Itron
Knowledge to Shape Your Future

Electric / Gas / Water
information collection, analysis and application

2010-2012 CPUC HEES Impact Evaluation

Final Report

Prepared for:

California Public Utilities Commission

Prepared by:

Itron, Inc.
1111 Broadway, Suite 1800
Oakland, California 94607

(510) 844-2800

July 8, 2013

Table of Contents

Executive Summary

This report presents a summary of the results from the 2010-2012 CPUC impact evaluation of the Home Energy Efficiency Survey (HEES) program. The main goal of the HEES program is to identify energy efficient measures and practices, educate the customer, and promote cost effective energy efficiency projects. The HEES Program aims to provide valuable analysis of customer end-use systems, identification of energy efficiency opportunities, and economic information for customers to make investment decisions.

ES.1 Evaluation Goals and Objectives

The overarching goals of this impact evaluation of the statewide HEES Programs are to measure the gross and net impacts resulting from the residential[1] energy surveys; provide feedback on the appropriateness of the recommendations customers receive as a result of the survey; evaluate the effectiveness of the program in driving customers to participate in other utility energy efficiency incentive programs; and provide recommendations on how the HEES Programs can be further improved to support the IOUs' overall efficiency goals and objectives. Estimates of gross savings, free-ridership, and net savings (kWh, kW and Therms) will be provided by utility, recommendation category (measure or practice) and survey delivery method (mail or online), whenever possible. Due to the timing of the rollout of the new Universal Audit Tool (UAT[2]), as well as other evaluations focused on this new tool, this evaluation is focused solely on the non-UAT portion of the 2010-2012 HEES Program.

ES.2 Evaluation Methods and Data Collection Activities

The gross and net impact approach implemented for this evaluation of the 2010-2012 HEES program measured participant response to the HEES survey in terms of the adoption of efficient measures that lead to energy savings. Impacts were evaluated using two primary methods. The first was a self-report method which utilized HEES participant telephone survey data to measure the frequency of measure and practice adoptions (uptake) and self-reported influence of the HEES survey on those adoption decisions (attribution). The second method involved employing a billing regression model to quantitatively estimate net program impacts.

---

1 The scope of this study is limited to residential surveys only.

2 In SDG&E service territory the UAT is called ICEAT (Integrated Customer Energy Audit Tool) and was rolled out in May of 2012, in PG&E service territory the UAT is called PEAT (Progressive Energy Audit Tool) and was launched in November of 2011, and in SCE service territory the UAT is also called ICEAT and was rolled out in March of 2012.

These methods were supported by a combination of IOU program (both HEES and non-HEES) tracking data (to identify HEES participants and recommendation measure adoptions installed through other IOU energy efficiency programs), a HEES participant telephone survey (which was the basis for self-reported measure and practice adoption and attribution data), and multiple years of participant billing and weather data (for use in the regression models).

Table ES-1 below provides a summary of the data collection activities conducted as part of the impact evaluation of the HEES program. As this table shows, the primary data collection activities included analysis of program tracking data (for both the HEES Program and other IOU energy efficiency (EE) programs), billing data, weather data, Customer Information System (CIS) data, and Computer Assisted Telephone Interviews (CATI) conducted with HEES Program participants. Data collected during the CATI telephone surveys were essential in evaluating the program from both a process point of view and estimating self-reported gross and net savings parameters. The program tracking data (both HEES and from other EE programs), the billing data and the weather data were used within the regression modeling activities.

Table ES-1: Data Collection Activities

Data Collection Type	Sample Frame	Sample Size			Timing
		PG&E	SCE/SCG[3]	SDG&E	
Program Tracking Data	HEES Participants	86,225	SCE: 209,171	19,048	January 2010 – mid-to-end 2012[4]
	EE Participants	431,133	571,458 / 268,731	117,790	Through Q4 2011
Billing Data	HEES Sample and NP Matching Sample	NP: 773,727 PT: 61,943	NP: 1,655,050 PT: 139,286	NP: 88,135 PT: 7,277	PG&E (08-12) SDG&E (08-12) Edison (08-11)
Weather Data	CA IOU Territory	All CA Weather Stations			2008 - 2012
CIS Data	HEES Sample and NP Matching Sample	NP: 775,089 PT: 61,951	NP: 1,655,047 PT: 139,650	NP: 89,760 PT: 7,282	2012
CATI Phone Surveys	HEES Participants	Completes: 250	Completes: 501	Completes: 277	May - July 2012

ES.3 Impact Findings

ES.3.1 Results of the Self-Reported Uptake and Attribution Analysis

Table ES-2 through Table ES-5 below provide the results of the self-reported uptake and attribution analysis by recommendation category (measure and practice) and utility. This evaluation did not attempt to estimate gross and net kWh or Therm savings based on the self-

[3] The original HEES tracking data provided to the evaluation team from the SCE and SCG program implementers was nearly identical (95%+ match). The utility flag provided on the file was nonsensical. Due to the difficulty distinguishing SCE HEES participants from SCG HEES participants in this file and the large overlap between SCE and SCG customers, SCE and SCG were treated as one utility for the CATI phone surveys. For the billing analysis, SCG participants were excluded since the billing analysis was an electrical billing model only.

[4] Program tracking data contained participants from January 2010 through various end dates by IOU (PG&E - through April 2012, but very few after November 2011, SCE/SCG – through August 2012, SDG&E through July 2012).

reported uptake and attribution analysis, and thus this table presents gross and net estimates of the number of HEES recommendations implemented. Care was taken to insure that measure savings were not double counted between utility EE programs and the HEES program. Complete utility program tracking data from all EE programs was pulled and matched to the HEES participants to ensure that the gross estimated quantity of HEES recommendations implemented excludes those that received support from a utility EE program. The net estimated quantity of recommendations implemented is calculated by multiply the gross quantity of HEES recommendations implemented by the estimated program attribution score which is based on customers' self-reported program influence level on their resulting recommendation adoption. These results were based solely on self-reported adoptions of efficient equipment. No field inspections were completed as part of this evaluation. Such an effort would was outside the scope of the evaluation due to the expense of such an activity for a program that spans four IOUs and more than 50 recommended measure and practice efficiency upgrades.

Table ES-2 below provides estimates by IOU of the number of recommended measure end-use categories recalled. As this table shows overall recall rate across all measure categories was similar across utilities, ranging from a high of 55% for SCE/SCG participants to a low of 46% for PG&E participants (overall average measure recall was 49%). Lighting measures were recalled at the highest rates by participants at all three utilities (73% PG&E, 64% SCE/SCG and 75% SDG&E). Overall lighting measure recall was 68%. HVAC measure recommendations had the lowest levels of recall across all utilities (29%), whereas pool measures had the highest levels of recall overall (62%) after lighting. This table also shows that the distribution of measure recommendation categories given to participants varied by IOU. Hot Water and HVAC recommendations were the most common measure recommendation categories for PG&E participants, Lighting and Hot Water categories were the most common measure recommendation categories for SCE/SCG and SDG&E participants.

Table ES-2: Self-Reported Measure Recommendation Recall

Utility	Measure End-use Category	Recommendations Provided	Recall Rate	Recommendations Recalled
PG&E	Lighting	187,265	73%	136,436
	Pool	17,387	66%	11,544
	Hot Water	377,148	54%	202,656
	Building Envelope	78,874	47%	37,361
	Kitchen	63,855	43%	27,321
	Laundry	102,301	30%	30,918
	HVAC	283,934	22%	62,087
	PG&E Total	1,110,764	46%	508,324
SCE/SCG	Lighting	276,471	64%	177,034
	Pool	50,585	60%	30,402
	Building Envelope	2,715	51%	1,380
	Kitchen	75,502	49%	36,807
	HVAC	108,006	48%	51,651
	Laundry	10,922	44%	4,811
	Hot Water	111,036	42%	46,272
	SCE/SCG Total	635,236	55%	348,356
SDG&E	Lighting	18,809	75%	14,196
	Pool	1,427	60%	853
	Kitchen	6,733	57%	3,843
	Building Envelope	12,108	47%	5,709
	Hot Water	17,914	43%	7,614
	HVAC	10,054	42%	4,251
	Laundry	79	36%	29
	SDG&E Total	67,124	54%	36,495
Statewide Total		1,813,124	49%	893,175

Table ES-3 below provides estimates of the net number of measures installed as a result of the HEES program that received no utility sponsored incentive through another utility EE program. The results in this table have been sorted by utility and descending net implementation rate. These estimates were derived by applying the recall, uptake and attribution rates (determined based on self-report data collected during the CATI telephone surveys) to the number of recommendations given by each of the IOUs through the 2010-2012 HEES program[5]. As this table shows, across all IOUs approximate 129,000 recommended measures were implemented outside of utility EE programs and attributed to HEES program participation (out of 1.8 million measure recommendations given through HEES). This yields an overall net implementation rate of 7%. This net implementation rate was highest for SCE/SCG (9%), followed by SDG&E (7%) and PG&E (6%). Attribution of implemented measures to the HEES program was quite similar across IOUs, averaging 39% statewide. It was interesting to note that statewide the highest net implementation rate across measure recommendations was for Lighting and Hot Water measures (19% and 5%, respectively). The lowest net implementation rates were for Building Envelope, Laundry, and HVAC measure recommendation categories (each < 1.5%). The high level of Lighting and Hot Water measure implementation is likely due to the low cost associated with implementing these measure recommendation (lighting measures were primarily CFLs and motion sensors on indoor/outdoor lighting, and hot water measures included insulating water heaters and installing faucet aerators and low flow showerheads) as compared to the Building Envelope, Laundry, and HVAC measure categories that include significantly more expensive measure investments (such as replacing a heating or AC system, installing a whole house fan, insulation, or a new washer or dryer).

