	Pool Pumps	0.46	0.33	0.67
	Programmable Thermostats	0.46	0.46	0.10
	Water Heater	1.00	1.00	1.00
	Whole House Evaporative Cooler	1.00	1.00	1.00
	Whole House Fan	1.00	1.00	1.00
	Windows	0.51	0.51	0.53
SCE	Air Conditioners	1.36	1.10	1.00
	Heat Pumps	1.00	1.00	1.00
	Room AC	1.00	1.00	1.00
	Insulation	2.01	2.01	0.65
	Pool Pumps	0.46	0.33	0.67
	Programmable Thermostats	0.46	0.46	0.10
	Water Heater	1.00	1.00	1.00
	Whole House Evaporative Cooler	1.00	1.00	1.00
	Whole House Fan	1.00	1.00	1.00
	Windows	0.51	0.51	0.53
SCG	Insulation	0.55	0.50	0.23
	Clothes Washer - Energy Star	1.02	1.75	0.65
	Dishwasher - Energy Star	1.00	1.00	1.00
	Furnace - Gas	0.92	0.92	0.92
	Programmable Thermostats	0.46	0.45	0.10
	Water Heater	1.00	1.00	1.00
SDG&E	Air Conditioners	1.36	1.10	1.00
	Heat Pumps	1.00	1.00	1.00
	Room AC	1.00	1.00	1.00
	Insulation	0.55	0.50	0.23
	Clothes Washer - Energy Star	1.02	1.75	0.65
	Dishwasher - Energy Star	1.00	1.00	1.00
	Furnace - Gas	0.92	0.92	0.92
	Pool Pumps	0.67	0.64	0.67
	Programmable Thermostats	0.46	0.45	0.10
	Water Heater	1.00	1.00	1.00
	Whole House Evaporative Cooler	1.00	1.00	1.00
	Whole House Fan	1.00	1.00	1.00
	Windows	0.51	0.51	0.53

Table 9-34 below provides the ex post gross savings estimates resulting from the gross impact analysis. The statewide ex post gross kWh estimate was 54,217 MWh, which was approximately 71 percent of the ex ante gross kWh estimate (76,556 MWh). The statewide ex post gross kW and Therm estimates are also provided in this table and were approximately 68 and 46 percent of the ex ante gross estimates, respectively.

Table 9-34: Ex Post Gross Savings Estimates

		Ex Post Gross Energy Savings		
Utility	Technology	kWh	kW	Therms
PG&E*	Air Conditioners	4,715,119	6,740	0
	Heat Pumps	343,870	311	0
	Room AC	126,365	196	0
	Insulation	3,376,877	5,228	420,010
	Clothes Washer - Energy Star	4,234,338	1,590	2,310,640
	Dishwasher - Energy Star	2,762,968	455	850,144
	Furnace - Gas	0	0	660,661
	Pool Pumps	2,223,942	2,461	0
	Programmable Thermostats	5,230,155	8,038	311,104
	Water Heater	57,615	9	121,394
	Whole House Evaporative Cooler	193,487	299	0
	Whole House Fan	547,851	849	0
	Windows	2,492,064	3,863	522,549
	TOTAL	26,304,650	30,038	5,196,502
SCE	Air Conditioners	3,331,353	5,068	-
	Heat Pumps	169,677	200	-
	Room AC	279,685	324	-
	Insulation	565	1	-
	Pool Pumps	3,578,801	1,265	-
	Programmable Thermostats	3,360,307	1,405	-
	Water Heater	12,825	-	-
	Whole House Evaporative Cooler	2,286,145	1,947	-
	Whole House Fan	1,150,842	1,784	-
	Windows	258,967	264	-
	TOTAL	14,429,168	12,257	-
SCG	Insulation	2,706,528	2,456	303,970
	Clothes Washer - Energy Star	2,335,074	15	1,265,976
	Dishwasher - Energy Star	1,576,224	-	484,992
	Furnace - Gas	-	-	132,526
	Programmable Thermostats	2,404,370	-	285,807
	Water Heater	-	-	78,312
	TOTAL	9,022,196	2,471	2,551,584
SDG&E	Air Conditioners	459,469	516	-
	Heat Pumps	55,603	40	-
	Room AC	75,819	59	-
	Insulation	16,991	12	13,058
	Clothes Washer - Energy Star	631,307	4	345,767
	Dishwasher - Energy Star	519,688	85	159,904
	Furnace - Gas	-	-	10,934
	Pool Pumps	581,728	33	-
	Programmable Thermostats	686,731	73	30,050
	Water Heater	3,402	1	3,934
	Whole House Evaporative Cooler	3,762	7	-
	Whole House Fan	585,120	462	-
	Windows	841,462	886	-
	TOTAL	4,461,081	2,179	563,646
STATEWIDE	Air Conditioners	8,505,941	12,324	-
	Heat Pumps	569,150	551	-
	Room AC	481,869	579	-
	Insulation	6,100,961	7,696	737,038
	Clothes Washer - Energy Star	7,200,719	1,609	3,922,383
	Dishwasher - Energy Star	4,858,880	540	1,495,040
	Furnace - Gas	-	-	804,121
	Pool Pumps	6,384,471	3,759	-
	Programmable Thermostats	11,681,564	9,517	626,961
	Water Heater	73,842	9	203,640
	Whole House Evaporative Cooler	2,483,393	2,252	-
	Whole House Fan	2,283,813	3,095	-
	Windows	3,592,492	5,013	522,549
	TOTAL	54,217,096	46,945	8,311,733

9.5 Net Savings Results

A summary of the results of the self-report net-to-gross and the discrete choice analyses for the non-lighting measures are presented in the section below. Complete results are included in Appendix G.

9.5.1 *Self-Report Net-to-Gross Analysis*

The self-report analysis was conducted based on the data collected during the participant and non-participant surveys to estimate free-ridership and spillover rates. Currently IOUs in California cannot include participant or non-participant spillover in estimates of net savings claims, however since they represent an additional social benefit from the HEER Program we have calculated estimates of both participant and non-participant spillover and present the results the section below. The following section presents the results of the self-reported free-ridership and spillover analysis for HEER Program participant and non-participant populations.

Free-Ridership Results

The results of the self-report free-ridership (FR) analyses are provided in Table 9-35 below. This table presents the FR results by measure group, delivery channel (Point-of-Sale (POS) vs. Non-POS for pool pumps and programmable thermostats), and Tier Level (for central air conditioners only). For programmable thermostats the results were also broken down based on whether the measure was installed at the same time a rebated furnace, central AC or heat pump was installed (Solo versus Dual install). As one might expect the level of FR is higher for participants who installed the programmable thermostat at the same as a heating or cooling measure. The overall FR score is calculated by weighting the measure level FR by the energy savings associated with the measure installed (a joint kWh and Therm energy weight was created for this purpose[160]). As this table shows, the overall HEER FR rate was 44 percent, resulting in an overall net-to-gross (NTG) ratio of 56 percent. The measure with the lowest level of FR based on the self-report scoring method was whole house fans with 29 percent FR, followed by room ACs and pool pumps which each had 31 percent FR. The highest level of FR was found for dishwasher participants who had 59 percent FR and a resulting NTG ratio of 41 percent.

[160] This joint energy weight was calculated as kWh savings + 29.3*Therm savings (source http://www.interconnector.com/onlineservices/converter.html)

Table 9-35: Self-Reported Free-Ridership and NTG Ratios for HEER Measures

Measure	N	Free Ridership	NTG Ratio
Central Air Conditioner	253	48%	52%
ES and Tier 1	116	55%	45%
Tier 2	133	44%	56%
Tier 3	4	50%	50%
Central Heat Pump	55	45%	55%
Clothes Washer	254	43%	57%
Dishwasher	52	59%	41%
Evaporative Cooler	51	34%	66%
Gas Furnace	50	49%	52%
Insulation	253	47%	53%
Pool Pump	404	31%	69%
Pool Pump	354	31%	69%
Pool Pump POS	50	28%	72%
Programmable Thermostat	601	46%	54%
Solo Install	354	43%	57%
Dual Install	141	57%	43%
P-Stat POS	106	42%	58%
Room Air Conditioner	50	31%	69%
Water Heater	53	42%	58%
Whole House Fan	53	29%	71%
Windows	254	53%	47%
Overall Energy Weighted	**2,383**	**44%**	**56%**

Participant Spillover

Participant spillover results for each of the HEER measures are summarized in Table 9-36 below. As mentioned above spillover adoptions are not included in the calculation of NTG ratios used to estimate total Program impacts, however are included in this section to give the reader evidence of the spillover which seems to occur in the marketplace. This table provides both the total number of energy-efficient (EE) measure adoptions that participants installed in addition to their Program rebated measure adoption. It also includes those measure adoptions determined to be spillover adoptions (those in which the customer indicated the HEER Program was “Very Influential” in their decision to install the new measure). These results are based on surveys completed with 2,207 HEER Program participants. Further details concerning the calculation of these figures are included in Appendix G.

For central ACs, although 106 energy-efficient ACs were found to be installed by HEER Program participants outside the program, only 13 of those were classified as spillover adoptions (based on the participant saying the rebate Program was highly influential. Participant spillover results ranged from a high of six percent for central air conditioning purchases to a low of zero percent for heat pumps, evaporative coolers, room air conditioners and whole house fans where no spillover adoptions were identified. This table also shows that while the spillover rate from the survey for central ACs and clothes washers is relatively similar (0.59% versus 0.68%), the final participant spillover rate was more than two-thirds smaller for clothes washers (6.2% versus 1.9%) due to the large participant population for the clothes washer measure.

Table 9-36: Results of the Participant Spillover Analysis by Measure

Participant Spillover Criteria	Central AC	Heat Pump	Clothes Washer	Dish-washer	Evap Cooler	Gas Furnace	Insulation	Pool Pump	P-Stat	Room AC	Water Heater	Whole House Fan	Windows
Surveyed Participants with EE Adoptions	106	2	125	55	0	18	176	10	244	1	45	0	94
Surveyed Participants with Spillover Adoptions	13	0	15	4	0	1	7	1	5	0	2	0	8
Spillover Rate	0.59%	0.00%	0.68%	0.18%	0.00%	0.05%	0.32%	0.05%	0.23%	0.00%	0.09%	0.00%	0.36%
Participant Population (Excluding Measure)*	539,496	589,444	436,201	493,212	588,497	572,732	554,451	574,733	517,415	579,051	576,917	584,232	478,395
Population Extrapolated Spillover Adoptions	3,178	0	2,965	894	0	260	1,759	260	1,172	0	523	0	1,734
Total 2004/2005 HEER Participants*	50,902	954	154,197	97,186	1,901	17,666	35,947	15,665	72,983	11,347	13,481	6,166	112,003
Final Participant Spillover Rate	**6.2%**	**0.0%**	**1.9%**	**0.9%**	**0.0%**	**1.5%**	**4.9%**	**1.7%**	**1.6%**	**0.0%**	**3.9%**	**0.0%**	**1.5%**

When reviewing these results it is important to keep in mind that there is some question regarding whether the Program adoptions and the participant spillover adoptions are entirely comparable. For instance for the insulation and window measures we did not collect data from Participants who installed these measures outside of the Program on the number of square feet installed. The participant tracking data shows the average insulation installation was roughly 1,272 ft^2 and the average window installation was 187 ft^2, but if the installations outside of the Program were on average smaller than these installations, then the spillover rate would theoretically be lower. For a few of the other measures similar uncertainty exists such as whether the distribution of pool pump motor speed (single versus two-speed) or Central AC Tier level (I, II or III) is similar for those installed inside and outside the program. These results should be interpreted with this uncertainty in mind.

Non-Participant Spillover

Non-Participant spillover results by measure are summarized in Table 9-37 below. These results are based on surveys completed with 2,206 HEER Program non-participants who resided in single family detached (SFD) homes. This table provides both the total number of energy-efficient (EE) adoptions identified in the survey, in addition to those determined to be spillover adoptions (adoptions were considered spillover adoptions if the customer indicated the HEER Program was “Very Influential” in their decision to install the new measure). Further details concerning the calculation of these figures are included in Appendix G.

Non-Participant spillover results ranged from a high of 59 percent for room air conditioners to a low of zero percent for heat pumps, evaporative coolers and whole house fans where no spillover adoptions were identified. This wide variation in results is correlated with the number of spillover adoptions identified in the survey and the total number of Program participants for a particular measure. For room ACs, although only three spillover adoptions were identified in the survey, this translated to 6,692 adoptions across the population, which was 59 percent of the total number of installed room ACs within the Program.

Table 9-37: Results of the Non-Participant Spillover Analysis by Measure

Non-Participant Spillover Criteria	Central AC	Heat Pump	Clothes Washer	Dish-washer	Evap Cooler	Gas Furnace	Insulation	Pool Pump	P-Stat	Room AC	Water Heater	Whole House Fan	Windows
Surveyed Non-Participants with EE Adoptions	90	0	123	49	0	9	181	13	206	6	31	0	80
Surveyed Non-Participants with Spillover Adoptions	6	0	8	2	0	2	4	2	2	3	1	0	4
Surveyed Non-Participant Spillover Adoptions in 2004/2005	4.0	0.0	5.3	1.3	0.0	1.3	2.7	1.3	1.3	2.0	0.7	0.0	2.7
Non-Participant Spillover Rate	0.18%	0.00%	0.24%	0.06%	0.00%	0.06%	0.12%	0.06%	0.06%	0.09%	0.03%	0.00%	0.12%
Population Extrapolated 2004/2005 Spillover Adoptions	13,383	0	17,844	4,461	0	4,461	8,922	4,461	4,461	6,692	2,231	0	8,922
Total 2004/2005 HEER Participants*	50,902	954	154,197	97,186	1,901	17,666	35,947	15,665	72,983	11,347	13,481	6,166	112,003
Final Non-Participant Spillover Rate	**26%**	**0%**	**12%**	**5%**	**0%**	**25%**	**25%**	**28%**	**6%**	**59%**	**17%**	**0%**	**8%**

* Including Procurement Measures

An important thing to keep in mind when reviewing the non-participant spillover results is that although more than 2,500 telephone surveys were conducted with customers who did not participate in the HEER Program, this sample represents only a small fraction of a percent of the total non-participant population. For the non-participant spillover analysis the population analyzed was limited to only Single-Family Detached (SFD) home-owners (thus excluding renters). This left a surveyed population of roughly 2,200 customers and an overall statewide customer population of close to 7.5 million. This results in every non-participant surveyed representing approximately 3,400 non-participating customers statewide, and thus one spillover adoption identified in the survey represents approximately 3,400 spillover adoptions in the overall population. For some measures, such as heat pumps and evaporative coolers there were not even 3,400 measures installed through the program. Because of this issue it is recommended that these results be used to evaluate whether there is evidence of spillover for each of the HEER measures, as opposed to focusing on the final estimated non-participant spillover rate.

9.5.2 *Discrete Choice Analysis*

Discrete Choice analysis was performed on four of the 14 non-lighting measures based on the prioritization described above. These measures included clothes washers, central air conditioning, insulation and programmable thermostats. A two-stage discrete choice model, which models the probability of purchasing high-efficiency measure as the product of the probability that the measure is purchased and the probability that the high-efficiency measure is selected, was used for three of the four measures evaluated. The exception was for insulation for which it was unnecessary to model the second stage since it is assumed that all insulation installations are energy efficient. The results of this analysis are used to estimate a net-to-gross ratio, as well as spillover and free-ridership rates, associated with each of the measures evaluated.