As mentioned above, survey respondents who indicated that they had received a rebate for the implementation of the recommended measure were not included in the HEES uptake rate (to avoid double counting these measure implementations with another utility EE program). The quantity of self-reported measure installations through another EE program was quite small (< 2% overall, 1% reporting installing measure before HEES and 1% reporting installing the measure after HEES) due to the fact that whenever possible measures installed through other EE programs were not included as prompted measure recommendations in the telephone survey as they had been removed during the data cleaning process that was completed prior to completing the survey (based on a comparison between the HEES program tracking data and the other utility EE program tracking data).

[5] Based on the final tracking data received by the evaluation team.

Table ES-3: Self-Reported Measure Recommendation Uptake and Attribution

Utility	Measure End-use	Estimated Uptake Rate[6]	Estimated Attribution Rate	Net Recommendations Implemented	Net Implementation Rate
PG&E	Lighting	80%	37%	40,270	22%
	Hot Water	18%	48%	17,671	5%
	Pool	12%	28%	391	2%
	Kitchen	8%	56%	1,262	2%
	HVAC	10%	62%	3,948	1%
	Building Envelope	4%	50%	692	1%
	Laundry	11%	23%	815	1%
	PG&E Total	32%	40%	65,049	6%
SCE/SCG	Lighting	72%	38%	48,212	17%
	Hot Water	31%	45%	6,544	6%
	Laundry	26%	45%	560	5%
	Pool	10%	30%	928	2%
	Kitchen	10%	31%	1,159	2%
	HVAC	5%	62%	1,565	1%
	Building Envelope	0%	0%	0	0%
	SCE/SCG Total	44%	39%	58,969	9%
SDG&E	Lighting	71%	35%	3,534	19%
	Hot Water	31%	45%	1,057	6%
	Laundry	22%	35%	2	3%
	Pool	11%	29%	27	2%
	Kitchen	12%	23%	105	2%
	Building Envelope	9%	36%	174	1%
	HVAC	5%	36%	84	1%
	SDG&E Total	37%	36%	4,984	7%
Statewide Total		37%	39%	129,003	7%

[6] The uptake rate presented here only included high efficiency measure installations that occurred after the respondent had taken the HEES survey.

Table ES-4 and Table ES-5 below provide similar results for the practice recommendation groupings. As Table ES-4 below shows, recall of practice recommendations was significantly higher than for measure recommendations (92% as compared to 49%). Efficient Cooling and Dishwashing practices were the most commonly recalled practice recommendations (96%), while efficient Refrigerator and Freezer practices were the least commonly recalled practice recommendations (87%). Overall these recall levels are extremely high which may result from these recommendations being more "common sense" in nature (i.e. things parents have been telling kids for years, turn off the lights when you are not in a room, raise your thermostat setting when the house is unoccupied, and air dry dishes), and thus survey respondents may report a higher recall of these energy saving practices.

Table ES-4: Self-Reported Practice Recommendation Recall by IOU

Utility	Practice Category End-use	Recommendations Provided	Recall Rate	Recommendations Recalled
PG&E	Efficient Pool and Spa Practices	56,816	96%	54,543
	Efficient Dishwashing Practices	102,683	96%	98,085
	Efficient Clothes Washing Practices	15,923	95%	15,206
	Efficient Cooling Tips	153,306	94%	143,520
	Efficient Building Envelope Practices	153,944	90%	139,105
	Efficient Water Heater Practices	185,617	90%	167,655
	Efficient Clothes Drying Practices	143,141	88%	125,964
	Efficient Refrigerator and Freezer Practices	253,771	87%	220,956
	Other Practices	75,957	85%	64,563
	Efficient Home Heating Practices	195,492	80%	157,244
	Efficient Lighting Practices	7,494	50%	3,747
	PG&E Total	1,344,144	89%	1,190,589
SCE/SCG	Efficient Dishwashing Practices	31,764	98%	31,248
	Efficient Clothes Drying Practices	158,391	98%	154,885
	Efficient Cooling Tips	252,723	98%	246,713
	Efficient Home Heating Practices	304,556	97%	294,208
	Efficient Clothes Washing Practices	145,377	95%	138,641
	Efficient Building Envelope Practices	155,663	95%	148,019
	Efficient Lighting Practices	205,006	95%	193,996
	Efficient Pool and Spa Practices	51,757	94%	48,746
	Efficient Water Heater Practices	133,132	94%	124,526
	Other Practices	9,634	88%	8,445
	SCE/SCG Total	1,448,005	96%	1,389,427
SDG&E	Efficient Dishwashing Practices	10,029	97%	9,775
	Efficient Cooling Tips	11,054	97%	10,723
	Efficient Clothes Washing Practices	14,159	96%	13,661
	Efficient Clothes Drying Practices	3,488	96%	3,357
	Efficient Water Heater Practices	9,326	93%	8,641

Utility	Practice Category End-use	Recommendations Provided	Recall Rate	Recommendations Recalled
	Efficient Building Envelope Practices	18,296	92%	16,913
	Other Practices	13,014	92%	12,013
	Efficient Pool and Spa Practices	3,769	92%	3,462
	Efficient Refrigerator and Freezer Practices	8,841	90%	7,944
	Efficient Lighting Practices	90	89%	80
	Efficient Home Heating Practices	14,396	87%	12,491
	SDG&E Total	106,462	93%	99,061
Statewide	Total	2,898,611	92%	2,679,077

Table ES-5 below provides estimates of the net number of practice recommendations implemented as a result of the HEES program (sorted by the net implementation rate). These estimates were again derived by applying the recall, uptake and attribution rates (determined based on self-report data collected during the CATI phone surveys) to the number of practice recommendations given by each of the IOUs through the 2010-2012 HEES program[7]. As this table shows across all IOUs approximate 325,000 recommended practices were implemented and attributed to HEES program participation (out of 3 million practice recommendations given through HEES). This results in a net practice measure implementation rate of 11%.

Net practice implementation rates were 11% across all of the utilities. Similarly, uptake and attribution also were very closely aligned in each of the service territories. Statewide the highest net implementation rate across practice recommendations was Efficient Refrigerator and Freezer Practices (19%), followed by Efficient Water Heater Practices (18%). The lowest net implementation rates were for Efficient Cooling and Lighting Practices (both around 8%). It is somewhat surprising that lighting practices had such low implementation rates considering lighting measures had the highest net implementation rates. The low net implementation rate for lighting practices was primarily driven by the low level of reported uptake (13% versus 19% across all measures). HEES program attribution and recall of Lighting Practice recommendations were close to the statewide mean rate across all practice categories. Common Lighting Practice recommendations were to replace halogen torchiere's and to use timers to switch lights on and off at preset times.

It is interesting to note that while practice recommendations were recalled more frequently than measure recommendations (92% vs. 49%), recalled measure recommendations were reportedly

[7] Based on the final tracking data received by the evaluation team.

installed (uptake) more often than recalled practice recommendations (37% vs. 19%). As a result the two types of recommendations (measure and practice) had virtually the same "net uptake" (that is the uptake rate out of all recommendation given, net uptake = recall * uptake), 18% versus 17%. The difference between the two types of recommendations lies between whether a participant self-reported that they recalled the receiving recommendation or did not recall receiving the recommendation.

Table ES-5: Self-Reported Practice Recommendation Uptake and Attribution

Utility	Practice Category End-use	Estimated Uptake Rate	Estimated Attribution Rate	Net Recs Implemented	Net Implmnt Rate
PG&E	Eff. Refrigerator and Freezer Practices	30%	77%	50,524	20%
	Efficient Water Heater Practices	21%	69%	23,862	13%
	Other Practices	35%	39%	8,925	12%
	Efficient Clothes Washing Practices	21%	56%	1,804	11%
	Efficient Pool and Spa Practices	17%	70%	6,364	11%
	Efficient Clothes Drying Practices	20%	58%	15,035	11%
	Efficient Building Envelope Practices	19%	53%	13,633	9%
	Efficient Home Heating Practices	14%	73%	15,512	8%
	Efficient Dishwashing Practices	16%	53%	8,046	8%
	Efficient Cooling Tips	11%	51%	8,318	5%
	Efficient Lighting Practices	13%	40%	187	3%
	PG&E Total	20%	63%	152,210	11%
SCE/SCG	Efficient Water Heater Practices	36%	72%	32,669	25%
	Efficient Building Envelope Practices	25%	60%	22,343	14%
	Other Practices	29%	45%	1,093	11%
	Efficient Dishwashing Practices	15%	74%	3,569	11%
	Efficient Clothes Washing Practices	21%	56%	16,222	11%
	Efficient Home Heating Practices	17%	63%	32,018	11%
	Efficient Cooling Tips	16%	61%	24,183	10%
	Efficient Lighting Practices	13%	64%	16,082	8%
	Efficient Clothes Drying Practices	12%	61%	11,262	7%
	Efficient Pool and Spa Practices	9%	56%	2,563	5%
	SCE/SCG Total	19%	63%	162,003	11%
SDG&E	Efficient Pool and Spa Practices	36%	86%	1,084	29%
	Efficient Water Heater Practices	32%	60%	1,645	18%
	Efficient Clothes Washing Practices	22%	70%	2,077	15%
	Efficient Dishwashing Practices	23%	55%	1,223	12%

Utility	Practice Category End-use	Estimated Uptake Rate	Estimated Attribution Rate	Net Recs Implemented	Net Implmnt Rate
	Other Practices	19%	61%	1,383	11%
	Efficient Building Envelope Practices	22%	52%	1,927	11%
	Efficient Cooling Tips	15%	60%	989	9%
	Efficient Clothes Drying Practices	13%	60%	268	8%
	Efficient Lighting Practices	13%	62%	6	7%
	Efficient Home Heating Practices	7%	56%	488	3%
	Eff. Refrigerator and Freezer Practices	6%	51%	263	3%
	SDG&E Total	19%	61%	11,351	11%
Statewide Total		19%	63%	325,564	11%

ES.3.2 Regression Based HEES Net Impact Results

Table ES-6 below summarizes the net HEES per participant savings estimates from the regression-based impact analysis assessment. These results are based on the model specification that incorporated dummy variables (as opposed to ex ante savings estimates) to control for the impacts resulting from other utility energy efficiency programs[8]. As this table shows, HEES online program participants in PG&E and SDG&E service territory decreased their usage in the first year post-HEES survey by an average of 316 kWh and 294 kWh (both 3.1%), respectively. For Edison, the on-site and telephone surveys had the highest influence, with participants decreasing their usage by 528 kWh (5.6%) and 720 kWh (6.5%), respectively net of the savings due to other program support. The reduction in energy use resulting from Edison's mail-in surveys was smaller at 210 kWh (2.1%) and the online surveys led to the smallest reduction in energy use (53 kWh, or 0.7%, for the long online survey and no significant savings resulting from the short online survey).

[8] Five dummy variables were included to represent the various measure types installed through other EE programs (HVAC, Lighting, Refrigerator, Water Heater, and Other)

Table ES-6: Regression-based Estimates of First Year Net per Participant HEES Impacts

Utility	Delivery Method	Average Monthly Usage		1st-Year Net HEES Per Participant Impacts	
		Pre-HEES	Post-HEES	kWh	% Savings
PG&E	Online	841	811	316	3.1%
SDG&E	Online	782	749	294	3.1%
Edison	On-site	791	724	528	5.6%
	Telephone	930	874	720	6.5%
	Mail-In	838	800	210	2.1%
	Long Online	628	613	53	0.7%
	Short Online	486	474	0	0.0%
	Average	742	714	152	1.7%

As the table above shows, the regression-based first year net HEES impact estimates varied significantly by delivery method (for Edison, the only utility that had substantial enough populations participants across the delivery methods other than online). The evaluation team believes the increased savings from the on-site, telephone, and mail surveys are attributable to two inter-related factors. The first factor is the higher than average pre-HEES average monthly usage. As the table above shows, Edison customers who took the HEES survey via telephone had pre-HEES usage that was 50% larger than those who took the long online survey. Similarly, on-site and mail-in survey participants had pre-HEES usage that was 25% and 33% larger, respectively. The second factor is the targeting that was done to drive customers to the on-site, telephone and mail surveys. These survey delivery methods were typically delivered to customers who either complained of high bills (and thus may have more incentive to take action to reduce their monthly bills) or were identified as hard-to-reach[9] and who likely had higher levels of achievable savings.

The table above also shows that savings from the online surveys (long online for SCE) were quite similar for PG&E and SDG&E, but significantly lower for SCE. Again, the evaluation team believes much of this difference can be attributed to the marketing done by SCE that drives higher usage customers to the mail, telephone or on-site delivery options. By proactively

[9] SDG&E partnered with the County of San Diego's Land Use Department to proactively reach hard-to-reach customers in San Diego (the County of San Diego was responsible for the selection of customers who received the mail-in survey). In addition to mailing HEES surveys to high use customer, SCE/SCG did some mailing jointly with specific water agencies (San Gabriel Valley Water, Golden State Water), as well as mailings to the homes of school children as part of the schools direct mail campaign.

marketing the other delivery options to these customers they have effectively removed the high usage (and likely high savings) customers from the population of customer taking the online survey.

The PG&E regression based net savings estimate are significantly higher than those found for PG&E for the 2006-08 program cycle. The revised 2006-08 evaluation report[10] estimated net HEES per participant savings (across the mail and online delivery methods offered) to be 31 kWh. This estimate was based on a gross energy savings of 241 kWh per participant and a net attribution rate of 12.7%. While both the recommendation algorithms and the average of number of recommendations given per survey remained fairly consistent between the two program cycles for PG&E, there were a number of differences between the program cycles and the evaluation methods used which may have resulted in the differences in the estimated net program impacts. These differences included the following:

- Significantly Different Model Baseline Usage Estimation – The 2006–08 model was a participant only billing analysis, whereas the 2010-2012 used a matched non-participant sample to control for changes (weather, economy, etc.) unrelated to the HEES program.
- Different Model Specifications were Used
- Different Delivery Methods Offered – The 2006-08 HEES program was delivered both on-line and via the mail, whereas the most recent program cycle was only offered online.

The 2010-2012 regression based net savings estimate found for SCE were closely aligned with the net savings impacts the ex ante net HEES savings estimates[11] used within the 2010-12 program cycle to assign program impacts. As shown in Table ES -7 below, the savings estimates for mail–in surveys, the largest survey type in the 2010-12 cycle, were nearly identical (ex ante savings estimate of 212 kWh per survey versus the evaluation estimated savings of 210 kWh per survey). The current evaluation savings estimates for the other survey types were all larger than the ex ante estimates. Applying the evaluation savings estimates to the population of 2010-12 participants yields results in an overall net savings estimate that is 7% higher than the savings based on the ex ante estimates.

[10] *Addendum to the Process Evaluation of the 2006-08 HEES program: Estimating Energy Savings Associated with the HEES Program, Net of Savings Attributed to other PG&E Programs (REVISED APRIL 13, 2011)*, ECONorthwest, December 15, 2010.

[11] SCE's ex ante HEES savings estimates are based on work completed by John Peterson of Athens Research and are documented in a Memo titled "Memo on HEES 2004-2005 savings analysis: dated September 7, 2007.

Table ES -7: Comparison of SCE Ex Ante and Current Evaluation per Unit Net Savings Estimates

Survey Type	2010-12 Participants	Ex Ante (kWh)	2010-12 Estimate (kWh)
Online Short	17,538	0	0
Online Long	64,501	36.7	53
Mail-In	122,442	211.8	210
Telephone	1,140	281.8	720
On-site	3,550	314.7	528

Table ES-8 below shows the first-year regression-based net HEES impacts based on the evaluation findings. As this table shows the overall HEES impact is nearly 65,000 MWh, of which nearly 50% was generated from the SCE program, 42% from PG&E's program and the remaining 9% from SDG&E's program.

Table ES-8: Regression-based Estimates of Overall First-Year Net HEES Impacts[12]

Utility	Delivery Method	2010-2012 Participants	First-Year Net[13] HEES Impact		
			Per/Participant (kWh)	Total (MWh)	% of Statewide Total
PG&E	Online	86,255	316	27,257	42%
SDG&E	Online	19,048	294	5,600	9%
Edison	On-site	3,550	528	1,874	3%
	Telephone	1,140	720	821	1%
	Mail-In	122,442	210	25,713	40%
	Long Online	64,501	53	3,419	5%
	Short Online	17,538	0	0	0%
	Average	209,171	152	31,827	49%
Statewide	Total	314,474	206	64,683	100%

[12] These net impacts are based on the final tracking dataset we received from the IOUs. Any additional 2010-2012 HEES surveys that occurred after the final datasets were received from the IOUs are not included in these savings estimates but can be easily incorporated if the IOU and delivery method are known.

[13] These net savings estimates are based on the regression billing analysis using the PSM selected non-participant sample. The evaluation teams views the PSM method as the best available method (in the absence of an experimental design derived non-participant sample) to control for energy savings actions that are non-induced by the HEES program.

ES.4 Process Findings

HEES Process related findings are provided below.