Clothes Washers

The results of the two-stage discrete choice model for clothes washers are provided below in Table 9-38. These results show that the probability of a participant purchasing a high-efficiency clothes washer within the Program was estimated to be 56 percent, compared with a 13 percent probability that these same participants would have purchased a high-efficiency clothes washer in the absence of the Program. Participant level free-ridership was estimated from these probabilities by dividing the probability of making the purchase without the Program by the probability of making the purchase with the Program. By this definition the average energy-weighted estimate of free-ridership (FR) across all 238 participants is equal to 19 percent. The net-to-gross ratio for these participants, which is equal to one minus the FR rate, was equal to 81 percent. The NTG ratios for participants who purchased clothes washers outside of the Program and for non-participants were estimated to be much lower (30% and 20%, respectively).

Table 9-38: Two-Stage Estimated Probabilities for Purchasing a High-Efficiency Clothes Washer

Customer Segment	Purchase EE Inside or Outside Pgm	N	Probability of Purchasing a High Efficiency Clothes Washer		NTG
			With Program	Without Program	
Participant	Inside	238	0.56	0.13	81%
	Outside	325	0.18	0.11	30%
Non-Participant	Outside	445	0.15	0.11	20%

Table 9-39 breaks down the estimated probabilities of purchasing an energy-efficient clothes washer by a customers' self-reported degree of Program influence. Program participants who reported the HEER Program to be highly influential had an estimated purchase probability of 63 percent, whereas those who reported that they were not highly influenced by the Program had an estimated probability of 54 percent. The NTG ratios associated with these two participant groups were 86 and 79 percent, respectively.

The estimated level of participant and non-participant spillover can also be calculated from Table 9-39 below. As described above participant spillover is equal to the high efficiency purchases made by participants outside of the Program for which they claimed the Program to be highly influential. Based on this definition participant spillover rates were equal to approximately 72 percent for the four percent of the population who reported being highly influenced by the Program. Non-participant spillover was calculated in a similar manner on the non-participant population and resulted in an estimate of 44 percent for the one percent of the population who reported being highly influenced by the Program.

Table 9-39: Two-Stage Estimated Probabilities for Purchasing a High-Efficiency Clothes Washer by Program Influence

Customer Segment	Purchase EE Inside or Outside Pgm	Program Highly Influential	N	Probability of Purchasing a High Efficiency Clothes Washer		NTG
				With Program	Without Program	
Participant	Inside	Yes	58	0.63	0.10	86%
		No	180	0.54	0.13	79%
	Outside	Yes	12	0.30	0.09	72%
		No	313	0.17	0.11	28%
Non-Participant	Outside	Yes	6	0.44	0.27	44%
		No	439	0.15	0.11	19%

Central Air Conditioning

The results of the two-stage discrete choice model for the central air conditioning measure are provided below in Table 9-40. These results show that the probability of a participant purchasing a high-efficiency air conditioning system within the Program was estimated to be 58 percent, compared with a 23 percent probability that these same participants would have purchased a the same air conditioner in the absence of the Program. Participant level free-ridership estimated across all 248 participants was equal to 33 percent and the resulting NTG for these participants was equal to 67 percent. The NTG ratios for participants who purchased air conditioners outside of the Program and for non-participants were estimated to be much lower (25% and 30%, respectively).

Table 9-40: Two-Stage Estimated Probabilities for Purchasing a High-Efficiency Air Conditioner

Customer Segment	Purchase EE Inside or Outside Pgm	N	Probability of Purchasing a High Efficiency Air Conditioner		NTG
			With Program	Without Program	
Participant	Inside	244	0.58	0.23	67%
	Outside	81	0.33	0.25	25%
Non-Participant	Outside	20	0.37	0.23	30%

Table 9-41 breaks down the estimated probabilities of purchasing a high-efficient air conditioner by a customers' self-reported degree of Program influence. Program participants who reported the HEER Program to be highly influential had an estimated purchase probability of 57 percent, whereas those who reported that they were not highly influenced by the Program had an estimated probability of 59 percent. Although the probability of purchase estimate was higher for those who claimed the Program was not highly influential, the resulting NTG ratios associated with these two participant groups were 71 and 65 percent, respectively, indicating the Program was responsible for a higher percentage of the high-efficiency adoptions in this first population.

The estimated level of participant and non-participant spillover can also be calculated from Table 9-41 below. Participant spillover rates were equal to approximately 31 percent for the 14 percent of the participant population who reported being highly influenced by the Program. Non-participant spillover was estimated to be 72 percent for the single respondent who reported being highly influenced by the Program.

Table 9-41: Two-Stage Estimated Probabilities for Purchasing a High-Efficiency Air Conditioner by Program Influence

Customer Segment	Purchase EE Inside or Outside Pgm	Program Highly Influential	N	Probability of Purchasing a High Efficiency Air Conditioner		NTG
				With Program	Without Program	
Participant	Inside	Yes	52	0.57	0.19	71%
		No	192	0.59	0.25	65%
	Outside	Yes	11	0.32	0.23	31%
		No	70	0.34	0.26	25%
Non-Participant	Outside	Yes	1	0.60	0.17	72%
		No	19	0.36	0.24	29%

Wall and Ceiling Insulation

The results of the single-stage discrete choice model for insulation are provided below in Table 9-42. These results show that the probability of a participant installing insulation in their home within the Program was estimated to be 70 percent, compared with a 23 percent chance that these same participants would have installed insulation in their homes in the absence of the Program. These probabilities result in an estimated free-ridership (FR) rate of 30 percent and thus a net-to-gross ratio of 70 percent. The model also estimated that customers who participated in other HEER Programs had a 48 percent chance of installing insulation with the rebate Program and a 36 percent chance in the absence of the program.

Table 9-42: Estimated Probabilities for Purchasing Insulation

Customer Segment	Installation Inside or Outside Pgm	N	Probability of Installing Insulation		NTG
			With Program	Without Program	
Participant	Inside	243	0.70	0.23	70%
	Outside	157	0.48	0.36	16%
Non-Participant	Outside	166	0.44	0.32	15%

Table 9-43 breaks down the estimated probabilities of purchasing insulation by a customers' self-reported degree of Program influence. Program participants who reported the HEER Program to be highly influential had an estimated purchase probability of 69 percent; those who reported that they were not highly influenced by the Program had an estimated probability of 71 percent. Although the probability of purchase estimate was slightly higher for those who claimed the Program was not highly influential, the resulting NTG ratios associated with these two participant groups were 72 and 69 percent, respectively, indicating the Program was responsible for a higher percentage of the insulation adoptions in the highly influenced population.

The estimated level of participant and non-participant spillover can also be calculated from Table 9-43 below. Participant spillover rates were equal to approximately 55 percent for the three percent of the participant population who reported being highly influenced by the Program. Non-participant spillover was estimate to be 62 percent for the two percent of the population who reported being highly influenced by the Program (note this is based on an n of 3).

Table 9-43: Estimated Probabilities for Purchasing Insulation by Program Influence

Customer Segment	Installation Inside or Outside Pgm	Program Highly Influential	N	Probability of Installing Insulation		NTG
				With Program	Without Program	
Participant	Inside	Yes	58	0.69	0.21	72%
		No	185	0.71	0.24	69%
	Outside	Yes	5	0.74	0.33	55%
		No	152	0.47	0.36	15%
Non-Participant	Outside	Yes	3	0.83	0.31	62%
		No	163	0.43	0.32	14%

The discrete choice modeling efforts found that a customers' probability of installing insulation was increased if they were aware of the HEER Program, if they had some insulation already installed in their home, if they were predisposed to taking energy efficiency actions and if they had recently remodeled their home leading to an increase in their homes square-footage.

Programmable Thermostats

The results of the two-stage discrete choice model for the ENERGY STAR (ES) programmable thermostat measure are provided below in Table 9-44. These results show that the probability of a participant purchasing an ES programmable thermostat with the Program was estimated to be 68 percent, compared with a 35 percent probability that these same participants would have purchased the same programmable thermostat in the absence of the Program. Participant level free-ridership estimated across the 567 participants who received a rebate for their programmable thermostat purchase was equal to 51 percent and the resulting NTG for these participants was equal to 49 percent. The NTG ratios for participants who purchased ES programmable thermostats outside of the Program and for non-participants were estimated to be much lower (29% and 8%, respectively). These results are supported by the findings from contractor interviews conducted in late 2006 for this evaluation. HVAC contractors reported that they believe installing ENERGY STAR programmable thermostats has become standard practice (93 percent said they always install a new ENERGY STAR programmable thermostat with a central air conditioning purchase). They felt that the $20 rebate offered had little effect on the sales of these thermostats because of the size of the rebate and the maturity and market penetration of the technology.

Table 9-44: Two-Stage Estimated Probabilities for Purchasing an ENERGY STAR® Programmable Thermostat

Customer Segment	Purchase EE Inside or Outside Pgm	N	Probability of Purchasing a ES Programmable Thermostat		NTG
			With Program	Without Program	
Participant	Inside	567	0.68	0.35	49%
	Outside	477	0.46	0.31	29%
Non-Participant	Outside	502	0.27	0.24	8%

Table 9-45 breaks down the estimated probabilities of purchasing an ES programmable thermostat by a customers' self-reported degree of Program influence. Program participants who reported the HEER Program to be highly influential had an estimated purchase probability of 79 percent; those who reported that they were not highly influenced by the Program had an estimated probability of 64 percent. The resulting NTG ratios associated with these two participant groups were 63 and 45 percent, respectively.

The estimated level of participant and non-participant spillover can also be calculated from Table 9-45 below. Participant spillover rates were equal to approximately 44 percent for the five percent of the participant population who reported being highly influenced by the Program. Non-participant spillover was calculated in a similar manner on the non-participant population and resulted in an estimate of 55 percent for the three percent of the population who reported being highly influenced by the Program.

Table 9-45: Two-Stage Estimated Probabilities for Purchasing an ENERGY STAR® Programmable Thermostat by Program Influence

Customer Segment	Purchase EE Inside or Outside Pgm	Program Highly Influential	N	Probability of Purchasing a ES Programmable Thermostat		NTG
				With Program	Without Program	
Participant	Inside	Yes	140	0.79	0.32	63%
		No	427	0.64	0.36	45%
	Outside	Yes	22	0.85	0.48	44%
		No	455	0.44	0.31	28%
Non-Participant	Outside	Yes	15	0.47	0.22	55%
		No	487	0.27	0.24	7%

Table 9-46 below breaks down the estimated probabilities of purchasing an ES programmable thermostat by the delivery channel with which the participant received his or her rebate. This table shows that the NTG ratios are very similar, 49 and 50 percent, for the POS and mail-in application channels.

Table 9-46: Two-Stage Estimated Probabilities for Purchasing an ENERGY STAR® Programmable Thermostat by Delivery Channel

Customer Segment	Purchase EE Inside or Outside Pgm	Delivery Channel	N	Probability of Purchasing a ES Programmable Thermostat		NTG
				With Program	Without Program	
Participant	Inside	POS	98	0.60	0.33	49%
		Application	469	0.68	0.35	50%
	Outside	na	477	0.46	0.31	29%
Non-Participant	Outside	na	502	0.27	0.24	8%

9.5.3 *Net Savings Results*

Based on the net savings analyses described above (self-report free-ridership and discrete choice analysis) NTG ratios were created for each of the 14 measures to calculate ex post net savings estimates. For the measures in which distinct NTG ratios were estimated using both discrete choice and self-report analysis methods, the NTG ratios utilized for the final evaluation results were based upon the discrete choice modeling results since they are thought to be more reliable.

The NTG ratios for each measure are included in Table 9-47 below. Multiplying the ex post gross impact estimates (Table 9-34 above) by these NTG ratios results in the ex post net savings estimates. As mentioned above, Appendix G3 contains a series of tables that walk though all of the steps and assumptions used to estimate the ex post net impact estimates and realization rates starting from the ex ante gross impact estimates.

Table 9-47: Net-to-Gross Ratios by HEER Measure

HEER Measure	NTG Ratio
Air Conditioners	67%
Heat Pumps	55%
Room AC	69%
Insulation	70%
Clothes Washer - Energy Star	81%
Dishwasher - Energy Star	41%
Furnace - Gas	52%
Pool Pumps	69%
Programmable Thermostats	49%
Water Heater	58%
Whole House Evaporative Cooler	66%
Whole House Fan	71%
Windows	47%

As Table 9-48 below provides the ex post net savings estimates resulting from the net and gross impact analysis. The statewide ex post net kWh estimate was 33,536 MWh, the ex post net kW estimate was 29.2 MW, and the ex post net Therm estimate was 5,381,840 Therms.

Table 9-48: Ex Post Net Savings Estimates

Utility	Technology	Ex Post Net Energy Savings kWh	kW	Therms
PG&E*	Air Conditioners	3,159,130	4,516	-
	Heat Pumps	190,691	173	-
	Room AC	87,034	135	-
	Insulation	2,363,814	3,660	294,007
	Clothes Washer - Energy Star	3,429,814	1,288	1,871,619
	Dishwasher - Energy Star	1,119,135	184	344,349
	Furnace - Gas	-	-	340,240
	Pool Pumps	1,538,937	1,703	-
	Programmable Thermostats	2,562,776	3,939	152,441
	Water Heater	33,631	5	70,861
	Whole House Evaporative Cooler	128,517	198	-
	Whole House Fan	386,984	600	-
	Windows	1,158,957	1,796	243,016
	TOTAL	16,159,420	18,196	3,316,533
SCE	Air Conditioners	2,232,007	3,395	-
	Heat Pumps	94,094	111	-
	Room AC	192,633	223	-
	Insulation	395	0	-
	Pool Pumps	2,476,482	876	-
	Programmable Thermostats	1,646,550	689	-
	Water Heater	7,486	-	-
	Whole House Evaporative Cooler	1,518,493	1,293	-
	Whole House Fan	812,918	1,260	-
	Windows	120,435	123	-
	TOTAL	9,101,494	7,970	-
SCG	Insulation	1,894,570	1,719	212,779
	Clothes Washer - Energy Star	1,891,410	12	1,025,441
	Dishwasher - Energy Star	638,447	-	196,445
	Furnace - Gas	-	-	68,251
	Programmable Thermostats	1,178,141	-	140,045
	Water Heater	-	-	45,713
	TOTAL	5,602,567	1,731	1,688,674
SDG&E	Air Conditioners	307,844	346	-
	Heat Pumps	30,834	22	-
	Room AC	52,220	41	-
	Insulation	11,894	9	9,141
	Clothes Washer - Energy Star	511,358	3	280,071
	Dishwasher - Energy Star	210,499	34	64,769
	Furnace - Gas	-	-	5,631
	Pool Pumps	402,548	23	-
	Programmable Thermostats	336,498	36	14,724
	Water Heater	1,986	0	2,296
	Whole House Evaporative Cooler	2,499	4	-
	Whole House Fan	413,310	327	-
	Windows	391,329	412	-
	TOTAL	2,672,820	1,257	376,632
STATEWIDE	Air Conditioners	5,698,981	8,257	-
	Heat Pumps	315,620	306	-
	Room AC	331,888	399	-
	Insulation	4,270,672	5,387	515,927
	Clothes Washer - Energy Star	5,832,582	1,304	3,177,131
	Dishwasher - Energy Star	1,968,080	219	605,563
	Furnace - Gas	-	-	414,122
	Pool Pumps	4,417,967	2,601	-
	Programmable Thermostats	5,723,966	4,663	307,211
	Water Heater	43,104	6	118,870
	Whole House Evaporative Cooler	1,649,509	1,496	-
	Whole House Fan	1,613,212	2,186	-
	Windows	1,670,721	2,331	243,016
	TOTAL	33,536,301	29,155	5,381,840

Table 9-49 provides the estimated net realization rates (RR) for each measure based on the ex post net savings estimates provided in Table 9-48. As this table shows the overall net RR for electric energy usage on a statewide basis was estimated to be 52 percent. Similar net RR for electric demand (kW) and gas Therm savings were approximately 51 and 37 percent of the ex ante net estimates, respectively. To show the impact that low RR for programmable thermostats have on the overall RR for the HEER Program the overall net RR rate was recalculated with the programmable thermostat measure removed. The resulting RR increased to 66 percent RR on kWh savings, 61 percent RR on kW savings, and 54 percent RR on Therm savings.