- **Sources of HEES Awareness** - Utility bill inserts and utility websites were the most common sources of initial program awareness among HEES program participants (64% across all HEES programs statewide). Website's were more frequently the primary source of HEES awareness for online HEES survey participants, while bill inserts were more often the primary source of awareness for HEES mail survey participants. Utility mailings and emails were also reported as significant sources of initial program awareness (18%). The California Solar Initiative (CSI) Program was reported to be a more significant source of program awareness for SDG&E participants than for participants at other utilities (24% at SDG&E, compared to 5% statewide). This is likely a result of the significantly smaller HEES program within SDG&E service territory (<20,000 surveys completed in SDG&E versus 86,000 and 210,000 participants at PG&E and SCE between January 2010 and mid-2012) and thus a larger proportion of participants were driven to HEES by the CSI program requirement[14].
- **Reasons for HEES Participation** – Saving money and high energy bills were reported as the largest motivational factors for taking the HEES survey (53% statewide). Other frequently reported motivational factors were a simple curiosity about the HEES program and the energy saving opportunities that exist for one's home, a concern for the environment, a desire to save energy and to obtain an incentive being offered for completing a survey. No customers self-reported health[15] as a motivational factor for participating in the HEES program.
- **Satisfaction with and Usefulness of HEES Recommendations** – Overall, participants reported being satisfied with both the energy savings recommendations they received through the HEES program and the energy savings generated as a result of the implementation of these recommendations (mean satisfaction scores of 6.9 and 7.0, respectively, on a zero to 10 scale). In service territories offering both mail and online surveys, online survey satisfaction was notably higher with respect to both recommendations and energy savings. The primary reasons expressed by telephone survey respondents for their dissatisfaction with the HEES program was that they had not achieved any noticeable energy savings as a result of implementing HEES recommendations, and that the HEES recommendations were too generic and/or needed more detailed information (such as pay-back period). Many participants voiced their desire for follow-up activity post HEES-survey to help them with recommendation implementation (including monetary assistance), which we believe will be improved with

[14] A requirement of the CSI program is to complete a HEES survey for one's residence.

[15] Health was not provided as a prompted response to any questions.

the move to the Universal Audit Tool. It is also interesting to note that while PG&E's HEES program provided, on average, nearly three times the number of recommendations to participants (28 versus approximately 10), PG&E participants reported only slightly lower than average rankings of usefulness and satisfaction (mean usefulness ranking of 6.4 for PG&E versus 6.9 statewide and mean satisfaction ranking of 6.6 for PG&E versus 7.0 statewide).

- **Similarity of HEES Recommendations from Previous Program Cycle –** Comparison made between the current program cycle (2010-12) and the previous cycle (2006-08) for PG&E and SCE (based on 2006-08 HEES Process Evaluation Reports[16]) with respect to the recommendations provided to program participants found many similarities. These included similar volumes of recommendations provided to PG&E participants per survey (28.5 vs. 30), continued high levels of satisfaction reported with the recommendations provided and the savings these recommendations generated, and that low-cost or no-cost practice recommendations were implemented at higher rates than measure recommendations.
- **HEES Survey Delivery Method Selection** - During the 2010-2012 program cycle, 58% of HEES surveys were completed online, 41% were completed via the mail, and the remaining one percent was completed either in-home or via the telephone. Statewide, less than one-third of respondents who completed a HEES mail survey were aware of the online survey option. The majority of respondents (61%) who were aware of the online survey reported taking the mail survey because it was more convenient or the preferred format. An additional 20% reported taking the mail survey for internet reasons (lack of internet access, reluctance to share personal information online, or not internet savvy). This is an important finding for utilities to keep in mind as they transition to the online UAT to avoid failing to reach large proportions of customers who have historically taken mail surveys. Ensuring appropriate UAT marketing materials directed towards the typical mail survey respondents may help increase awareness and usage of the online tool within this population. While the population of customers reporting they are unable or unwilling to complete the survey via the internet is small (about 6% of all mail survey respondents), the IOUs will need to ensure these customers are still being reached.
- **Smart Grid Enabled Program Participation** – Overall, 15% of PG&E and SCE/SCG telephone survey respondents reported they had signed up to receive the energy alerts/budget notifications offered by their utility to assist them in managing their household energy consumption. As expected, respondents who had completed the HEES survey online were significantly more likely to sign up for energy alerts than those who completed the HEES survey via mail (22% versus 7%, respectively). Two-thirds of those who signed up for energy alerts stated they did so on a date after their HEES survey date,

[16] No comparisons were completed for SDG&E as a 2006-08 HEES evaluation report did not contain data for comparison.

10% did so on a date prior to their HEES survey date, and the remaining were unsure of when they signed up for the energy alert. Thirty-eight percent of respondents reported that someone in their household had utilized the online energy summaries on their utilities website to track their household energy usage. Again, online HEES participants were much more likely to do so (53% of online HEES participants versus 13% of mail HEES participants). The frequency with which customers checked their online energy summaries varied widely with 31% reporting they did so less than once a month, 45% reporting did so approximately once a month, and 21% reporting they did so more than once a month.

- **CARE Programs** – According to telephone survey data, 29% of SCE/SCG HEES participants who received a recommendation to contact their utility to see if they qualified for the CARE program, did in fact do so. Amongst those who followed up, 50% reported signing up for the CARE program, 43% reported they were not eligible for CARE, and 7% reported they were not interested in CARE after hearing more about it. Overall, 15% of survey respondents who received the CARE recommendation reported signing up for it, although more HEES online respondents did so (24%) than HEES mail respondents (6%).

ES.5 Recommendations

Recommendations for residential energy survey program improvements are provided below.

- **Improved Program Tracking Data** – Currently cleaning HEES recommendation data is a very manual and laborious task, as there are very limited naming conventions and few meaningful recommendation descriptor variables, making a manual review of the entire recommendation text a necessity. Including variables that categorized recommendations into type, such as measure or practice, and end-use, such as HVAC, lighting, or water heating would be a first step. Additionally, ensuring consistent account numbers were included in the HEES tracking data that would allow for a reliable linking to CIS and billing data would greatly assist evaluation efforts.
- **Continuation of Mail Surveys to Non-Internet Savvy Customers –** The UAT program that is currently being rolled out to replace HEES is strictly an opt-in program that is currently delivered exclusively online[17][18]. The research conducted as part of this evaluation indicates there is a group of customers (around 6%) who completed the HEES survey via the mail who reported that they were either unwilling or unable to complete a home energy survey via the internet (either they did not have internet access, they were

[17] According to the team conducting the WO027 UAT evaluation.

[18] SCE has indicated that they will be working with a third party vendor to provide audits similar to those provided by the UAT through the mail.

reluctant to share personal information online, they had a slow internet connection, or they were not internet savvy). The evaluation team believes it is important that these customers not be overlooked in the transition to the UAT. Along this same line, utilities should investigate whether there are any effective, low-cost means of engaging these non-internet using customers with quasi-real-time alerts (similar to the online alerts they currently offer) to aid them in reducing their energy consumption.

- **Increased Customization of HEES Recommendations** – Less generic, more customized HEES recommendations (including information on estimated pay-back period associated with recommended energy efficiency upgrades) would increase the value participants receive from the HEES surveys. The evaluation team believes that the move to the UAT will allow for such customization and thus will improve the perceived value of such surveys.
- **Include Health-Based Messaging with HEES Recommendations** – Consider providing health-based information along with the HEES recommendations as current research[19] observed that targeted health-based messaging to certain demographic populations (for instance those with young kids) resulted in more long-term energy reductions than recommendations focused solely on the monetary savings generated from taking energy efficiency actions.
- **Follow-up Post HEES Survey** – Following-up with HEES participants a short-time after they have received the survey recommendations will ensure they did in fact receive the HEES recommendations (~2% reported they never received the recommendations), as well provide additional encouragement or assistance in implementation one or more of HEES recommendations.

[19] Delmas, Magali and Bill Kaiser. "Engage UCLA Behavioral Responses to Real-Time Individual Energy Usage Information: A Large Scale Experiment" (Summary). Funded by CA ARB (10-322:1).

1

Introduction

The Work Order for which this document has been produced (WO36) is dedicated to the study of the impacts associated with the Home Energy Efficiency Survey (HEES) Programs delivered through California's portfolio of energy efficiency programs. The impact evaluation findings for the four California Inventor-Owned (IOU's) utilities are presented in this report along with a series of process related findings such as participants' sources of HEES awareness, satisfaction with HEES recommendations and resulting energy savings, and usage of other IOU provided energy management assistance tools.

1.1 Background

This work was originally given a high priority rating (Rating A) because the provision of customized energy recommendations are of particular interest in the pursuit of deep energy efficiency retrofits as well as integrated solutions. For these reasons energy surveys are of high interest for strategic planning and future program efforts. Furthermore, there has been a long standing debate over whether surveys have energy savings, how much savings they have, and how those savings can be measured.