Table 9-49: Statewide Net Realization Rates

HEER Measure	Net Realization Rates		
	kWh	kW	Therm
Air Conditioners	108%	88%	-
Heat Pumps	66%	66%	-
Room AC	81%	81%	-
Insulation	74%	83%	30%
Clothes Washer - Energy Star	103%	177%	66%
Dishwasher - Energy Star	51%	51%	51%
Furnace - Gas	-	-	58%
Pool Pumps	41%	28%	-
Programmable Thermostats	27%	28%	6%
Water Heater	71%	72%	70%
Whole House Evaporative Cooler	75%	76%	-
Whole House Fan	81%	82%	-
Windows	29%	29%	31%
TOTAL	52%	51%	37%

9.6 Effective Useful Life (EUL)

No EUL analysis was completed for this study. Itron did compare the effective useful life (EUL) assumptions included in each of the IOUs reporting workbooks with those published in the California PUC Energy Policy Manual version 2 (Table 4.1) and found that the reported EULs matched for the majority of the HEER non-lighting measures. A few of the measures were not included in the Manual and thus could not be compared in the same manner. These measures included room air conditioners, pool pumps, and whole house fans. The EULs used in the impact evaluation analyses were thus based on Energy Policy Manual v2 where available and based on the each of the utilities reported EULs in the remaining cases. Table 9-50 below provides the IOU reported EULs from the IOU workbooks, the EULs from Table 4.1 of the Energy Policy Manual v2 and the final EULs used for this evaluation.

Table 9-50: Effective Useful Life Estimates by Measure and IOU

Measure	Effective Useful Life					
	PG&E	SCE	SCG	SDG&E	Table 4.1	Used in Report
Central Air Conditioner	15	18		15	15	**15**
Central Heat Pump	15	18		20	20	**20**
Room A/C	15	15		15	Not Avail	**15**
Attic Insulation	20	20	20	20	20	**20**
Wall Insulation	20	20	20	20	20	**20**
Clothes Washer	10		10	10	10	**10**
Dishwasher	13		10	10	5	**5**
Gas Furnace	20		20	20	20	**20**
Pool Pump	15	15		15	Not Avail	**15**
Programmable Thermostat	11	12	11	11	11	**11**
Water Heater	13	13	15	15	15	**15**
Whole House Evaporative Cooler	15	7		15	15	**15**
Whole House Fan	15	18		16	Not Avail	**Utility**
High Performance Window	20	20		20	10	**10**

As the table above shows that the EULs included in PG&E's workbooks matched those in the Energy Policy Manual for all but two of the measures (dishwashers which had an EUL three years longer and water heaters which an EUL that was two years shorter). SCE matched for six of their 11 measures, SCG matched for six of their seven measures, and SDG&E matched for 13 of their 14 measures. The reported EUL for dishwashers in the Energy Policy Manual was five years, which was less than half of the estimated EUL at each of the utilities.

10

Program Level Savings

This section contains the estimated Lifetime Savings and Cost Effectiveness tables for each IOU and statewide.

10.1 Lifetime Savings

Table 10-1 through Table 10-5 show the SFEER Program savings over the lifetime of the measures installed by IOU and statewide. These data were compiled by combining gross program projected savings (goals – not reported), net evaluation results (ex post) with the effective useful life (EUL) estimates for each measure. The tables were calculated using the EUL estimates from Table 4.1 of the Energy Efficiency Policy Manual Version 2 (EEPM v2). We planned on creating a second set of tables for CFLs based on the most recent EUL estimates for CF lamps based on the 2007 SCE CFL Study[161], however this study has not yet been finalized at this time. We can distribute updated lifetime savings tables based on this study at a later time if desired. Calendar year 2004 savings reflect the savings associated with measures installed in 2004 only, while calendar year 2005 and beyond savings reflect measures installed during both 2004 and 2005.

The calculation of the lifetime savings estimates for CFLs have been modified slightly to account for the fact that this study found 24 percent of the CFLs purchased through the Program to be in storage. Unfortunately data was not collected during the course of this study to determine the fate of these stored bulbs and thus we took a conservative approach to estimating the impact of these bulbs. The method we used to address this issue we to assume that the EUL for 31.6 percent of the bulbs (24% in storage/76% not in storage) is actually 16 years rather than 8 years. This doubling of the EUL for the percentage of participants who have bulbs in storage assumes that when their CFLs burns out at year 8, one of the bulbs in storage will be installed and thus the Program impact will continue for another 8 years. The savings estimates in the table below have been calculated using this adjustment method.

[161] SCE Assessment Study of CFL Hours of Use and EULs being completed by Itron and Jeff Hirsch and Associates (Not yet complete).

Table 10-1: Program Savings – PG&E

Year	Calendar Year	MWh Savings		Peak MW Savings		Therm Savings	
		Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]
1	2004	261,312	101,339	64	18	6,449,689	1,935,878
2	2005	684,830	265,554	140	36	9,985,239	3,316,533
3	2006	684,830	265,554	140	36	9,985,239	3,316,533
4	2007	684,830	265,554	140	36	9,985,239	3,316,533
5	2008	684,830	265,554	140	36	9,985,239	3,316,533
6	2009	683,034	264,827	139	36	9,432,646	3,092,706
7	2010	682,067	264,435	139	36	9,135,095	2,972,184
8	2011	682,067	264,435	139	36	9,135,095	2,972,184
9	2012	535,042	208,053	116	32	9,135,095	2,972,184
10	2013	269,589	105,522	75	24	9,135,095	2,972,184
11	2014	263,176	102,477	69	22	6,359,525	1,720,669
12	2015	251,463	98,750	53	18	2,198,818	740,169
13	2016	248,848	98,161	49	17	1,483,279	705,108
14	2017	248,848	98,161	49	17	1,483,279	705,108
15	2018	248,848	98,161	49	17	1,483,279	705,108
16	2019	243,749	95,242	41	13	1,434,721	676,764
17	2020	150,089	58,922	23	8	1,361,885	634,247
18	2021	2,024	2,555	3	4	1,361,885	634,247
19	2022	2,024	2,555	3	4	1,361,885	634,247
20	2023	1,855	2,461	3	4	1,361,885	634,247
TOTAL	**2004-2023**	7,513,353	2,928,269			112,254,110	37,973,366

* Definition of Peak MW as used in this evaluation is coincident peak demand.
1 Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2 Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

Table 10-2: Program Savings – SCE

Year	Calendar Year	MWh Savings		Peak MW Savings		Therm Savings	
		Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]
1	2004	230,808	86,403	40	10	0	0
2	2005	443,829	166,821	77	19	0	0
3	2006	443,829	166,821	77	19	0	0
4	2007	443,829	166,821	77	19	0	0
5	2008	443,829	166,821	77	19	0	0
6	2009	443,829	166,821	77	19	0	0
7	2010	443,829	166,821	77	19	0	0
8	2011	443,829	166,821	77	19	0	0
9	2012	309,035	116,512	56	15	0	0
10	2013	182,603	68,876	36	12	0	0
11	2014	182,072	68,741	36	12	0	0
12	2015	178,274	67,885	34	11	0	0
13	2016	174,767	67,095	33	11	0	0
14	2017	174,767	67,095	33	11	0	0
15	2018	174,767	67,095	33	11	0	0
16	2019	166,841	63,091	26	7	0	0
17	2020	77,327	28,895	10	2	0	0
18	2021	170	94	0	0	0	0
19	2022	170	94	0	0	0	0
20	2023	39	22	0	0	0	0
TOTAL	**2004-2023**	4,958,446	1,869,646			0	0*

Definition of Peak MW as used in this evaluation is coincident peak demand.
1 Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2 Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

Table 10-3: Program Savings – SCG

Year	Calendar Year	MWh Savings		Peak MW Savings		Therm Savings	
		Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]
1	2004	6,629	2,594	2	1	3,204,195	764,532
2	2005	14,013	5,603	5	2	6,834,210	1,688,674
3	2006	14,013	5,603	5	2	6,834,210	1,688,674
4	2007	14,013	5,603	5	2	6,834,210	1,688,674
5	2008	14,013	5,603	5	2	6,834,210	1,688,674
6	2009	13,194	5,271	5	2	6,582,014	1,586,523
7	2010	12,437	4,964	5	2	6,349,218	1,492,229
8	2011	12,437	4,964	5	2	6,349,218	1,492,229
9	2012	12,437	4,964	5	2	6,349,218	1,492,229
10	2013	12,437	4,964	5	2	6,349,218	1,492,229
11	2014	11,453	4,151	5	2	5,511,726	1,051,290
12	2015	7,587	2,495	5	2	3,001,108	398,166
13	2016	4,921	1,895	5	2	1,543,492	326,743
14	2017	4,921	1,895	5	2	1,543,492	326,743
15	2018	4,921	1,895	5	2	1,543,492	326,743
16	2019	4,921	1,895	5	2	1,501,987	302,515
17	2020	4,921	1,895	5	2	1,465,180	281,030
18	2021	4,921	1,895	5	2	1,465,180	281,030
19	2022	4,921	1,895	5	2	1,465,180	281,030
20	2023	4,921	1,895	5	2	1,465,180	281,030
TOTAL	**2004-2023**	184,032	71,934			83,025,937	18,930,992

* Definition of Peak MW as used in this evaluation is coincident peak demand.
1 Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2 Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

Table 10-4: Program Savings – SDG&E

Year	Calendar Year	MWh Savings		Peak MW Savings		Therm Savings	
		Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]
1	2004	133,906	50,222	22	4	326,173	97,638
2	2005	137,732	51,783	23	5	1,064,902	376,632
3	2006	137,732	51,783	23	5	1,064,902	376,632
4	2007	137,732	51,783	23	5	1,064,902	376,632
5	2008	137,732	51,783	23	5	1,064,902	376,632
6	2009	137,582	51,722	23	5	1,018,530	357,849
7	2010	137,213	51,572	23	5	904,998	311,863
8	2011	137,213	51,572	23	5	904,998	311,863
9	2012	47,881	18,201	9	2	904,998	311,863
10	2013	47,881	18,201	9	2	904,998	311,863
11	2014	47,144	17,943	9	2	782,650	247,447
12	2015	44,955	17,151	8	2	240,831	25,314
13	2016	44,119	16,962	8	2	72,554	17,068
14	2017	44,119	16,962	8	2	72,554	17,068
15	2018	44,119	16,962	8	2	72,554	17,068
16	2019	42,840	16,179	7	1	68,620	14,772
17	2020	551	211	0	0	68,620	14,772
18	2021	86	43	0	0	68,620	14,772
19	2022	86	43	0	0	68,620	14,772
20	2023	38	16	0	0	68,620	14,772
TOTAL	**2004-2023**	1,460,659	551,092			10,808,547	3,607,294

* Definition of Peak MW as used in this evaluation is coincident peak demand.
1 Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2 Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

Table 10-5: Program Savings – Statewide

Year	Calendar Year	MWh Savings		Peak MW Savings		Therm Savings	
		Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]	Gross Program-Projected Savings[1]	Net Evaluation Confirmed Savings[2]
1	2004	632,655	240,558	129	33	9,980,057	2,798,048
2	2005	1,280,405	489,760	245	62	17,884,351	5,381,840
3	2006	1,280,405	489,760	245	62	17,884,351	5,381,840
4	2007	1,280,405	489,760	245	62	17,884,351	5,381,840
5	2008	1,280,405	489,760	245	62	17,884,351	5,381,840
6	2009	1,277,638	488,640	244	61	17,033,189	5,037,078
7	2010	1,275,546	487,792	244	61	16,389,311	4,776,277
8	2011	1,275,546	487,792	244	61	16,389,311	4,776,277
9	2012	904,394	347,730	186	51	16,389,311	4,776,277
10	2013	512,510	197,564	125	40	16,389,311	4,776,277
11	2014	503,845	193,311	118	37	12,653,901	3,019,406
12	2015	482,279	186,281	100	33	5,440,757	1,163,649
13	2016	472,655	184,112	94	31	3,099,325	1,048,919
14	2017	472,655	184,112	94	31	3,099,325	1,048,919
15	2018	472,655	184,112	94	31	3,099,325	1,048,919
16	2019	458,351	176,406	78	23	3,005,328	994,051
17	2020	232,887	89,923	37	11	2,895,685	930,049
18	2021	7,201	4,586	8	6	2,895,685	930,049
19	2022	7,201	4,586	8	6	2,895,685	930,049
20	2023	6,853	4,393	8	6	2,895,685	930,049
TOTAL	2004-2023	14,116,490	5,420,942			206,088,593	60,511,652

* Definition of Peak MW as used in this evaluation is coincident peak demand.
1 Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2 Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

10.2 Cost-Effectiveness

Table 10-10 show the total resource cost (TRC) test results based on evaluation results for each IOU and statewide, as compared to program goals and reported accomplishments[162].

Table 10-6: Total Resource Cost – PG&E

Category	Evaluation Results	Program Reported	Program Projected
Costs	$72,676,013	$91,286,867	$77,177,291
Benefits	$133,447,628	$284,153,562	$206,326,618
Net Benefits	$60,771,616	$192,866,695	$129,149,326
Ratio	1.84	3.11	2.67
Levelized Cost - Electric	$0.0279	$0.0351	$0.0296
Levelized Cost - Gas	$1.4175	$1.7805	$1.5053

[162] These tables are not adjusted for the CFL bulbs in storage.