The goal of residential energy surveys is to identify energy efficient (EE) measures and practices, educate the customer, and promote cost effective energy efficiency projects. The HEES Program aims to provide valuable analysis of customer end-use systems, identification of EE opportunities, and economic information for customers to make investment decisions. HEES is also a conduit for increasing participation in other IOU EE incentive programs, providing direct support for and coordination with these programs. The impact of energy surveys is tightly bound to both the content and the delivery of energy information and recommendations. In order to create energy impacts, the HEES Programs must effectively communicate energy information and advice. Therefore the unique characteristics of program design and structures are an essential driver to the resulting energy survey savings.

1.2 Budget and Expenditures for the Statewide HEES Program

Table 1-1 below presents information on the HEES budget, expenditures, and projected and installed impacts through September 2012 by utility, and as a percent of the 2010-2012 statewide

program cycle total. The statewide budget for HEES was 1.12%[20] of the total portfolio budget and the projected HEES energy impact was 0.22%[21]. This projected and installed impact is based entirely on claimed savings from SCE no other utilities have claimed impacts from the HEES Program within this current program cycle[22]. As the table below shows, while all IOUs have stayed within their HEES Program budget for the 2010-2012 program cycle (as of September 2012), SDG&E's budget is close to being exhausted and PG&E has more than $6 million remaining.

Table 1-1: Statewide HEES Budget and Expenditure to Date[23]

Utility	Program Cycle Budget	Expenditures To Date	% Spent to Date	Projected Impact (MWh)	Installed Impact To Date (MWh)
PG&E	$26,055,654[24]	$19,961,950	77%	0	0
SCE	$8,470,911	$7,375,497	87%	22,086	42,384
SCG	$2,378,112	$1,954,075	82%	0	0
SDG&E	$2,262,780	$2,219,264	98%	0	0
Statewide	$39,167,457	$31,510,786	80%	22,086	42,384
% of Total 2010-12 Statewide Cycle	1.12%	1.22%	74%	0.22%	0.44%

1.3 Program Description

The HEES Program offers tailored home energy surveys to residential IOU customers. These surveys start by collecting customer-specific home information, including an equipment inventory and usage history, and then use this data to make home-specific energy conservation recommendations presented to the customer in a formal report. This survey report outlines

[20] The program budgets were revised in January 2012, resulting in larger HEES budgets for PG&E, SCE, and SDG&E.

[21] HEES programs statewide did not project any Therm savings for the 2010-2012 cycle.

[22] The SCE claimed savings are assigned by HEES program delivery method (mail, phone, online or in-home) and have no correlation to the recommendations provided to the customer through the survey. They range from a low of 37 kWh for the 15-minute online survey to a high of 315 kWh for the in-home survey. No savings are claimed for the 5-minute online survey. These savings estimates are based on research conducted by Athens Research on the 2004-2005 HEES Program.

[23] Program budgets and program expenditures to date were found in IOU's Monthly Energy Efficiency Report for September 2012 on the California Energy Efficiency Groupware Application (http://eega.cpuc.ca.gov/)

[24] According to PG&E their program budget included other initiative such as work with OPOWER and investigation and launch of programs centered on behavioral outreach (i.e. Home Energy Reports).

potential energy (kWh and Therms) and dollar savings resulting from the implementation of recommended measures (equipment) or practices (changes in behavior) and provides referrals to IOU EE incentive programs to assist with the implementation of these recommendations. The surveys are offered in various formats including online, telephone, mail, or in-home, with the majority of PG&E and SDG&E customers using the online tool, and the majority of SCE/SCG taking the mail survey.

As part of the HEES program, SCE, SCG and SDG&E provided Home Energy Kits to a portion of the HEES survey participants[25]. The free measures included in the kit were one or two CFLs, an LED night light, a low-flow showerhead, and 3 faucet aerators. SCE stopped distributing these kits as of mid-2011; however SCG began distributing similar kits via direct mail in joint partnership with two southern California water agencies around that same time.

Throughout the course of 2012, a new online tool called the Universal Audit Tool (UAT) has been rolled out across the four IOUs[26] and will eventually replace all surveys currently offered to residential customers. The new tool will have a central database that will store energy survey recommendations, energy savings calculations and customer survey information. One objective of the UAT is to provide integrated solutions that include energy efficiency, demand response and distributed generation options for customers. It will also establish energy consumption benchmarks for customers to assess their relative efficiency and potential. The new structures are designed with the objective of improved data management and reporting through greater uniformity of information and presentation. An evaluation of the new UAT is being conducted under WO027.

1.3.1 Program Delivery

The 2010-2012 HEES Program is currently offered to residential customers via multiple delivery methods including online, telephone, mail, and in-home.

Table 1-2 below provides the distribution of HEES surveys by delivery method based on the most recent HEES tracking data provided to the evaluation team[27]. As this table shows, statewide the most common HEES survey method is online (58%), followed by mail surveys (41%). This HEES evaluation focused primarily on online and mail surveys as they made up 99% of the HEES surveys in the 2010-2012 program cycle. Whenever possible, evaluation results are presented by survey delivery method.

---

25 Energy Kits were not offered to SCE customers who completed the short 5-minute online survey.

26 Dates of UAT rollouts were November 2011 for PG&E, March of 2012 for SCE and May of 2012 for SDG&E.

27 The final HEES tracking database from PG&E contained HEES surveys with report dates from January 2010 through April 2012 (however there were very few surveys completed after November 2011). The SCE/SCG tracking database contained surveys completed between January 2010 and early August 2012, and the SDG&E tracking database contained surveys that occurred between January 2010 and July 2012.

Table 1-2: Distribution of HEES Surveys Across Delivery Method

Utility	Delivery Method				
	Online	Mail	Telephone	In-Home	Total
PG&E	86,255	-	-	-	86,255
SCE/SCG	82,039	122,442	1,140	3,550	209,171
SDG&E	12,841	6,207	-	-	19,048
Total	181,135	128,649	1,140	3,550	314,474

1.3.2 Program Timeline

HEES programs were in full-swing at the onset of the 2010-2012 program cycle (January 2010). The three figures below show graphs of the number of HEES surveys completed for each of the IOUs by month and delivery method. Figure 1-1 shows that PG&E had a consistently high volume of HEES surveys completed online throughout all of 2010. This figure also shows the complete drop-off of online HEES surveys in November 2011 when PG&E transitioned to the UAT.

Figure 1-1: Distribution of PG&E HEES Online Surveys

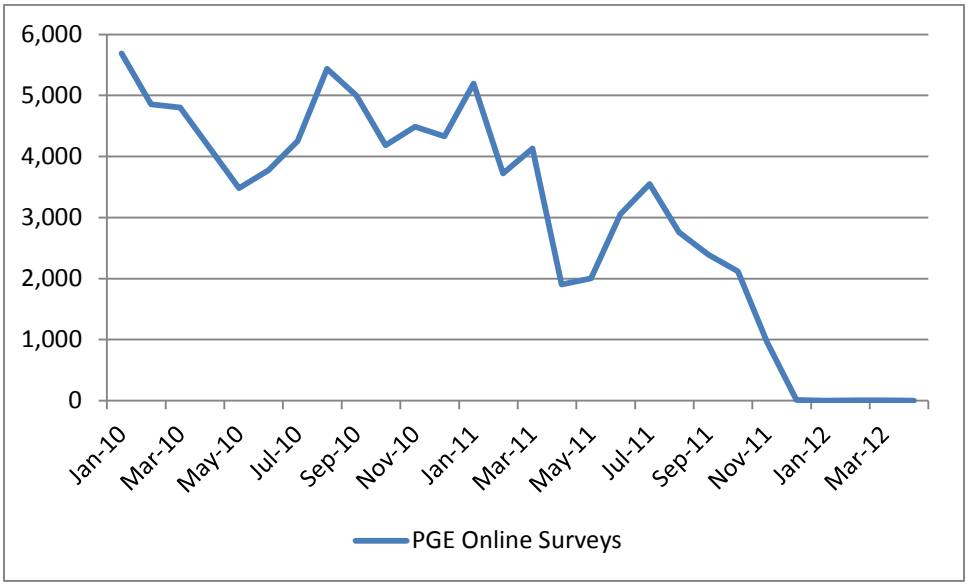


Figure 1-2 provides the distribution of HEES surveys completed in SCE and SCG service territory between January 2010 and July 2012. As this tables shows the volume of mail surveys is much spikier due to the nature of customer outreach (bulk mailings) which results in HEES mail surveys. The graph also shows an increase in the volume of online surveys in the fall of 2010. The evaluation team is currently researching changes to the marketing of the online HEES at this time which may have resulted in this spike.

Figure 1-2: Distribution of SCE/SCG HEES Surveys

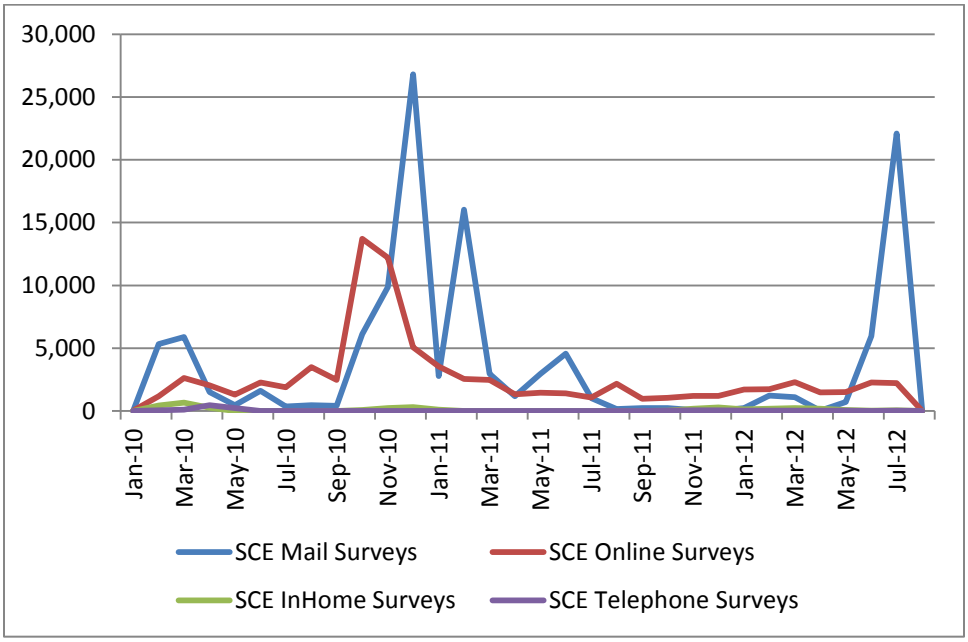
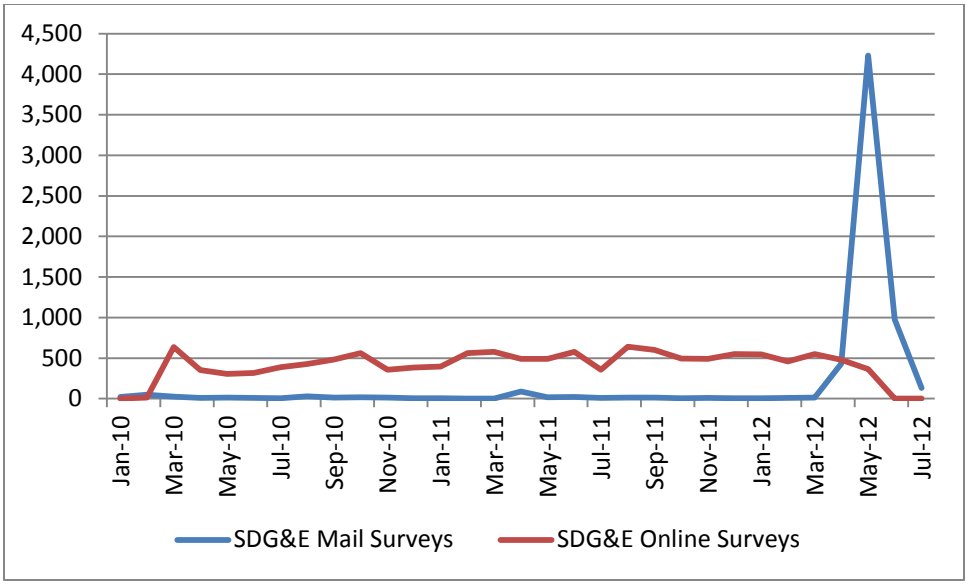


Figure 1-3 below shows a relatively stable volume of mail and online HEES surveys from January 2010 through March 2012. According to SDG&E the enormous spike in SDG&E mail surveys shown below is "the result of a partnership with the County of San Diego Dept. of Planning and Land Use. During the first quarter of 2012, SDG&E proactively mailed 250,000 surveys to customers who were identified by the San Diego County as residing in hard-to-reach areas."

Figure 1-3: Distribution of SDG&E HEES Surveys



1.4 Overview of Recommendation Categories to be Studied

The recommendations provided through the HEES Program can be divided into a series of 23 Measure recommendation categories and 11 Practice recommendation categories. Measure recommendations include the purchase of energy efficient items for one's home (such as a new high efficiency washer or dryer), whereas practice recommendations include actions that one may take, on either a daily or semi-regular basis, to improve the energy efficiency of their home (such as using an insulated pool cover or washing clothes in cold water).

Table 1-3 and Table 1-4 below show the distribution of the HEES measure and practice recommendations across the IOUs. As these tables show, the recommendations provided through the HEES surveys differ by IOU. However, two of the most common HEES measure recommendations given by each of the utilities were to install CFLs, low-flow showerheads or faucet aerators. PG&E also frequently provided a recommendation to participants to insulate their water heater (15%), whereas SCE/SCG recommended installing a whole house fan (14%) and SDG&E recommended installing insulation (19%). Please note the percentages provided in this table represent the fraction of the overall recommendations that fell into one measure category or another, not the percentage of HEES respondents that received these recommendations.

Table 1-3: Distribution of Measure Recommendations across IOUs

Measure Recommendations	PG&E	SCE/SCG	SDG&E
AC System	4%	1%	3%
CFLs	17%	32%	24%
Clothes Dryer	5%	0%	0%
Dishwasher	3%	0%	0%
Elec. Ignition on Heating System	3%	0%	0%
Freezer	1%	0%	0%
Furnace	0%	3%	4%
Heat Pump	4%	0%	5%
Heat Trap	8%	0%	0%
Heating System[28]	6%	0%	0%
Insulate Water Heater	15%	0%	2%
Insulation	7%	1%	19%
Motion Sensors for Lighting	0%	11%	0%
Pool Heater	0%	2%	0%
Pool Pump	2%	6%	2%
Range	0%	6%	1%
Recycle Freezer	0%	2%	0%
Recycle Refrigerator	0%	3%	9%
Refrigerator	1%	1%	0%
Showerheads and Faucet Aerator	12%	16%	26%
Washing Machine	4%	2%	0%
Water Heater	7%	2%	0%
Whole House Fan	0%	14%	3%
Surveys Completed PTD	86,255	209,171	19,048
Measure Recommendations Given PTD	1,110,764	635,236	67,124
Average Measure Recommendations per Survey	12.9	3.0	3.5

[28] PG&E's recommendation included in this category generically called for replacing a "heating system", whereas SCE and SDG&E specifically recommended replacing a furnace and therefore were included in the furnace category above.

As Table 1-4 below shows that while the most common practice recommendations given by PG&E were efficient refrigerator and freezer practices, such as raising the temperature settings of your unit and performing regular maintenance, SCE/SCG did not provide any of these types of recommendations. SCE/SCG most frequently provided HEES participants with home heating recommendations, which included tips such as lowering thermostat settings, sealing leaky ducts, and performing regular heating system maintenance. The building envelope practice recommendation given by SDG&E most frequently was to seal around windows and doors.

Table 1-4: Distribution of Practice Recommendations across IOUs

Practice Recommendations	PG&E	SCE/SCG	SDG&E
Efficient Building Envelope Practices	11%	11%	17%
Efficient Clothes Drying Practices	11%	11%	3%
Efficient Clothes Washing Practices	1%	10%	13%
Efficient Cooling Tips	11%	17%	10%
Efficient Dishwashing Practices	8%	2%	9%
Efficient Home Heating Practices	15%	21%	14%
Efficient Lighting Practices	1%	14%	0%
Efficient Pool and Spa Practices	4%	4%	4%
Efficient Refrigerator and Freezer Practices	19%	0%	8%
Efficient Water Heater Practices	14%	9%	9%
Other Efficient Practices	6%	1%	12%
Surveys Completed PTD	86,255	209,171	19,048
Practice Recommendations Given PTD	1,344,144	1,448,005	106,462
Average Practice Recommendations per Survey	15.6	6.9	5.6

As shown in the two tables above, the number of recommendations given to a customer also varied significantly by IOU. PG&E provided the highest number of recommendations (measure and practice) per survey (an average of more than 28), while SCE/SCG averaged 10 per survey and SDG&E averaged nine. The relationship between the volume of recommendations provided and the recall and uptake of these recommendations is discussed in Section 3. Forty-five percent of PG&E's recommendations were measure recommendations, whereas 30% of SCE/SCG and 39% of SDG&E recommendations were measures and the rest were practices.

1.5 Evaluation Research Objectives

The primary research issues for this evaluation center around determining net and gross *ex post* impacts resulting from the HEES Program. Specific researchable issues are briefly listed below.

1. Verify the number of residential energy surveys completed as part of the 2010-2012 HEES Program.

2. Evaluate program success by estimating the savings that can be attributed to the program based on self-reported implementation rates (uptake) of survey-recommended measures and practices. Whenever possible the savings will also be assessed by survey delivery method (online, mail, phone or in-home)

3. Estimate participant free-ridership to support the development of net-to-gross ratios and net savings values.

4. Assess the impact of the HEES Program on customer awareness and knowledge of energy efficiency opportunities.

5. Provide ongoing feedback and corrective guidance regarding program design and implementation.

2

Evaluation Methods

This section presents an overview of the analytic methods and data collection activities implemented as part of the 2010-2012 HEES impact evaluation, including the data sources and sample designs used as a base for these data collection activities.