Table 10-7: Total Resource Cost – SCE

Category	Evaluation Results	Program Reported	Program Projected
Costs	$16,805,820	$21,174,242	$16,987,680
Benefits	$24,253,066	$56,329,596	$39,653,614
Net Benefits	$7,447,246	$35,155,354	$22,665,934
Ratio	1.44	2.66	2.33
Levelized Cost - Electric	$0.0302	$0.0381	$0.0306
Levelized Cost - Gas	N/A	N/A	N/A

Table 10-8: Total Resource Cost – SCG

Category	Evaluation Results	Program Reported	Program Projected
Costs	$20,368,254	$24,841,030	$22,635,496
Benefits	$9,728,180	$32,003,269	$27,400,693
Net Benefits	-$10,640,074	$7,162,239	$4,765,197
Ratio	0.48	1.29	1.21
Levelized Cost - Electric	$0.2152	$0.2625	$0.2392
Levelized Cost - Gas	$0.5120	$0.6244	$0.5690

Table 10-9: Total Resource Cost – SDG&E

Category	Evaluation Results	Program Reported	Program Projected
Costs	$10,986,998	$14,062,884	$11,385,612
Benefits	$24,146,352	$46,664,902	$31,697,995
Net Benefits	$13,159,353	$32,602,018	$20,312,382
Ratio	2.20	3.32	2.78
Levelized Cost - Electric	$0.0264	$0.0338	$0.0273
Levelized Cost - Gas	$2.0140	$2.5778	$2.0871

Table 10-10: Total Resource Cost – Statewide

Category	Evaluation Results	Program Reported	Program Projected
Costs	$120,837,085	$151,365,022	$128,186,080
Benefits	$191,575,227	$419,151,329	$305,078,919
Net Benefits	$70,738,141	$267,786,306	$176,892,839
Ratio	1.59	2.77	2.38
Levelized Cost - Electric	$0.0749	$0.0923	$0.0817
Levelized Cost - Gas	$0.9859	$1.2457	$1.0403

Table 10-11 through Table 10-15 show the participant test results based on evaluation results for each utility and statewide, as compared to program goals and reported accomplishments.

Table 10-11: Participant Test – PG&E

Category	Evaluation Results	Program Reported	Program Projected
Costs	$100,857,183	$100,857,183	$77,698,654
Benefits	$504,287,393	$765,042,478	$562,893,716
Net Benefits	$403,430,210	$664,185,295	$485,195,062
Ratio	5.00	7.59	7.24

Table 10-12: Participant Test – SCE

Category	Evaluation Results	Program Reported	Program Projected
Costs	$19,141,695	$19,141,695	$14,886,477
Benefits	$100,495,201	$158,518,387	$112,774,345
Net Benefits	$81,353,506	$139,376,692	$97,887,867
Ratio	5.25	8.28	7.58

Table 10-13: Participant Test – SCG

Category	Evaluation Results	Program Reported	Program Projected
Costs	$25,373,067	$25,373,067	$21,057,540
Benefits	$29,906,576	$74,826,373	$63,499,256
Net Benefits	$4,533,510	$49,453,307	$42,441,716
Ratio	1.18	2.95	3.02

Table 10-14: Participant Test – SDG&E

Category	Evaluation Results	Program Reported	Program Projected
Costs	$15,132,415	$15,132,415	$11,593,696
Benefits	$105,404,914	$154,100,999	$105,391,835
Net Benefits	$90,272,500	$138,968,585	$93,798,138
Ratio	6.97	10.18	9.09

Table 10-15: Participant Test – Statewide

Category	Evaluation Results	Program Reported	Program Projected
Costs	$160,504,359	$160,504,359	$125,236,367
Benefits	$740,094,085	$1,152,488,237	$844,559,151
Net Benefits	$579,589,726	$991,983,878	$719,322,783
Ratio	4.61	7.18	6.74

Table 10-16 through Table 10-20 show the results of a basic cost-effectiveness test for each of the measures on the margin (that is with the Administration, Marketing and Implementation costs removed). For this calculation the costs are equal to the net incremental measure costs for each measure and the benefits are equal to the net resource benefits for each measure. The resulting net benefits and benefit-cost ratios indicate which measures are and are not cost-effective when all overhead costs have been removed.

Table 10-16: Measure Level Cost Effectiveness – PG&E

Measure	Costs	Benefits	Net Benefits	Ratio
Central AC	$5,523,195	$2,158,834	($3,364,361)	0.39
Heat Pump	$123,428	$129,243	$5,815	1.05
Room AC	$72,774	$59,584	($13,191)	0.82
Insulation	$5,408,285	$3,652,243	($1,756,042)	0.68
Clothes Washer	$14,136,181	$8,339,060	($5,797,121)	0.59
Dishwasher	$2,222,064	$1,018,807	($1,203,257)	0.46
Furnace	$5,654,052	$1,957,811	($3,696,240)	0.35
Pool Pump	$532,245	$1,048,635	$516,390	1.97
Prog Thermostat	$1,309,196	$1,960,381	$651,185	1.50
Water Heater	$288,544	$354,929	$66,384	1.23
Evaporative Cooler	$47,520	$87,266	$39,746	1.84
Whole House Fan	$119,774	$265,811	$146,037	2.22
Windows	$3,004,904	$2,379,106	($625,798)	0.79
CFL	$21,755,540	$96,979,702	$75,224,162	4.46
Torchieres	$104,451	$653,137	$548,686	6.25
Light Fixtures	$1,772,740	$12,403,080	$10,630,340	7.00
Overall	**$62,074,893**	**$133,447,628**	**$71,372,736**	**2.15**

Table 10-17: Measure Level Cost Effectiveness – SCE

Measure	Costs	Benefits	Net Benefits	Ratio
Central AC	$4,090,122	$1,525,272	($2,564,850)	0.37
Heat Pump	$65,715	$78,686	$12,971	1.20
Room AC	$178,868	$131,639	($47,230)	0.74
Insulation	$3,336	$331	($3,006)	0.10
Pool Pump	$2,037,296	$1,692,337	($344,959)	0.83
Prog Thermostat	$723,602	$891,486	$167,885	1.23
Water Heater	$2,627	$5,116	$2,489	1.95
Evaporative Cooler	$294,115	$1,037,683	$743,568	3.53
Whole House Fan	$223,277	$632,338	$409,061	2.83
Windows	$319,503	$60,544	($258,959)	0.19
CFL	$3,278,076	$14,483,224	$11,205,148	4.42
Torchieres	$945	$15,077	$14,132	15.95
Light Fixtures	$551,408	$3,699,334	$3,147,926	6.71
Overall	**$11,768,891**	**$24,253,066**	**$12,484,175**	**2.06**

Table 10-18: Measure Level Cost Effectiveness – SCG

Measure	Costs	Benefits	Net Benefits	Ratio
Insulation	$5,247,690	$2,796,933	($2,450,756)	0.53
Clothes Washer	$7,805,180	$4,575,044	($3,230,136)	0.59
Dishwasher	$1,267,648	$581,211	($686,437)	0.46
Furnace	$1,571,039	$392,730	($1,178,308)	0.25
Prog Thermostat	$880,025	$1,168,026	$288,000	1.33
Water Heater	$192,166	$214,235	$22,069	1.11
Overall	**$16,963,747**	**$9,728,180**	**($7,235,567)**	**0.57**

Table 10-19: Measure Level Cost Effectiveness – SDG&E

Measure	Costs	Benefits	Net Benefits	Ratio
Central AC	$430,141	$210,370	($219,772)	0.49
Heat Pump	$21,201	$20,898	($303)	0.99
Room AC	$43,665	$35,750	($7,914)	0.82
Insulation	$375,845	$57,879	($317,966)	0.15
Clothes Washer	$2,106,081	$1,246,920	($859,161)	0.59
Dishwasher	$417,949	$191,628	($226,321)	0.46
Furnace	$178,890	$32,402	($146,489)	0.18
Pool Pump	$174,874	$274,297	$99,423	1.57
Prog Thermostat	$123,769	$237,929	$114,159	1.92
Water Heater	$9,904	$12,110	$2,207	1.22
Evaporative Cooler	$6,811	$1,697	($5,115)	0.25
Whole House Fan	$139,132	$297,443	$158,311	2.14
Windows	$931,926	$765,208	($166,718)	0.82
CFL	$4,428,230	$20,520,436	$16,092,206	4.63
Light Fixtures	$26,261	$241,386	$215,125	9.19
Overall	**$9,414,679**	**$24,146,352**	**$14,731,673**	**2.56**

Table 10-20: Measure Level Cost Effectiveness – Statewide

Measure	Costs	Benefits	Net Benefits	Ratio
Central AC	$10,043,458	$3,894,475	($6,148,983)	0.39
Heat Pump	$210,345	$228,828	$18,483	1.09
Room AC	$295,307	$226,973	($68,335)	0.77
Insulation	$11,035,156	$6,507,386	($4,527,770)	0.59
Clothes Washer	$24,047,442	$14,161,024	($9,886,418)	0.59
Dishwasher	$3,907,661	$1,791,646	($2,116,015)	0.46
Furnace	$7,403,980	$2,382,943	($5,021,037)	0.32
Pool Pump	$2,744,415	$3,015,269	$270,853	1.10
Prog Thermostat	$3,036,592	$4,257,822	$1,221,230	1.40
Water Heater	$493,240	$586,390	$93,150	1.19
Evaporative Cooler	$348,446	$1,126,646	$778,200	3.23
Whole House Fan	$482,183	$1,195,592	$713,409	2.48
Windows	$4,256,333	$3,204,858	($1,051,475)	0.75
CFL	$29,461,846	$131,983,362	$102,521,516	4.48
Torchieres	$105,396	$668,214	$562,818	6.34
Light Fixtures	$1,799,946	$12,659,542	$10,859,596	7.03
Overall	**$100,222,210**	**$191,575,227**	**$91,353,017**	**1.91**

11

Conclusions and Recommendations

11.1 Lighting

11.1.1 *Summary of Findings*

The lighting component of this Study investigated measures included in the Upstream Lighting component of the SFEER Program. These measures include compact fluorescent lamps (CFLs), indoor and outdoor compact fluorescent (CF) fixtures, and CF torchieres. Lighting measure findings are organized around five major topics:

- Market characteristics;
- Market barriers;
- Program design;
- Program publicity; and
- Program impacts.

<u>Market characteristics</u>

Increase in CFL availability

As of the end of 2006, more than 1,800 ENERGY STAR® qualified CFL models were being produced by 117 manufacturers around the world. These products represent a wide array of styles, wattages, and features. Starting in 2003, approximately 300 new ENERGY STAR models have gone to market each year, and the total number of qualifying models more than doubled between 2004 and 2006. While the number of non-twister (or non-spiral) models has increased significantly over time, twister style bulbs continue to dominate the market. Sixty percent of the models produced in 2006 were twister style bulbs, and 70 percent were between 13 and 23 Watts.

Increase in CFL market shares

The total U.S. market for CFLs in the U.S. is steadily increasing. Between 1999 and 2005, residential sales of medium screw-based CFLs increased at a rate of nearly 40 percent in California and in the U.S. as a whole. CFL market shares have also increased in the U.S. as a whole and in California since 1999, but California's market share has been consistently higher – the 2005 market share in California was more than double that of the U.S. in 2005 (estimated at 6.4% and 2.7%, respectively).[163]

Increase in CFL awareness and purchase rates

Consumer awareness of CFLs and CF fixtures has increased substantially over the past several years, with 95 percent of the general population aware of CFLs (up from 82% in 2003) and nearly a third of the population aware of CF fixtures. The CFL purchase rate has increased to nearly two-thirds of the population (up from 56% in 2003), while at least 6 percent of the population has purchased CF fixtures. Thirty percent of the population is aware of CFLs but has not yet purchased any.

CFL installations in homes

The average CFL purchaser household in California has 7 CFLs installed of a total of approximately 41 sockets. Forty percent have between 1 and 5 CFLs installed, and 30 percent have between 6 and 10 CFLs installed. Bedroom fixtures are the most likely to be filled with CFLs, where 61 percent of lamps are CFLs. About one-quarter of living/family and kitchen lamps are CFLs, while only 12 percent of dining room lamps are CFLs.

Nearly three-quarters of CFLs installed in these households are spiral bulbs. Among specialty CFLs installed in California households, the most common types include pin-based, globes and reflector style bulbs. These other types are more likely to be found in kitchens and bathrooms. The lighting component of the 2004/2005 SFEER Program provided incentives for nearly 15 million low-Wattage CFLs (less than 30 watts) but only approximately 104,000 specialty CFLs. Specialty CFLs thus only accounted for 1 percent of total CFLs (units) for which the Program provided incentives (and 1% of the total incentive dollars provided).

Two-thirds of CFLs installed in these households are between 11 and 15 Watts. Notably, the majority of 2004/2005 incentives were directed towards higher wattage bulbs (around 18-30 watts based on lumen equivalents.) However, prior years' programs were more focused on lower wattage bulbs. Nearly a third of the CFLs for which Program incentives were provided were less than 18W/1,100 lumens in 2004/2005, a decrease from more than 40 percent in 2003 and more than 60 percent in 2002. Also, according to Program staff, the majority of non-promotional bulbs that are sold by suppliers have been in the lower wattage range.

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[163] These are highly conservative estimates of California market shares as the data omit CFL sales through Costco, which was responsible for approximately 10 percent of CFL incentives through the Upstream Lighting component of the 2004/2005 SFEER Program in California and likely represents a noteworthy proportion of CFL sales nationwide.

CFL Storage

Nearly 60 percent of CFL purchasers were storing CFLs – 5 on average among those who store. Most keep them on hand to replace CFLs as they burn out. Many of these same households also have incandescent bulbs in storage and those who store have on average 13 incandescent bulbs. Most of these households say that when an incandescent bulb burns out they will install a CFL. Their decisions depend most on the room in which the bulb will be installed and whether they have CFLs or incandescent bulbs in storage.

Future CFL purchase and installation intentions

Almost all CFL purchasers intend to install new CFLs once their existing CFLs burn out. When asked about specific CFL installations during the onsite survey, 2004/2005 CFL purchasers were somewhat less likely to replace specialty CFLs with new CFLs than they were to replace twister-style CFLs with CFLs. Nearly three-quarters of consumers say they are likely to buy CFLs in the coming year.

CFL production and sales

CFL manufacturers expressed concern regarding several recent and ongoing manufacturing, importing or distributing problems that may restrict the future production and supply of CFL products. These include competition for production capacity from other markets around the world and a shortage of some CFL components (e.g., capacitors, phosphorus) which could increase CFL manufacturing costs. However, most manufacturers believe that product pricing will either remain the same or decrease over the next several years. The vast majority expect their CFL sales to increase as well, primarily as a result of greater awareness and acceptance by both customers and retailers of CF products. However, many manufacturers expressed concern that the limited number of Program incentives could hinder these sales increases.

CFL disposal and recycling

Publicity regarding mercury contamination from CFL disposal has recently increased as the products become more common in the marketplace. A number of manufacturers report that product recycling is a promising option, but most indicate that the direction for these efforts should come from state or local governments, non-profits, or individual customers rather than manufacturers. A couple of manufacturers thought that CFLs should be mandated to have lower levels of mercury (less than 5-6 milligrams per bulb). Other manufacturers thought that serious regulation is not needed because CFLs contribute less to mercury pollution than incandescent bulbs when power plant emissions are considered. Manufacturers also varied in their approaches to disseminating information about disposal options – with some putting on information on their labels or websites.

Market barriers

CFL quality and consumer satisfaction

Through the Upstream Lighting of the 2004/2005 Program as well as its predecessor programs, the California IOUs have supported national efforts to improve CFL quality. IOU staff have served as board members for the Program for the Evaluation and Analysis of Residential Lighting (PEARL), which tests popular CFL models to determine whether they meet the specifications of the federal ENERGY STAR program. This testing initiative also helps to identify potential issues with CF products that are new to the market. Additionally, the Program promotes only ENERGY STAR CF products, which have high quality standards established by the U.S. Department of Energy and Environmental Protection Agency.