2.1 Analytic Methods

The gross and net impact approach implemented measured participant response to the HEES survey in terms of the adoption of efficient measures and practices that lead to energy and demand savings. Impacts were evaluated using two primary methods. The first was a self-report method which, utilized HEES participant telephone survey data to measure the frequency of measure and practice adoptions and self-reported influence of the HEES survey on those EE adoption decisions for a sample of the participant population (attribution). The second method involved employing a billing regression model to quantitatively estimate net program impacts.

These methods were supported by a combination of IOU program (both HEES and non-HEES) tracking data (to identify HEES participants and recommendation measure adoptions installed through other IOU energy efficiency programs), a HEES participant telephone survey (which was the basis for self-reported measure and practice adoption and attribution data), and multiple years of participant billing and weather data (for use in the regression models).

Both of these methods are described in further detail below.

2.1.1 Self-Report Measure and Practice Adoptions and Attribution

The participant telephone survey collected self-reported data on participant EE measure and practice adoptions. These data were used to estimate recommendation uptake occurring within the participant population. The scope of analysis included all recommended measures and practices adopted by participating customers. The approach entails documenting equipment adoptions and behavioral changes that survey participants make, and the influence the HEES program has in these energy efficient actions.

It is important to note here that recommendations made through the energy surveys that are implemented through a utility incentive programs are not eligible for impact claims by the HEES

program. This study completed a thorough analysis of incentive program tracking data to ensure measure savings were not double counted[29].

2.1.2 Regression Based Impact Analysis

This section describes the methodology used to estimate the change in electricity usage resulting from participation in the HEES Programs. The section begins with a discussion of experimental and quasi-experimental designs and the potential issues associated with using quasi-experimental design to evaluate program impacts. Following the discussion of quasi-experimental design, the section describes the matching methodology necessitated by the program design. The matching methods subsection concludes with graphical representations of the matched participant and nonparticipant samples. Additional information on the matched samples is available in Section 4 - Appendices.

Quasi-Experimental Design

Ideally, a controlled experimental design would be used to determine the influence of a program on household behavior. Using a controlled experimental design, households would be randomly assigned to participant (treatment) and nonparticipant (control) groups. Households would not choose to receive the treatment; the choice would be made randomly by the designers of the experiment. If an experimental design methodology had been used to determine participation in HEES program, the random assignment to control and participant groups would ensure that the pre-program average energy consumption and the monthly distribution of consumption of the control and participant households would be approximately equivalent. Given the similarity of consumption prior to program implementation, measurable differences in average energy consumption following program implementation would be reasonably attributable to the program.

Participation in the HEES program, however, is voluntary. Given that individuals self-select themselves into the HEES program, the participant and nonparticipant groups are likely to differ systematically. The self-selection is likely to be associated with other important differences that exist between participant and nonparticipant households that could help explain the participation choice and associated usage of these households.

For example, a household that has recently decided to reduce its carbon footprint is likely to be looking for ways to reduce its energy usage. As they take steps to reduce their energy usage, they may take the HEES survey to help achieve their goal. If it turns out that they do reduce their usage, part of this reduction in energy usage is due to their decision to reduce their carbon footprint and would not be attributable to the impact of their participation in the HEES program.

[29] This will be conducted wherever possible. For upstream programs, for instance, it is impossible to identify individual purchasers due to the program delivery method.

Without a randomly selected control group that includes households with randomly distributed views on carbon footprints, the analysis methodology cannot separate the reduction in energy usage resulting from the HEES program from the reduction in energy usage resulting from their decision to focus on reducing their carbon footprint. In this example, the lack of a randomly selected control group would lead to an inflated estimate of the influence of the HEES program on reductions in household energy usage. The lack of an experimental design for HEES program makes the accurate estimation of the influence of the programs on electricity consumption difficult, if not impossible to determine.

Since HEES participants voluntarily participated in the program, the impacts of the program must be estimated using quasi-experimental matching methods. Using matching methods to choose the nonparticipant households can partially control for the selection bias from voluntary participation. Matching methods, however, rely on two key assumptions to replicate analyses that would be undertaken as controlled experiments. First, matching methodologies assume that differences which lead households to participate in the program can be fully described by observable characteristics in the participant and nonparticipant populations. The second requirement for matching methods is that the study can be divided into two clear stages: a design phase (one full year pre-HEES survey) and an analysis phase (post-HEES survey).

Turning to the first assumption, for program such as the HEES program there may be unobservable factors that influence a customer's decision to participate in HEES and thus matching on observable characteristics alone may not be sufficient to minimize potential bias in the nonparticipant sample. Consider the example of the household that has recently decided to reduce their carbon footprint. This household was more likely to sign up for the HEES program and more likely to reduce their electricity consumption in the absence of the program. Comparing the change in usage of this household with the change in usage among other households that did not participate in the HEES program is likely to overstate the impact of the HEES program. For examples such as this, matching methods could be used to choose a "matched" group of nonparticipant control households. The household characteristics available to select a matched nonparticipant control group could only include characteristics that are observable to the utilities (and thus would exclude items such as a household's "decision" to reduce its carbon footprint, which is not observable to a utility). The observable household characteristics include California Alternative Rates for Energy (CARE) and Family Electric Rate Assistant (FERA) status, household geographic location, usage level, usage distribution, how the households usage responses to weather changes, and the households' history of past energy efficiency programs participation. Matching on these observable characteristics would likely reduce the potential bias in the estimate of the program's impact. The reduction in bias is due to the assumption that households with similar observable characteristics also have similar views on carbon footprints. If, in our example, it is reasonable that after controlling for these observable characteristics there is no remaining correlation between signing up for the HEES program and

recent views on carbon footprints, then there is no sample selection bias remaining due to a household's views on carbon footprints.

Following the matching process, although the matching procedure helps to eliminate the bias due to observable characteristics, it is not possible to determine if it has controlled for all the potential selection bias. The unobservable nature of some of the characteristics, leads to the possibility that even after matching on observable characteristics, the unobservable characteristics are still correlated with program participation, and lead to bias in estimating program impacts.

The second requirement for a matching methodology is that there must be two clear stages to the study. The first stage must be a clearly observable design stage where the households can be compared prior to any potential program impact. The design stage is needed to match households on observable characteristics that have not been impacted by the program. The second stage is the analysis stage, where the potential program impacts are estimated.

For this HEES program evaluation, the regression analysis focused on households that participated in HEES between January 2010 and mid-2011. In order to improve the matching process the sample of HEES participants at each utility was divided into four or five sub-samples according to the quarter when they first participated in the HEES program[30]. Separate design and analysis stages were then defined for each of the sub-samples. The design stage was the 12 months prior to the start of the quarter during which they participated in the HEES program and the analysis stage was the 12 months (or more if data was available) after the quarter of their participation.

Control Group Matching Methodology

To facilitate the estimation of program impacts in this environment, the evaluation team developed a quasi-experimental design using a matched non-participation sample to help mitigate self-selection bias. For a matching methodology to help mitigate self-selection bias, it must be true that differences which lead households to participate in the program can be described by observable characteristics. The matching methodology used for the HEES evaluation is known as the propensity score matching (PSM) method[31] and this method uses observable characteristics of the participant and nonparticipant groups to develop to constructs a propensity score for each participant and non-participant. These propensity scores are essentially probability scores (taking a value of 0 to 1) that reflect the probability that the participant or non-participant would participate in the HEES program. Selecting a sample of non-participants that

[30] PG&E and SDG&E each had 5 sub-samples representing Q1 2010 through Q1 2011. Edison had four sub-samples representing Q1 2010 through Q4 2010.

[31] http://biostat.jhsph.edu/~estuart/Stuart10.StatSci.pdf

are equally likely to participate in the HEES program (based on their observable characteristics) limits the potential sample selection bias associated with the non-experimental nature of the design. The significant differences between the participant and a randomly selected non-participant sample prior to matching and the insignificant differences between the participant and matched non-participant sample following matching help to validate the PSM method.

In order to be included in the PSM process one full year of design period billing data are required. This helps ensure that the response of household usage to different weather conditions is fully captured and incorporated into the model. It is especially important to include how a household's usage changes in response to extreme weather conditions, since it is during these extreme conditions that a household's disposition toward energy conservation becomes apparent. Because of the extremely mild summer in SDG&E territory in 2010, the design period was extended to also include July to September of 2009 which includes periods of high temperatures. At least one full year of analysis period (post-HEES period) is also required to examine the impacts of the HEES program. Again including all weather conditions in the analysis period is necessary to have a full picture of the impact of the HEES program. Also, since it is common that the impacts of an energy survey program such as HEES take time to realize, and it is also common that the impacts of a program diminish over time, the longer the analysis period, the better. For Edison, since no billing data were available after December 2011, all participants who enrolled after November 2010 did not have enough analysis period data and hence were dropped from the regression modeling.