CFL product quality continues to be a concern for both suppliers and consumers. Problems with bulb performance hindered the adoption of earlier CFL models and may have created some long-standing customer prejudices against the technology. Some of the lighting manufacturers interviewed in support of this Study expressed concerns that price competition may encourage the use of cheaper components for CFLs, ultimately leading to degradation of product quality. Additionally, a number of larger, well-established CFL manufacturers claim that some of the newer CFL producers are getting increased penetration in the California lighting market particularly because the Program (and other energy-efficiency programs) lends these manufacturers legitimacy and provides easier access to retailers. Some of the established manufacturers view the new market entrants not only as low-cost producers but also as low-quality producers. However, all of the CFLs offered through the Program are ENERGY STAR products and thus have to meet the ENERGY STAR standard. Not surprisingly, the newer manufacturers dispute the established manufacturers’ claims and feel they offer quality products.

Consumer satisfaction with CFLs is moderately high, with an average rating of 7.7 on a scale of 1 to 10 where 1 means “not satisfied” and 10 means “very satisfied” among CFL purchasers. Regarding specific CFL attributes, consumer satisfaction is highest with length of CFL life (8.5) and lowest with the way they look in fixtures (6.6) followed by the color of light (7.4). Recent CFL purchasers are more likely to be satisfied with CFLs than purchasers who have not bought any CFLs recently. This could be because recent purchasers have had positive experiences with newer technologies and lower prices. This also could be because prior purchasers who may have been dissatisfied with CFLs may be less likely to buy additional CFLs, and thus are not likely to be recent purchasers.

Consumers are more satisfied with CFLs that are installed in out-of-the-way locations such as halls, stairways and offices and less satisfied with CFLs in dining/living rooms and kitchens. This is likely because they are more likely to tolerate issues with brightness, light color and fit where aesthetics and light preference are not likely to be as important and/or in applications where they are used less frequently. Consumers are also more likely to be satisfied with spiral CFLs than specialty CFLs or CFLs controlled by timers or dimmers.

Barriers to CFL purchases and expanded CFL installations

Our surveys looked at barriers to CFL purchase and installations from a variety of angles including barriers to increasing CFL installations within households, reasons why consumers who are unlikely to buy CFLs within the next year are unlikely to do so, and reasons why consumers are using non-CFLs instead of CFLs in specific applications.

- CFL purchasers report that the main barriers to **increasing CFL installations** in their households are dissatisfaction with the way CFLs fit in fixtures (15% of purchaser households), because CFLs are not bright enough (15%), and because CFLs are too expensive (14%).
- The most common reasons that consumers are **unlikely to buy CFLs in the coming year** is that they are waiting for bulbs to burn out (16%) or they already have CFLs in storage (15%). Another 12 percent said that CFLs were not bright enough, and 10 percent said they were too expensive.
- **The most common reason that CFL purchasers have one or more incandescent lamps (versus CFLs) in use relates to incandescent bulb storage:** 17 percent of 2004/2005 CFL purchasers indicated that they have installed incandescent bulbs instead of CFLs because they had incandescent bulbs on hand when the prior bulb burned out. Another 17 percent said that they installed non-CFLs because the fixture required a specialty bulb such as a 3-way or dimmable bulb (which may indicate a lack of awareness about specialty CFLs or a lack of availability).

These results indicate that there are many remaining barriers to CFL purchase and installations, and no one barrier is dominant. Some consumers are still having issues with CFL brightness or price, others have CFLs in storage or are waiting for bulbs to burn out and still others have incandescent bulbs on hand and will use those up (and perhaps buy more) before buying CFLs. These barriers sometimes vary based on which lamp the consumer is considering. As described previously, room type and application (e.g., requiring specialty or controls) impact consumers' satisfaction with current CFLs and willingness to install CFLs in the future. Some other notable findings with respect to barriers:

- Our results show that consumers who purchased CFLs at grocery stores were more price-sensitive than shoppers in other store types.
- Consumers were mostly unaware that specialty CFLs are produced that will replace almost any screw-based lamp, including 3-way, dimmable and small-base lamps
- Manufacturers feel that price is a significant barrier to getting consumers to buy specialty CFLs
- Many consumers who said they are unlikely to buy CFLs in the coming year were unaware that CFLs are often sold for $2 or less.

- CFL manufacturers are aware that consumers still have issues with CFL light color and fluorescent products in general, and they feel that a combination of further technological improvements and consumer education about the current state of the technology would help to improve consumer acceptance

Program design

Program incentives tied to lumens versus watts

In 2004/2005, the Program tied its lighting incentives to lumens, whereas in the past incentives were based on CFL wattage. The reason for this change is that CFLs with the same wattage may emit varying light levels, while lumens more accurately represent brightness. This change was consistent with changes made by the national ENERGY STAR program to recommend CFLs based on lumen equivalents that correspond to various incandescent bulb wattages. Most manufacturers still label their CFLs with incandescent wattage equivalents so that customers do not have to understand lumens to select the right product. While this Program change occurred behind the scenes, it likely impacted the marketplace by updating incandescent to CFL equivalents based on actual brightness levels.

Expansion of CFL distribution channels

The Upstream Lighting component of the 2004/2005 Program expanded the number of stores that sell CFLs, with drug and grocery and discount stores (relatively new market entrants) accounting for two-thirds of total Program sales.

Drug and grocery and discount stores participated in the Program through the manufacturer buydown, with small CFL manufacturers (including many new market entrants) serving this market. This arrangement was a win-win because the larger more established CFL manufacturers have typically ignored this market, and smaller CFL manufacturers have had a hard time selling to the more established CFL retailers such as home improvement and big box stores.

This expansion into drug and grocery and discount stores is limited to spiral or twister-style CFLs. Specialty CFLs and CF fixtures and torchieres are still predominantly sold through home improvement stores. Likewise, most CFL purchasers buy CFLs in home improvement and hardware stores. This is likely because once the Program lighting promotions end, some drug and grocery and discount stores do not sell many (or any) CFLs, while the other more established retail channels continue to sell a wide variety of CFL products year-round.

Point-of-sale (POS) incentives for lighting

Only 8 percent of the low-wattage CFL incentives offered through the 2004/2005 Program were POS incentives – all from a single retailer (the remaining were manufacturer buydown incentives). While POS incentives were about half of the specialty CFL incentives, they were only about 20 percent of the CF fixtures and torchiere incentives. Three-quarters of participating retailers that sold CF products through the manufacturer buydown channel were unaware of the POS option.

The low penetration of POS incentives in the Program has been mostly due to lighting manufacturer preference for the buydowns with some additional effects from retailer unawareness of the POS option. All of the manufacturers preferred the buydowns. They claimed that smaller retailers face barriers to wider use of POS incentives including financial carrying costs, point-of-sale marketing costs, Program tracking requirements, other Program administrative compliance costs, and logistical challenges such as programming cash registers. Some manufacturers also pointed out that “keystone pricing” practices – where retailers set prices that are about double their wholesale costs – mean that consumers get more value out of upstream incentives (i.e., manufacturer buydown) than downstream incentives (i.e., POS). Since the lighting manufacturers have been recruiting most of the small-to-medium-sized retailers into the Program, the manufacturer buydown incentive has remained predominant.

While the manufacturer-driven nature of the lighting part of the Program is likely the primary cause of the low penetration of POS incentives, lighting retailer unawareness of the POS option may be a secondary factor. Fourteen out of 19 (74%) manufacturer buydown lighting retailer participants were unaware of the POS option. Eleven of these 19 retailers said that they would be interested in the POS option.

Program publicity

Promotion of rebated CFLs in stores

The Upstream Lighting component of the Program dedicates very little budget to marketing, directing most funds towards rebates. The Program does produce product stickers that they require to be affixed to every discounted bulb, which indicate the utility name and indicate the product is discounted. The Program also requires participating manufacturers to conduct at least a minimal level of marketing. The Program provides some oversight of promotional materials to ensure they are Program-compliant.

Prior California IOU lighting programs dedicated a much larger portion of funding towards marketing and training. These activities were scaled down mostly in response to supplier feedback that they preferred more rebates and to do their own advertising, since the utilities’ one-size-fits all approach was not appropriate for most retailers.

Manufacturers were satisfied with the Program’s approach to marketing in 2004/2005. However, retailers – especially smaller retailers – were less satisfied. This is likely because smaller retailers in particular have fewer resources to devote to promotional activities. They would also be more receptive to utility-developed promotional materials since they would have fewer restrictions on making use of those materials than larger retailers.

In-store CFL promotions have an impact on CFL purchases, with one-third of consumers first learning about CFLs from in-store displays or other point-of-sale materials. The same proportion of 2004/2005 CFL purchasers noticed retailer CFL advertising and reported that they were somewhat or very influenced by it when they made their purchase.

Program impacts

The evaluators used participating lighting retailer and manufacturer self-report interviews to estimate free-ridership and spillover for the Upstream Lighting component of the Program. Typically, consumer self-report surveys would be used, but that method was not suitable for this Program evaluation for a number of reasons, including lack of participating customer data. The evaluators heavily leveraged the Program tracking database, which contained detailed records on types and quantities of lighting products sold by retailer and manufacturer for each utility. The evaluators also relied on expert Program staff as well to help inform the construct of our survey and analysis approach, where they identified the distinct groups of retail channels and product types. Program staff also supplied the contact information for decision-makers at each participating supplier, and in many cases helped convince reluctant suppliers to cooperate with the evaluators.

CFL purchaser free-ridership by retail store channel

For low-wattage CFLs (under 30 Watts/2,600 lumens), which accounted for 97 percent of the lighting products discounted by the Program, the manufacturers and retailers estimated similarly high CFL sales volumes in absence of the program (high free-ridership rates of 66-75%) for big box and large home improvement stores, mid-level sales volumes in absence of the program (free-ridership rates of 42-51%) for drug and small hardware stores, and low sales volumes in absence of the program (free-ridership rates of 3-16%) for grocery and discount stores. Reasons for these differences included:

- *Differing price-sensitivity and shopping behavior* - Market actor interviews indicated that shoppers in big box and large home improvement stores are much less price-sensitive than those who buy CFLs in grocery stores. This lower price sensitivity was confirmed by our end-user surveys. In grocery and drug stores CFLs and incandescent bulbs are likely to be placed close together thus encouraging direct price comparisons. This is not the case in big box and large home improvement stores. In addition, people shopping for light bulbs in large home improvement stores, such as do-it-yourselfers, are likely to have a specific type of light bulb in mind when they enter the store. Therefore they are unlikely to comparison shop between CFLs and incandescent bulbs and will likely buy the CFL they were seeking whatever its price happens to be. Finally one lighting expert noted that while a non-discounted CFL would be a very small-ticket item for a person shopping at a large home improvement store, it would be a bigger ticket item for a person shopping at a grocery store.

- *Price caps*- Free-ridership is low among discount stores because they have 99¢/$1 price limits on their products and would simply not be able to sell such CFLs without the Program incentives.
- *Large chain internal pricing strategies* - Some very large general merchandise/big box chains set their prices for CFLs based on their own internal pricing strategies that are not based on whether SFEER Program rebates are available. These large chains are also able to extra price discounts from CFL suppliers without having to rely on Program incentives.

Gross and Net impact evaluation findings

The statewide gross realization rate across all lighting measures was estimated at 64 percent for kWh savings and 33 percent for kW savings. The statewide NTG ratio across lighting measures was estimated at close to 60 percent for both kWh and kW savings. Final estimated Net realization rates were estimated at 47 percent for kWh savings and 23 percent for kW savings. These results are broken down by measure in Table 11-1 below.

Ninety-seven percent of lighting incentives were paid out for CF bulbs, with more than two-thirds specifically for bulbs between 1,100 and 2,599 lumens. Gross realization rates are below 100 percent for most of the CF bulb categories because:

- 24 percent of CF bulbs that had been purchased during 2004/2005 were reportedly not installed as of late 2006,
- The Program assumed average operating hours of 3.5 per day versus the evaluation findings of 2.6, and
- The Program assumed that 20 percent of CFLs were operating during peak hours while the evaluation estimated 7 percent.

Net-to-gross ratios are lower than expected (the Program claimed 80%) because some participating retail channels would have sold around the same volume of CFLs in absence of Program incentives.

Table 11-1: Gross and Net Realization Rates and Net-to-Gross Ratios Across Lighting Measures

Lighting Measures	Gross Savings ex ante		Gross RR*		NTG Ratio ex ante		NTG Ratio ex post		Net RR	
	MWh	MW	kWh	kW	kWh	kW	kWh	kW	kWh	kW
ENERGY STAR CFL 450 to 799 Lumens	31,727	5	106%	50%	80%	80%	58%	58%	76%	36%
ENERGY STAR CFL 800 to 1,099 Lumens	193,994	30	62%	30%	80%	80%	62%	62%	49%	23%
ENERGY STAR CFL 1,100 to 2,599 Lumens	880,666	137	59%	28%	80%	80%	62%	62%	46%	22%
ENERGY STAR CFL 2,600 Lumens or Greater	5,841	1	30%	14%	80%	80%	72%	72%	27%	13%
ENERGY STAR Interior/Exterior Fixture < 1,100 Lumens	145	0	100%	100%	80%	80%	36%	36%	45%	45%
ENERGY STAR Interior/Exterior Fixture >= 1,100 Lumens	89,082	3	100%	100%	80%	80%	36%	36%	45%	45%
ENERGY STAR Torchiere < 65 Watt	389	0	100%	100%	80%	80%	63%	63%	79%	79%
ENERGY STAR Torchiere > 65 Watt	2,005	0	100%	100%	80%	80%	63%	63%	79%	79%
Total	1,203,849	176	64%	30%	80%	80%	59%	61%	47%	23%

11.1.2 *Conclusions and Recommendations*

Certain lighting retailer channels that have participated in the Program for a number of years (such as big box and large home improvement stores) will sell a similar volume of CFLs whether the Program provides incentives or not. The evaluation found high rates of free-ridership for these retailer channels. Many of these retailers carry a wide variety of CFLs year-round. Shoppers at these stores are often willing to pay more for light bulbs than they would at a grocery or drug store due to the wide selection and the way lighting products are promoted and displayed.

CFL sales for new entrant retailer channels are highly influenced by Program incentives. In fact, some retail channels (such as discount stores) would not sell any CFLs in absence of the Program incentives.

The inconsistent availability of CFL discounts for grocery, drug, and discount stores is a concern. The 2004/2005 Program made new inroads into less established CFL retail channels such as drug, grocery and discount stores. However, limitations in incentive funds meant that many of these stores could not make these discounted CFLs available year round. Inconsistent availability of discounts in such stores can have a number of negative impacts on CFL sales including:

- *Significant price barriers* – As explained above, shoppers in grocery and drug stores are more likely to directly compare CFL and incandescent bulb prices due to closer produce placement.
- *Unavailable products* – This is especially a problem for discount stores which may not be able to stock ENERGY STAR CFLs when Program incentives are not available. While the simple unavailability of CFLs when consumers are purchasing light bulbs is the most obvious negative effect on CFLs sales, there are also detrimental impacts on CFL awareness and acceptability.
  - *Awareness effects* - The end user survey results showed that the most-cited way in which consumers became aware of CFLs was through seeing in-store

displays or advertisements. Therefore when CFLs are not available on store shelves, or are given less prominent display due to the absence of Program discounts, shoppers that are new to CFLs are less likely to become aware of CFLs in this way. This is especially unfortunate since the discount shopping segment of the population may have lower-than-average awareness of CFLs. Even for prior CFLs buyers, the absence of CFLs on store shelves or in prominent displays can produce "out of sight, out of mind" effects.

  - *Acceptability effects* – The inconsistent availability of CFL products may make shoppers that are new to CFLs view them as "gimmicky" products or unreliable substitutes for incandescent bulbs.

- *Negative spillover* –A number of manufacturers noted that the lower CFL price points that result from the Program discounts lower the CFL price expectations of some shoppers. This can cause consumers to be less willing to buy non-discounted CFLs than they would be if they had never been exposed to the discounted-CFLs. "If they could buy the bulb for $1.99 and all the others are $5.99 or $6.99," explained one manufacturer, "they might not want to buy those and want everything for $1.99." Making the discounted CFLs available year round would eliminate these negative spillover effects.
- *Potentially greater exposure to low-quality CFL bulbs* – Some lighting manufacturers reported that when Program incentives were not available, some discount stores could only stock non-ENERGY STAR bulbs. Assuming that many discount shoppers are new to CFLs, it would be unfortunate if their first experiences with CFLs involved lower-quality products.

Based on these findings concerning free-ridership variation among retailer types and inconsistent availability of CFL products among certain stores, the evaluators recommend that the Program:

- Significantly reduce or eliminates incentives for low-wattage CFLs in big box or large home improvement stores. CFL discount programs in the Northwestern U.S. have already adopted such strategies.
- Increases incentive levels on low-wattage CFLs to grocery, drug and discount stores, where very low free-ridership exists and purchasers are very price-sensitive.
- Increases the allocation of incentive dollars for low-wattage CFLs sold in grocery, drug and discount stores so that they can be stocked year-round.
- Give preferential incentive allocations to grocery, drug, or discount stores that pledge to stock CFL products year-round.

Awareness of CFLs in general as a technology is extremely high – and most consumers buy CFLs to save energy. However, **consumer awareness and acceptance of specialty CFLs is very low,** as these products are not widely available and are comparatively expensive. Based on these findings the evaluators recommend that the Program:

- Continue to make incentives available for specialty CFLs, ENERGY STAR torchieres and hard-wired fixtures in big box and large home improvement stores as well as other retail channels. While the evaluators advocate the significant reduction or elimination of rebates for low-wattage CFLs in big box and large home improvement stores, the evaluators recommend that rebates be retained for other CF products in these stores due to relatively low rates of consumer awareness and lingering acceptance barriers.
- Increase incentive levels for specialty CFLs. A number of lighting manufacturers cited specialty CFLs as a product category where rebate levels are inadequate.
- Increase consumer education and awareness efforts that focus on specialty CFLs.
- Support quality testing for specialty CFLs. As the saturation of low-Wattage CFLs increases over time, specialty applications will account for an increasing share of the remaining CFL potential. Yet specialty CFLs are newer technologies that have not been tested as thoroughly as standard low-wattage bulbs. Recent PEARL testing results have shown that covered CFLs, for example, due not perform as well as bare bulbs, likely due to problems with heat retention.

Even though two-thirds of households in the state have purchased CFLs at one time or another, the fraction of residential lamp sockets filled with CFLs in California is still below 10 percent. Thus, **much potential remains for increasing CFL installations among CFL purchaser households**. Most households have only a few CFLs installed and have CFLs and incandescent bulbs in storage to be used as both CFLs and incandescent bulbs burn out. Based on these findings the evaluators recommend that the Program:

- Consider limiting the sale of promotional CFLs in multi-packs (since most households already have CFLs in storage) to keep the installation rate from declining and to capture energy savings impacts sooner. Evidence from a recent study in the Northwest show that consumers who purchase multi-packs are storing CFLs at a higher rate than single-pack purchasers.
- Encourage year-round stocking of CFLs in grocery, drug, and discount store channels (per the above recommendation). This should help reduce the purchase of incandescent bulbs and increase CFL purchases (by reducing the price and availability barriers) – helping to increase CFL saturation.
- Consider encouraging consumers to replace working incandescent bulbs now rather than waiting for them to burn out.
- Increase Program focus (as described in the above recommendations) on specialty CFLs to address 3-way, controlled and other applications to help expand CFL installations.

Many consumers are unaware that CFLs are sold in a wide variety of retail channels for $2 or less. Likewise, some consumers do not realize that CFL technology has improved. These barriers impact the CFL purchase rate (those who are aware of CFLs but have not yet bought them) and the rate of CFL saturation (prior CFL purchasers are who not buying more).

- The Program and the other marketing campaigns with which it coordinates should focus educational messages on CF product technology improvements.
- The prior recommendation regarding encouraging participating retailer stock CFLs year-round at promotional prices should be considered in order to convert non-purchasers and keep purchasers buying CFLs.

There are still some lingering issues regarding consumer perceptions of CFL quality and performance. Dissatisfaction with light brightness is an issue in particular (most consumers who cite problems with brightness feel CFLs are not bright enough). Also, consumers may be satisfied with CFLs in out-of-the-way fixtures, but are less accepting of CFLs in more visible or task-specific applications. Based on these findings the evaluators recommend that the Program:

- Consider conducting consumer education regarding recent improvements in CFL technology.
- Ensure that specialty CFLs perform well so that those products are well accepted by early adopters of that technology; this is key to making sure that specialty CFLs are accepted more widely by the general population.
- A continued Program focus on lumen equivalence will help ensure that consumers select the appropriate CFL to incandescent wattage.

The 2004/2005 Program was dominated by manufacturer buydown incentives, with few retailers offering POS rebates. Prior years' Programs included more POS incentives. This shift is likely due to retailers preferring the buydown option because it means less paperwork for them and newer retailer entrants who are unable to comply with the POS Program requirements. Since consumers are likely to get more value from manufacturer buydown this trend may be positive for the Program and the market.

- The manufacturer buydown option should be emphasized over the POS option since both consumers and the Program is likely to get more value per dollar spent.
- The POS option should be offered for strategic reasons, e.g., to recruit any retailers who would not be likely to participate via the manufacturer buydown.

This evaluation relied upon interviews with participating lighting manufacturers and retailers to inform free-ridership and spillover estimates for the Upstream Lighting component of the 2004/2005 Program. **This supplier self-report free-ridership and spillover approach was ultimately successful in generating defensible net-to-gross ratio estimates by retail channel and product type and was preferable to attempting to estimate free-ridership and spillover from customer interviews**. There are a number of good reasons for an upstream approach:

- Lighting manufactures and retailers are more knowledgeable than end users about the effect of financial incentives on CFL sales.
- The relative transparency of the manufacturer buydown and point-of-sale incentives (POS) to the customer, as opposed to mail-in rebates, for example, also makes it more doubtful that a customer would recall having received a Program discount on a CF product or the size of the discount.
- A downstream NTG approach presents a major logistical barrier because the Program has no records of individual customers who received incentives for lighting measures. The General Population Telephone Survey identified 2004/2005 CFL purchasers based on self-reports, but these data are not reliable because the survey was conducted in late 2006/early 2007 and recall of CFL purchases from two to three years prior is difficult.
- The Program's main impact is on introducing and sustaining the sale of CFLs in new retail channels, so direct customer free-ridership sequences (e.g., would you have bought the CFL if it cost $1 more) would miss those significant market effects (since in many cases the CFL would not have been sold in that store at all in absence of the Program).

These findings yield the following conclusions and recommendations:

- **The participating supplier self-report method likely provides more accurate estimates of free-ridership and spillover**. This method should be used instead of or at least in conjunction with consumer self-report methods for future evaluations.
  - If, in future evaluations, there is interest in comparing the results from the supplier-based NTG method with those from a consumer self-report method – despite the challenges posed by the latter method (most notably, that many CFL purchasers may not realize that the product they purchased was discounted by the program) – the utilities should consider collecting contact information from customers who purchase CFLs discounted by the program to ensure that evaluators have the contact information necessary for a consumer self-report analysis. The utilities may wish to consider providing CFL purchasers with a nominal incentive in exchange for their contact information (similar to the process through which contact information was obtained from 2004/2005 POS measure participants).
- **For planning purposes, the utilities should use the net-to-gross ratio estimates by product and store type provided in this report** (see Table 5-1 through Table 5-4) combined with appropriate weights based on the number of products they expect to rebate (by product and store type) to develop net-to-gross ratio estimates for current and future Upstream Lighting programs. There is a general belief that self-reported NTG estimates are biased low[164], however since it was not possible to conduct

[164] A comparison of the non-lighting NTG results from this study found self-report NTG estimates were lower than those resulting from the discrete choice. This finding was supported by a 2001 XENERGY meta-analysis that was completed as part of the Standard Performance Contracting Program.

additional NTG analysis for the lighting measures in this Program we were unable to determine if this hypothesis holds true for supplier self-report estimates.

- **Good detailed tracking data are essential to generating results, as is cooperation from expert IOU Program staff.** The Program should continue to collect and make available to evaluators complete and detailed tracking data. And Program staff should be invited to provide input into the construct of the free-ridership and spillover survey and analysis approach.
- **High response rate, at least among the major participating suppliers, is also essential to robust results.** Program staff should encourage participating suppliers to respond to evaluator requests for surveys and should continue to collect and provide current contact information in order to ensure high response rate.

Larger retailers are able to promote Program CFLs and are satisfied with how the Program deals with marketing. However, **smaller retailers (including many of the new entrants into the Program) could use more marketing support**. As noted, many customers first learn about CFLs stores and are encouraged to buy them based on point-of-purchase materials so failing to support retailer marketing could result in lost opportunities for consumer purchasing. Based on these findings the evaluators recommend that the Program:

- Consider offering marketing support to smaller retailers, and/or encouraging the manufacturers who serve them to provide promotional materials.

The Program realized low electricity and demand savings for lighting measures. The evaluation estimated that the Program saved 64 percent of gross electricity and 30 percent of claimed gross demand savings for lighting measures. Gross realization rates are below 100 percent for most of the CF bulb categories due to lower evaluation-estimated change in wattage, operating hours and installation rate as compared to Program assumptions.

- The Program should update its per unit savings parameters to reflect that installation rates are 76 percent, operating hours are 2.6 hours per day and peak usage is 7 percent.

The Program cannot claim savings for CFLs that are not installed. Seventy-six percent of the CFLs purchased during the 2004/2005 Program period are installed, but approximately 24 percent are in storage. The CFL storage rate is negatively impacting Program savings.

- One can assume that some proportion of the CFLs currently in storage will be installed at a later date, but at present, there exists no data to suggest how long "stored" CFLs generally spend in storage or the rate at which they replace CFLs versus other lamp types when they are eventually installed. The evaluators recommend that additional research should be conducted to clarify these issues; results from this research could be used to adjust future year Program savings to account for presently-stored CFLs that are installed in the future.

- As mentioned above, the evaluators recommend that the IOUs consider limiting the sale of promotional CFLs in multi-packs to keep the storage rate from increasing (and the installation rate from declining) and to capture energy savings impacts sooner. Evidence from a recent study in the Northwest shows that consumers who purchase multi-packs are storing CFLs at a higher rate than single-pack purchasers.

Lighting manufacturers are in disagreement about what should be done about the CFL disposal issue. CFLs contain trace amounts of mercury. Some manufacturers feel that governments, non-profits, or individual customers should be responsible for CFL recycling, while others feel that CFLs' mercury contribution is offset by avoided power plant emissions associated with incandescent bulb use and thus, no action is necessary. Some manufacturers label their products with information regarding proper disposal, while others do not.

Based on these findings the evaluators recommend that:

- the IOUs participating in the SFEER Program, along with other California utilities, engage lighting manufacturers in a collaborative working group process to try to find agreement on:
  - Uniform ways to provide CFL purchasers with disposal information;
  - Uniform ways to described mercury risk on product labeling; and
  - Strategies for increasing CFL recycling rates.

11.2 Non-Lighting

The non-lighting component of this Study investigated measures included in the Home Energy Efficiency Rebates (HEER) component of the Program, including home improvement measures, HVAC equipment, and appliances. The evaluation focuses on measures that contributed at least 10 percent each to the 2004/2005 SFEER Program's non-lighting kWh, kW or Therm savings. These measures include clothes washers, central air conditioners, insulation, pool pumps, programmable thermostats and windows. The Study also examined refrigerators because SCE and SDG&E provided a substantial number of rebates for refrigerators during 2004/2005 using procurement dollars, accounting for 5 percent of combined procurement and PGC-funded Program energy savings and 3 percent of demand savings (excluding incentives for lighting measures).

11.2.1 *Summary of Findings*

Findings related to the Program's non-lighting measures and the HEER (i.e., non-lighting) component of the Program are organized by the following six topics:

- Market characteristics;
- Equipment efficiency standards;
- Program influence and participant satisfaction;

- Program design;
- Program publicity; and
- Program impacts.

Market Characteristics

General Population Attitudes and Behaviors with Respect to Energy Efficiency

Prior evaluations associated with predecessor programs found that California consumers have generally rated themselves as fairly knowledgeable about conservation and energy efficiency. These ratings peaked during the energy crisis, as the state's residents were inundated with messages to conserve energy and install energy efficiency measures such as CFLs and programmable thermostats. Current ratings are slightly lower than during the energy crisis, but higher than levels prior to the crisis. The current media attention on global warming and heightened awareness of national security issues related to foreign oil dependence as a result of the ongoing Iraq war have likely contributed to keeping these efficiency-related issues in consumers' minds.

Awareness of the state's Flex Your Power campaign continues to be high – with a majority (52%) of the state's residents having heard of it and 38 percent of these reporting that the campaign influenced them to take actions to save energy. Likewise, more than half (64%) of the state's residents are aware of the ENERGY STAR program.

Almost all households (94%) said they routinely take actions to conserve energy – most often turning off lights when they are not being used (70%) and reducing home heating usage (49%). Media messages during and after the energy crisis focused on these types of conservation measures, so it is not surprising that these measures are most frequently cited by households. The statewide Flex Your Power campaign also focuses on conservation measures, as well as specific energy-efficiency measures such as lighting and appliances.

Likewise, prior evaluations have queried California consumers regarding their attitudes towards energy conservation and efficiency. On average, attitude ratings have been fairly high in terms of prioritizing energy efficiency. The current results showed that attitudes have stayed about the same over time or have slightly improved.

Market Trends for Emerging HVAC Equipment

The California IOUs have been promoting variable speed drives (VSDs) in residential central air conditioners and enhanced evaporative coolers. They have been providing training to HVAC distributors and contractors on the benefits of installing high efficiency furnaces and CACs with a VSD motor. They have also provided information on VSD benefits to consumers. In 2004, the Program introduced a new set of incentives for advanced whole house evaporative coolers including a higher incentive for the more efficient two-stage evaporative cooler, and an additional $100 for installations including exhaust dampers and a programmable thermostat. Customers could receive as much as $600 for a two-stage unit with which exhaust dampers and a programmable thermostat were installed.

Equipment Efficiency Standards

Energy Efficiency Standards Changes

Standards for energy-equipment are constantly changing. This is especially true in California where changes in the state's own Title 20 Appliance Efficiency Standards are occurring at the same time as national changes in minimum efficiency standards for residential central air conditioners and ENERGY STAR equipment. These changing standards can have significant impacts on the dealers and installation contractors who sell energy-efficient equipment. Recently, federal and/or California standards have changed for clothes washers, central air conditioners and pool pumps.

In 2004, ENERGY STAR raised the minimum efficiency levels for clothes washers to qualify for the ENERGY STAR label. Consequently, rebates offered by California electric and gas utilities were only for clothes washers that significantly exceeded these new, higher standards. Almost all of the participating appliance dealers interviewed in support of this study reported that they were aware of these changes, and the majority said that the changes did not cause them any problems.

Participating HVAC contractors report that the 2006 federal requirements for SEER 13 CACs had little or no effect on their business because most were already selling energy-efficient equipment. A number of contractors also pointed out that the new standards have raised average central air conditioners prices, and some claimed that this had reduced their central air conditioner sales.

Pool Pump Standards Changes

California is undergoing changes in pool pump requirements under Title 20 California Appliance Efficiency Regulations. These changes include:

- A switch to capacitor-start/capacitor-run or two-speed motor for all new pool pump installations or replacements occurring after January 1, 2006;
- Manufacturer requirements to display rated horsepower of the pump and total horsepower of the motor on all units as of January 1, 2008; and
- Also as of January 1, 2008, all pool pumps with capacities of 1 horsepower or greater must have a two-speed motor and automatic pump control system capable of controlling both high and low speeds separately.

Only 20 percent of the pool contractors interviewed in support of this Study were aware of the changing requirements prior to the interviews. Of those who were aware, only one knew any details. Many were quite upset upon hearing of the 2008 requirement that pool pumps with capacities of 1 horsepower or greater must have two-speed motors. Their chief concerns are that the change will lead to higher prices, consumer dissatisfaction, and other unspecified negative effects.

The majority of pool contractors felt the new labeling requirements (requiring pump and total motor horsepower on each unit) would have no effect on their companies. Nearly half stated the requirement might have a positive effect in reducing confusion and discouraging missing or misleading labeling.

Program Influence and Participant Satisfaction

Influences on Consumer Purchases of Program-Qualifying Equipment

Among Program participants who purchased their measures from a contractor, contractors had more influence on their purchase decision than other factors. Nearly 40 percent of participants reported their contractors were very influential in their purchase decision, almost twice the proportion of those who stated the rebate, Program, advertising materials, or salesperson were very influential.

HVAC equipment: Nearly 8 out of 10 HVAC equipment purchasers bought their equipment from a contractor. Of those, contractors told 4 of 5 about the rebate. Of the remaining (who bought their equipment from a retailer), most consulted with a salesperson about their purchase and two-thirds who did were informed about the rebate by the salesperson.

Programmable thermostats: In 2006, rebates for programmable thermostats were eliminated from the SFEER Program and other California energy-efficiency programs, partly because of prior evidence of high free-ridership and partly because of evidence that the measure was not being used as intended, with many users' behaviors negating the energy-efficiency benefits. Approximately half of programmable thermostats purchasers bought them in retail stores, while the other half purchased them directly from contractors.

- *Contractor installations*: More than 9 out of 10 of HVAC contractors reported that installing programmable thermostats is standard practice when installing a new central air conditioner or replacing a thermostat. Less than 10 percent of the contractors felt that the 2004/2005 Program rebate had any impact on their programmable thermostat sales. The majority also indicated that they "always" or "very often" override the thermostats' default settings to suit customer preferences and prevent callbacks, further supporting the Program planners' decision to eliminate programmable thermostats from the Program's portfolio of energy-efficiency measures.
- *Consumer installations*: Of those who purchased in stores, half consulted with salespeople regarding their purchase, and more than three-quarters indicated that the salesperson told them about the rebate Program and more than two-thirds indicated

that the salesperson told them about the thermostats' energy efficiency benefits. Of those who purchased their programmable thermostats from contractors, nearly two-thirds indicated that the contractors told them about the rebate Program and the same proportion reported that their contractors told them about the thermostats' energy efficiency benefits. Less than a third of programmable thermostat participants were aware of the rebate prior to deciding to purchase their thermostats.

Home improvement measures: Thirty-five percent of HEER participants who purchased home improvement measures (pool pumps, insulation, water heaters, windows, or programmable thermostats) bought them in retail stores, while the remainder purchased them directly from contractors. Among in-store purchasers, 3 out of 5 consulted with salespeople regarding their purchases, and two out of three indicated that the salesperson told them about the rebate Program. Of those who purchased their equipment from contractors, more than 2 out of 3 indicated that the contractors told them about the rebate Program and 85 percent reported that their contractors told them about the thermostats' energy efficiency benefits. The vast majority of these participants reported that they would have purchased the same measures in absence of the Program rebates. Less than half of home improvement measure participants who received rebates for windows, insulation, or pool pumps were aware of the rebates prior to deciding to purchase their equipment.

Appliances: Nearly all HEER participants who received rebates for appliances (clothes washers and dishwashers) bought them in retail stores (98%). Just under half of these reported having seen any in-store promotional materials (more than any other measure type). Nearly 9 out of 10 consulted with salespeople regarding their purchases, and three-quarters indicated that the salesperson told them about the rebate Program and/or their appliance's energy efficiency benefits. More than ninety percent of appliance participants reported that they would have purchased an energy-efficient clothes washer or dishwasher in absence of the Program rebates. Approximately 40 percent of participants who received clothes washer rebates were aware of the rebates prior to deciding to purchase their air conditioners.

Satisfaction with the Program

The vast majority of consumers and supply-side market actors (appliance dealers, HVAC contractors, and pool retailers/contractors) who participate in the Program are satisfied with the Program as a whole. However, a small proportion of HVAC contractors felt that Program staff could be more available, knowledgeable, and/or understanding of their needs. Pool contractors/retailers were more satisfied with their interactions with Program staff, but a far smaller proportion of pool retailers/contractors had any contact with Program staff than HVAC contractors or appliance dealers.

Participating customers are most satisfied with the Program as a whole as well as with their equipment and contractor (among those who purchased from contractors), and least satisfied with rebate turnaround time and savings on their utility bills.

Program Design

Program Support for Emerging HVAC Equipment
Interviews with participating HVAC contractors conducted in support of this Study indicate that less than a third of participating HVAC contractors currently install VSDs on their residential central air conditioners. By far, the greatest barrier to these installations is the high initial cost. More than two-thirds of participating contractors felt that the California utilities have encouraged greater use of VSDs, but nearly half of these contractors felt that the effects were small or limited in scope.

Nearly sixty percent of participating HVAC contractors install advanced two-stage evaporative coolers (AECs) in residential applications, but more than half of these contractors install them only "rarely." Participating contractors cited the energy-efficiency benefits of AECs and their low upfront costs compared with other cooling technologies, but on the downside felt that the technology is largely unable to remove humidity in extreme climates. Some also felt that installation of AECs was challenging, that they are aesthetically unpleasing, and that the profit margin is low for installers. Less than one-third felt that the California utilities have encouraged greater use of AECs.

Expansion of Point-of-Sale Rebates
Throughout its evolution, the Program has relied increasingly upon the point-of-sale (POS) delivery channel for incentives – particularly for lighting measures, but also for programmable thermostats and pool pumps as well as other HEER measures (such as clothes washers and whole house fans) on a more limited basis. The POS channel requires less of a financial investment for the Program than mail-in rebates because the incentive payment is streamlined (larger payments made to a small group of suppliers rather than smaller payments made to a large number of individual customers). However, the POS channel can create complications for some retailers – particularly smaller ones – because Program reporting requirements necessitate capture of line item detail (individual measure purchases) which may not be technologically feasible for some retailers. Additionally, the POS channel may lead to higher free-ridership rates since discounts are generally applied automatically, requiring no action (or even awareness) on the part of the consumer.

Despite the challenges posed by the POS channel, appliance dealers believe that Program staff needs to make a greater effort to enroll appliance dealers in the POS process. Approximately a third was unaware of its existence prior to the evaluation interviews.

Collecting POS Customer Data

The Program attempted to collect data on point-of-sale purchases (where no customer data are collected) by using nominal incentives to assist in collecting customer data. In 2004/2005, SCE utilized this approach to obtain contact information for programmable thermostat and pool pump POS participants. Customers would provide their contact information to the utility, and in return would receive a gift card for a nominal amount at a prominent retailer such as Starbucks. The evaluators obtained this information and used it to conduct surveys with POS purchasers. The data were useful to ensure that participants via all program delivery mechanisms were included in the evaluation. However, because of the large volume of measures the evaluators were unable to dedicate large enough sample sizes to make meaningful comparisons across POS versus non-POS groups by measure type.

Program Communications

Appliance dealers and HVAC contractors both expressed the feeling that the Program needs to improve communications regarding changes. Using a scale of 1 to 5 where 5 equaled "very easy" and 1 equaled "very difficult," the average HVAC contractor "easiness" rating was 3.4. Those HVAC contractors who had difficulty keeping up with Program changes cited general lack of communication from Program staff. A number of respondents said that they used to get "packets" or mailings from the utility but no longer receive these. HVAC contractors cited Program mailings as the most common way that they find out about program changes

Rebate Levels

Some HVAC contractors and pool retailers/contractors felt that the Program needs to increase (or restore) rebate levels. In 2006 SCE and SDG&E eliminated their central air conditioning rebates and many HVAC contractors pointed to this as a reason why they are not as involved in the program as they once had been. Pool contractors pointed to inadequate multi-speed pool pump rebates as a reason for not attending utility training classes promoting this technology. The low market penetration of multi-speed pumps among the participating pool contractors also indicates that rebate levels may be inadequate.

<u>Program Publicity</u>

Promotion of Energy-Efficient Products

The Program has in recent years prioritized incentives over marketing expenditures. While it has continued to use direct mail, utility websites and leveraging of trade ally relationships, direct consumer mass advertising is more limited. Instead, other programs that are part of the state's portfolio of energy efficiency programs have dedicated budgets for marketing and outreach (such as Flex Your Power and the Statewide Education and Training Program).

Nonetheless, the main channels through which 2004/2005 participants learned about the Program were through utility mass marketing (bill inserts, brochures, and other advertisements), retail salespeople or point-of-purchase materials, and contractors. Notably, consumers are increasingly made aware of the Program via the Internet – with 28 percent of participants obtaining applications on-line versus 21 percent in 2003 (a statistically significant change at the 90 percent level of confidence).

The main trade ally groups that the Program engages to promote the Program – HVAC contractors, retailers and pool contractors – have low satisfaction with Program marketing. In prior years, the Program emphasized regular visits to retailers to provide point-of-purchase materials, Program applications and updates on Program specification changes and timing of rebates. In recent years some utilities have done less of this. This may have contributed to low satisfaction levels for retailers. Contractors report seeing little or no Program marketing and would like to see an increase in direct consumer marketing.

Prior California IOU programs targeting the residential sector included retailer salesperson training on energy-efficient product specifications and how to promote energy-efficient products. Those services were discontinued after they were found to be ineffective due to high staff turnover and shifts in retail market (e.g., major chains no longer selling energy efficiency appliances). The IOUs continue to offer related training to contractors and others via their training centers, focusing mostly on technical matters such as changing codes and standards and basic and advanced building science. The research conducted in support of this evaluation indicates that the majority of trade allies that are engaged by the Program provide their employees with training on energy efficient products. Likewise, the majority of contractors and retailers differentiate energy-efficient products by using signage (retailers) and explaining the benefits to customers (contractors).

Marketing Support

As stated above, the Program is strategic with its marketing and does not spend substantial funds on consumer mass marketing. HVAC contractors and pool retailers/contractors both felt that the Program needs to improve/increase its marketing such that consumers would be more aware that rebates are available when they need new equipment.

<u>Program Impacts</u>

Measure Verification Rates are High Across all Measures

Onsite audits were able to verify that on average 97 percent of HEER measures were installed in the correct location and were Program qualifying. A number of units were unable to be confirmed as Program qualifying since they have since been discontinued (and thus we were unable to verify their parameters matching the Program qualifying specifications) and no lists of Program qualifying equipment were available for the 2004/2005 measures. The lowest levels of onsite measure verification were for the insulation and pool pump measures (91% and 93%, respectively). Verification issues for insulation surrounded the quantity of previously installed insulation and non-building envelope installations, and for pool pumps resulted from not making the Program required runtime reductions.

Ex Ante Gross Impacts are High and variable Across Utilities for Many Measures
Ex ante gross impact estimates for some measures are generally high and, thus, in some cases, the overall estimated ex ante energy savings are unrealistically large percentages of the customers' base consumption. In some cases the ex ante gross estimates are also drastically different from utility to utility. SCG, for instance, claimed ex ante electric savings for insulation installations that were 3.5 times higher than other utilities and gas savings that were 2.5 times than the other utilities. The billing analysis found that for SCG the expected ex ante savings for some customers made up nearly 80 percent of their base consumption.

Ex Ante Net-to-Gross Ratios are Likely High Given Current NTG Definition Rules
The ex ante NTG ratios assumed for HEER Program measures are likely high, taking values of either 0.8 or 0.89 for all HEER measures. Our estimated ex post NTG value for HEER (kWh) is 0.59 with measure-level values ranging from 0.41 to 0.81. Thus, our estimated value is roughly 0.25 less than the overall HEER ex ante value of 0.84. The NTG assumptions used for the SFEER program were likely based on Energy Efficiency Policy Manual, Version 2, which itself was largely based on an analysis in 2000 of net-to-gross ratios from evaluations conducted in the 1990s.[165] The 2000 NTG analysis recommended the use of a default NTG of 0.8 for programs that did not fall directly into the program categories included in the authors' analysis. The 2000 NTG analysis authors' caveated their results noting that NTG values from one era's programs and market conditions would not necessarily provide robust predictors for future programs and markets. This reflects that fact that many of the most important conditions in place during the 1990s-era evaluations have changed in ways that one would expect to result in different NTG ratios today. These include the characteristics of the measures themselves (including costs[166] and savings), market saturation, market penetration, consumer and supplier awareness and knowledge, and program features (including incentive levels and delivery mechanisms). In addition, it is possible that some of the NTG ratios in the 2000 analysis included spillover (both participant and non-participant).

Given these changes, it is not surprising that our estimates in this Study differ significantly from the ex ante values. In particular, it is important to keep in mind that some of the free-

[165] Proposed Net-to-Gross Ratios for PY2001 Program Elements, Report Issued Prior to Public Meeting, Response to Ordering Paragraph #7, Discussion Paper 1, Pacific Gas and Electric Company, Southern California Edison Company, San Diego Gas and Electric Company, Southern California Gas Company, September 5, 2000.

[166] For example, the incremental cost of low-e windows has decreased, and their availability and market share has increased, significantly since the late 1990s.

ridership observed in the 2004-2005 programs may actually be market effects induced by prior year programs. In this regard, although higher free-ridership has a negative association as it pertains to the marginal efficiency of programs in any program year, to the extent that the free-ridership, or a portion of it, is an effect of programs in prior years, it is a positive reflection of the longer term success of energy efficiency programs and policies in the state. Within the current scope and definitional requirements of NTG from the CPUC for this Study, any prior and current market effects result in reduction of program NTG ratios.

Lastly, several of the free-ridership estimates in this Study are based on self-reports, while a few measures' estimates based on our discrete choice analysis. There is some evidence, albeit limited and difficult to establish definitively, that self reported free-ridership estimates are generally biased downward. For example, a 2001 Study estimated a potential downward bias of roughly 0.1 for self reported free-ridership based on comparison of free-ridership estimates from studies that employed multiple methods.[167]

Evidence of Spillover Exists in the Market

There is evidence of both participant and non-participant spillover in the market based on our self-report and discrete choice analysis. These potential savings are not currently included as part of the total Net Program savings. In addition, we estimated non-participant spillover only as related to the 2004-2005 programs. Long term market effects could be more significant.

Gross and Net Realization Rates and NTG Ratios Vary Across Measures

Statewide gross realization rates across all measures were estimated to be 71 percent for kWh savings, 68 percent for kW savings, and 46 percent for Therm savings. NTG ratios were 62 percent for kWh and kW, and 65 percent for Therms. Final estimated Net RRs were estimated to be slightly higher than 50 percent for electric energy and demand savings (52% and 51%, respectively) and 37 percent for gas energy savings. These results are broken down by measure in Table 11-2. Associated measure specific impact findings are presented below.

[167] XENERGY and Ridge and Associates, 2001. *Improving the Standard Performance Contracting Program: an Examination of the Historical Evidence and Directions for the Future*, prepared by XENERGY Inc. and Ridge and Associates for Southern California Edison, November, 2001.

Table 11-2: Gross and Net Realization Rates and Net-to-Gross Ratios Across HEER Measures

HEER Measure	Percent of Savings				Gross Savings			Gross RR*			NTG Ratios						Net RR		
					ex ante			ex post			ex ante			ex post			ex post		
	Rebate $	kWh	kW	Thm	MWh	MW	Thm (MM)	kWh	kW	Thm	kWh	kW	Thm	kWh	kW	Thm	kWh	kW	Thm
Air Conditioners	13%	8%	17%	0%	6,254	11	0	136%	110%	-	84%	84%	-	67%	67%	-	108%	88%	-
Heat Pumps	1%	1%	1%	0%	569	1	0	100%	100%	-	84%	84%	-	55%	55%	-	66%	66%	-
Room AC	1%	1%	1%	0%	482	1	0	100%	100%	-	85%	85%	-	69%	69%	-	81%	81%	-
Insulation	10%	9%	11%	12%	6,632	8	2,025	92%	102%	36%	87%	86%	86%	70%	70%	70%	74%	83%	30%
Clothes Washer	34%	9%	1%	33%	7,060	1	6,034	102%	175%	65%	80%	80%	80%	81%	81%	81%	103%	177%	66%
Dishwasher	10%	6%	1%	8%	4,859	1	1,495	100%	100%	100%	80%	80%	80%	41%	41%	41%	51%	51%	51%
Furnace - Gas	10%	0%	0%	5%	0	0	871	-	-	92%	-	-	82%	-	-	52%	-	-	58%
Pool Pumps	4%	17%	17%	0%	13,420	11	0	48%	33%	-	81%	83%	-	69%	69%	-	41%	28%	-
Programmable Thermostats	5%	34%	30%	36%	25,395	21	6,270	46%	46%	10%	85%	81%	85%	49%	49%	49%	27%	28%	6%
Water Heater	1%	0%	0%	1%	74	0	204	100%	100%	100%	82%	81%	84%	58%	58%	58%	71%	72%	70%
Whole House Evap. Cooler	1%	3%	3%	0%	2,483	2	0	100%	100%	-	88%	88%	-	66%	66%	-	75%	76%	-
Whole House Fan	1%	3%	5%	0%	2,284	3	0	100%	100%	-	87%	87%	-	71%	71%	-	81%	82%	-
Windows	11%	9%	14%	5%	7,044	10	986	51%	51%	53%	83%	82%	80%	47%	47%	47%	29%	29%	31%
TOTAL	100%	100%	100%	100%	76,556	69	17,884	71%	68%	46%	83%	83%	82%	62%	62%	65%	52%	51%	37%

* Gross RR = 100% are based solely on results from onsite verification activities. No billing analysis or engineering modeling was done for these measures.

Measure Specific Impact Findings:

- **Central Air Conditioners** had higher ex post than ex ante gross savings as a result of the engineering analysis which estimated on average air conditioners rebated through the Program exceed their gross energy savings by between 10 and 36 percent. We hypothesize that this is driven by the climate zone distribution within PG&E service territory, however the workpapers do not thoroughly document the climate zone distribution their ex ante estimates are based upon. As mentioned elsewhere in this section, improvements made to the data elements captured in the tracking system would increase the level of accuracy in the impact result.
- **Insulation** program savings were heavily weighted to SCG participants. They made up 76 percent of the total ex ante kWh savings and 67 percent of the total ex ante Therm savings of the insulation program. As mentioned above, SCG claimed per unit kWh and Therm savings estimates that were 3.5 times and 2.5 times larger than those claimed by the other utilities. The billing analysis found only 55 percent of electric savings and 23 percent of gas savings for SCG which significantly drove down the estimated gross realization rates. Current workpapers do not include enough detail to shed light on the basis for these findings and thus we believe this should be an area of focus for the DEER team to determine what the appropriate savings estimates should be. As mentioned above the ex ante impacts are also very large relative to the RASS UEC for heating.
- **Clothes Washers** had higher ex post than ex ante electric savings results from the engineering analysis (which estimated greater than 100 percent of ex ante kWh and kW savings estimates), however this same estimated only 66 percent of the Therm savings were achieved. This low level of Therm savings was driven was partially driven by the increase in gas water heater efficiency levels in 2004 (to 60%). The discrete choice analysis resulted in a free-ridership estimate of 19 percent for clothes washers, translating to a NTG ratio of 81 percent, which was similar to the ex ante NTG ratio and thus had little effect on the ex post net RR.

- **Pool Pumps** savings ex post estimates were lower than Program ex ante based on our engineering analysis. These reductions resulted from changes to model assumptions regarding the Program-mandated runtime and horsepower reduction. The largest discrepancy between ex ante and ex post savings is with peak demand reduction (33%). The ex ante peak reduction of 1.07 kW/unit is high compared to the average prior power collected onsite (1.11 kW). Even if all of the baseline pool pumps were running throughout the peak period, it would be difficult to achieve such a demand reduction given the size of the baseline pumps.
- **Programmable Thermostats** were found to have both net and gross impacts that were lower than expected. Although the billing analysis found mild kWh savings (and very low Therm savings), these models were unstable and had relatively low levels of significance. Both the discrete choice and self-report net-to-gross analysis found approximately 50 percent of the program participants were free-riders. These analysis findings coincided with contractor interviews and customers' self-reports. HVAC Contractors indicated that they install ENERGY STAR programmable thermostats in nearly all their projects. Analysis of the participant and non-participant surveys found that only a small portion of the participants removed a manual thermostat and used the new programmable thermostat as it is intended to be used. In addition to this most customers reported that they would buy at least a Programmable thermostat, if not an ENERGY STAR programmable thermostat, in the absence of the Program. All of these findings lead to a belief that this market has been transformed and support the utilities' decision to drop this measure from the 2006/2008 rebate programs.
- **Windows** program savings came primarily from PG&E participants (69% of the statewide ex ante window kWh savings and 100% of the ex ante window Therm savings). The billing analysis found 51 percent of electric savings and 53 percent of gas savings for windows which indicates the ex ante savings estimates need to be reviewed (although the window program has been dropped from the 2006-2008 SFEER Program). This is another area that the DEER team should assess to come up with more accurate ex ante savings estimates.
- **Heat pumps, dishwashers, gas furnaces, and water heaters** ex post savings estimates are driven down as a result of the self-report based net-to-gross analysis. See previous discussion on net-to-gross.

Programmable Thermostat Realization Rates Significantly Pull Down Overall HEER Values

Programmable thermostats make up 31 percent of the ex ante gross kWh savings for the HEER component of the SFEER Program. They also make up 26 percent of the electric demand savings and 36 percent of gas energy savings. As Table 11-2 above shows Programmable Thermostats have the lowest net RR rates (27% for kWh, 28% for kW and 6% for Therms). These low net RR bring down the average for the HEER measures. The overall net RR for the HEER measures was recalculated with programmable thermostats removed and the resulting RR increased to 66 percent for kWh savings, 61 percent for kW savings, and 54 percent for Therm savings. Insulation was the other main factor driving down the net RR for Therms. When insulation and programmable thermostats were removed from the overall HEER average the net RR becomes 59 percent.

11.2.2 *Conclusions and Recommendations*

The general population continues to be aware of ways to save energy in their homes and is concerned about the environment and energy efficiency. In addition, the call to action generated from the energy crisis has not decreased dramatically with most households reporting that they regularly take actions to conserve energy. The Program relies on direct mail, IOU websites and its trade ally relationships to raise awareness of the Program. The Program is coordinated with other energy efficiency marketing and education programs such as Flex Your Power (which conducts mass consumer advertising) and the Statewide Education and Training Center (which offers contractors training on technical issues surrounding energy efficiency and informs them about rebate programs and specifications). As of 2005, the majority of Flex Your Power promotions occurred during the summer months and included lighting, air conditioning, and appliance measures only.

The trade ally groups with which the Program engages – retailers and contractors – believe the Program could do more to raise awareness among consumers about the Program and its energy efficiency products and rebates. Retailers in particular relied on regular visits from IOU representatives (typically third party contractors in the past) to provide them with rebate applications and update them on changing rebate levels and schedules. These visits have been deemphasized in recent years. Contractors periodically meet with the IOU Program staff and receive mail, fax and email notification of Program changes. However, they believe consumer awareness of the Program is low and they want the Program to do more to increase it.

- The Program may consider ramping back up its retailer support efforts, particularly for retail channels that sell products where it is difficult to meet goals. For retailers that primarily sell products where Program goals are met quickly, it is probably not necessary to increase support.
- The Program's bill inserts and online applications are effective at least for the products where goals are met. It may not make sense from a cost-effectiveness perspective for the Program to conduct mass consumer advertising to increase consumer awareness of the Program since many of its non-lighting measures are replace on burnout measures.
- Flex Your Power could be leveraged more effectively by tying it more directly to the Program. Flex Your Power should, if possible, conduct advertising on products for which the Program has trouble meeting goals, and attempt to return to a promotional schedule in which they time these promotions to correspond with IOU and national Program promotions.

Recent changes in Federal and state standards for energy efficiency equipment have, in general, not caused problems for equipment vendors, although changing pool pump standards may be a concern in the coming year. Many pool contractors were unaware of the upcoming standards changes. Likewise, few pool contractors were aware that the California utilities were offering education training events/demonstrations regarding high-efficiency pool pumps and there was significant skepticism among pool contractors about whether multi-speed pool pumps would perform as adequately as single-speed models. Finally, pool contractors reported that rebate levels were inadequate to overcome the higher costs of multi-speed pool pumps or encourage them to take training classes that covered the technology.

Based on these findings the evaluators recommend:

- Working with California pool contractor trade associations on the development of an educational campaign so that pool contractors in the state will be ready for the new standards.
- Increasing awareness of utility education and training opportunities for pool pump contractors.
- Increasing rebate levels for multi-speed pool pumps.

Some contractors (HVAC in particular) felt that the Program could do more to keep them informed about Program updates and that Program staff could generally be more available and knowledgeable. Trade allies would like to stay informed about changes in the program such as rebate levels, product specification changes and timing that rebates are available. Also, appliance dealers would like to be made aware of the point-of-sale rebate option.

- The Program should continue its outreach efforts to trade allies and consider increasing interactions with HVAC contractors and appliance dealers.

Significant cost and acceptance barriers remain for the greater use of variable speed drives (VSDs) and advanced evaporative coolers among HVAC contractors. Less than a third of HVAC contractors include VSDs with their CAC installations, and 85 percent felt that high initial cost was the greatest barrier to increased acceptance of VSDs. A larger proportion of the HVAC contractors reported that they installed advanced evaporative coolers, but most do so only rarely.

Based on these findings the evaluators recommend that the Program:

- Offer increased incentive levels, subject to cost-effectiveness considerations, for VSDs to overcome lingering cost barriers.
- Continue to offer financial incentives for advanced evaporative coolers and increase contractor education regarding this measure.

The collection of point-of-sale customer data using incentives combined with mail-back cards was useful in expanding the sample of participants included in the evaluation. The evaluation did not attempt to compare POS versus non-POS groups due to limited sample size. Future evaluations may be able to prioritize POS samples if that is a desired and high-priority objective.

- The IOUs should continue attempting to collect POS data using mail-back cards.
- The CPUC should determine during the next evaluation planning phase if it is desirable to compare POS versus non-POS participants, and if so, devote resources to oversampling on POS measures.

DEER Updates should utilize evaluation results to improve ex ante gross impact estimates. As noted previously, ex ante gross impact estimates for some measures appear to be generally high based on our evaluation results. The source of these estimates was not always clear from the workpapers. Sources may have included the 2001 DEER, 2004-2005 DEER, or non-DEER sources. In addition, IOUs may have used DEER differently, perhaps utilizing results for different segments or weighting the results across segments differently.

- To the extent feasible and appropriate, the current DEER Update should utilize the results in this evaluation Study, in conjunction with other updated sources, to further improve savings estimates and increase the consistency and transparency of user applications of DEER data.

Ex ante net-to-gross ratios also appear to be high given current CPUC NTG definition rules. Ex ante NTG ratios need to updated to reflect current market conditions and market effects that have occurred since the late 1990's when the current NTG assumptions were created.

- We recommend including NTG ratio updates as a key component in future SFEER evaluations. In addition, we recommend future evaluations also investigate the longer term market effects of these programs.

Retain Qualified Products Lists for Program years. When evaluations are conducted a year or more after the Programs have been implemented some models may have been discontinued thus making it difficult to look up the model specifications necessary to determine whether or not the rebated measure is Program qualifying.

Increase level of detail in Program workpapers. Workpapers would benefit from increased detail regarding the assumptions behind the ex ante savings estimates. For example, some workpapers provide limited information regarding assumptions and others reference personal e-mails. More thorough documentation is needed through the DEER effort to address these shortcomings.

Capture additional application data in tracking database. In order to facilitate future program evaluations, Itron recommends that the utilities modify their tracking database to capture data from paper rebate applications that is most relevant to the impact evaluations. Additional data needs include:

- **Recording and tracking of the ARI numbers of installed air conditioning systems** - The ARI number of the installed system uniquely identifies both the efficiency and cooling capacity of the system. The utilities should also include the SEER and cooling capacity ratings in the tracking system. For a split-system AC, the ARI number identifies a specific outdoor condenser unit and indoor evaporator coil combination. Although PG&E's database collects the make and model number of the outdoor unit in a split-system, the efficiency and capacity of the system also depends on the make and model of the indoor unit. The make and model of the indoor unit was not tracked in the PG&E database, or recorded on the application form. SCE collected various useful details (such as SEER, capacity and ARI reference numbers in a notes field) and SDG&E did not include any description of the installed units in their tracking systems. Unique variables should be used to track each individual parameter.
- **Collection of data on replaced equipment and the customers' home** - Energy impact estimates depend in part on the replaced equipment. Also, Itron believes that the utilities should explore the option of requesting certain pieces of demographic data in the rebate application. Data such as the floor area and vintage of the house, and the age of the equipment being replaced, would improve the accuracy of impact and savings estimates. Savings are different from impacts -- savings reflect the change in usage due to a given retrofit, while impacts reflect the expected change in usage relative to a program baseline. Billing regression estimates of savings, in particular, would be improved in many applications with additional information on the equipment being replaced. This information would need to be collected on the application, and entered into the database.