Table 2-1 below provides a summary of the sub-samples used to conduct the PSM. This summary provides, for each sub-sample, the quarter of HEES participation, as well as the design and analysis periods.

Table 2-1: Summary of Propensity Score Matching Sub-Samples

	Sub-Sample 1	**Sub-Sample 2**	**Sub-Sample 3**	**Sub-Sample 4**	**Sub-Sample 5[32]**
HEES Participation	Q1 2010	Q2 2010	Q3 2010	Q4 2010	Q1 2011
Design Period	1/09 to 12/09	4/09 to 3/10	7/09 to 6/10	10/09 to 9/10[33]	1/10 to 12/10[34]
Analysis Period[35]	4/10 to 3/11	7/10 to 6/11	10/10 to 9/11	1/11 to 12/12	4/11 to 3/12

[32] Sub-sample 5 was only used for PG&E and SDG&E. For Edison no billing data was available after December 2011 and thus adequate analysis period data was not available for sub-sample 5.

[33] The design period for SDG&E sub-sample 4 was extended to include July 2009 through September 2010. This was done due to the extremely mild summer weather in 2010.

[34] The design period for SDG&E sub-sample 5 was extended to also include the period from July 2009 through September 2009. This was done due to the extremely mild summer weather in 2010.

Table 2-2 below provides the number of participants and nonparticipants by utility that had enough billing data within the design and analysis periods to be included within the PSM process.

Table 2-2: Participant and NonParticipant Samples for the PSM

Utility	Group	Sub-Sample 1	Sub-Sample 2	Sub-Sample 3	Sub-Sample 4	Sub-Sample 5
PG&E	# NonParts	392,109	392,206	394,419	396,491	139,171
	# Participants	4,820	3,862	5,515	4,965	3,918
	# Matched NonParts	4,746	3,823	5,421	4,891	3,787
	# Matched Parts	4,820	3,862	5,515	4,965	3,916
	%Match	100.0%	100.0%	100.0%	100.0%	99.9%
Edison	# NonParts	843,469	844,457	846,946	862,047	
	# Participants	11,248	5,155	3,891	28,643	
	# Matched NonParts	10,986	5,111	3,866	27,747	
	# Matched Parts	11,246	5,154	3,888	28,624	
	%Match	99.9%	99.9%	99.9%	99.9%	
SDG&E	# NonParts	42,029	41,997	42,192	41,214	31,859
	# Participant	214	321	452	429	735
	# Matched NonParts	418	629	874	844	1,422
	# Matched Parts	212	320	451	428	734
	%Match	99.1%	99.7%	99.8%	99.8%	99.9%

After the sample of participants and feasible nonparticipant matches have been constructed, a Logit[36] model was built to construct the propensity scores. The regression used an indicator variable of being a participant as the dependent variable, with site specific characteristic variables as independent variables. These independent variables included monthly energy usage, standard deviation of monthly usage, covariance between usage and weather across pre-program months, CARE and FERA status, household geographic location, previous energy efficiency program participation, and whether a gas account can be associated with the site. For each utility sub-sample, a Logit model was run, and the propensity scores were calculated as the fitted probability of being a participant using the regression results from the Logit model.

35 Additional months of data were used if available

36 Logit – A non-linear regression technique typically used to estimate the probability of dependent variable (i.e. program participation) is zero or one based on a number of input or explanatory variables.

Finally, the PSM method pairs the participant and nonparticipant households with similar propensity scores in each sub-sample across the three utilities. Nearest neighbor matching (with replacement) was used in the matching process, and a radius of about one-quarter of the standard deviation of the propensity scores is imposed to ensure the quality of matching. If no nonparticipants fall within one-quarter of the standard deviation of a particular propensity score, the participant was dropped from the sample due to the lack of a valid match. As can be seen from Table 2-2 above, almost every participant found a match from the nonparticipant sample, and matching rates were higher than 99% for all sub-samples.

Three matching methods were tried including 1:1 matching, 1:2 matching and 1:2 Kernel matching. 1:1 matching selects a single nonparticipant that is the closest match to each participant; 1:2 matching selects two nonparticipants to match a single participant; and 1:2 Kernel matching selects two nonparticipants and weights them inversely proportional to the distance between the participant and the nonparticipant propensity scores. While 1:1 matching selects the best nonparticipant sample given the information provided in the Logit model, in the case of a smaller sample, the sample selected by this method may lead to unstable regression results because one outlier selected into the sample can affect the results dramatically. Applying 1:N (where N>1) matching introduces increased variation into the next step of analysis and kernel weights provide a balance between variation and matching quality.

In the HEES analysis, since PG&E and Edison both had large sample sizes, 1:1 matching samples were selected for the regression analysis. SDG&E, on the other hand, had a relatively small sample, and hence all three methods were tried in the regression analysis. The regression results from each of these matching methods yielded similar results and therefore, the 1:1 matching sample was selected for SDG&E, so as to be consistent with the other two IOUs. The results of the PSM matching are provided in Section 3.1.4

Billing Analysis Regression Model Development

To estimate the monthly kWh savings attributable to participation in the HEES program, billing analyses were performed using the entire sample of matched data.[37] For each site, various participation variables were created to determine the observable impact of HEES program participation on kWh usage. These variables are all indexed by site (*i*) and time (*t*). Examples of some of these participation variables are as follows.

- **PostHEES_1$_{it}$**: This variable equals 1 for site *i* in all months following the first HEES participation. The variable is zero otherwise.

[37] The analysis from this point forward did not distinguish between the sub-sample populations within an IOU service territory. Analysis of the differences between usage and the sub-samples was primarily driven by survey delivery method (certain periods had higher percentages of various survey delivery methods) which the billing analysis was used to segment the billing models.

- **PostHEES_4$_{it}$**: This variable equals 1 for site *i* starting three months from the first HEES participation. The variable is zero otherwise.
- **PostHEES_7$_{it}$**: This variable equals 1 for site *i* starting six months from the first HEES participation. The variable is zero otherwise.
- **PostHEES2_1$_{it}$**: This variable equals 1 for site *i* in the months following the second time[38] site *i* took the HEES survey. The variable is zero otherwise.
- **PostHEES3_1$_{it}$**: This variable equals 1 for site *i* in the months following the third time site *i* took the HEES survey. The variable is zero otherwise.

Within Edison service territory different types of surveys were offered to customers[39] and thus the variables above were further refined as below.

- **PostOnSite_1$_{it}$**: This variable equals 1 for site *i* in the months following the first On-Site HEES participation. The variable is zero otherwise.
- **PostTel_1$_{it}$**: This variable equals 1 for site *i* in the months following the first Telephone HEES participation. The variable is zero otherwise.
- **PostMail_1$_{it}$**: This variable equals 1 for site *i* in the months following the first Mail-In HEES participation. The variable is zero otherwise.
- **PostShort_1$_{it}$**: This variable equals 1 for site *i* in the months following the first Online Short HEES participation. The variable is zero otherwise.
- **PostLong_1$_{it}$**: This variable equals 1 for site *i* in the months following the first Online Long HEES participation. The variable is zero otherwise.
- **PostTYPE_4$_{it}$, and PostTYPE_7$_{it}$** were defined similarly, where **TYPE ϵ {Online, Tel, Mail, Short, Long}.**

In addition to the HEES program participation variables, the billing analysis model incorporated either monthly ex ante kWh savings estimates or dummy variables to control for the savings resulting from other energy efficiency programs. The results of both of these approaches (ex ante savings variables or dummy variables) are presented in this report. Both approaches resulted in similar HEES program impact estimates. However since it is often indicated in the literature, that the ex ante energy efficiency kWh savings are not very good estimations of the savings (and thus may introduce more error into the model), the models using dummy variables to control for other EE program savings were selected as better estimates of the HEES program impacts.

[38] If a customer took the HEES survey for a second time, zero otherwise.

[39] SDG&E also offered surveys via multiple delivery methods (online and mail), however the sample of mail participants was very small (around 300) during the participation timeframe and thus the regression was performed for just the HEES online participants.

The ex ante energy efficiency kWh savings were found by merging each of the IOUs energy efficiency tracking databases with the matched billing analysis samples. The yearly ex ante kWh savings were allocated to monthly savings values using the DEER[40] load profile estimates. The dummy variables for different categories of kWh savings were then set to be one for the participants in the months where the ex ante energy efficiency kWh savings were positive, and zero otherwise.

The HEES regression model was designed to determine the independent influence of HEES participation on a participant's electricity consumption. The model selected was a site and time-fixed effect model. Robust standard errors were constructed to account for the panel data structure of the model and to correct for the time-series dependence and cross-sectional dependence of the residuals.

The following two equations illustrate the regression models estimated, the first using the ex ante energy efficiency kWh saving, and the second using the dummy variables for each type of the energy efficiency savings. The models were estimated using the PSM matched sample of participants and nonparticipants.

Ex Ante Savings Model

$$kWh_{i,t} = \alpha_i + \gamma_t + \beta_1 HDD_{i,t} + \beta_2 CDD_{i,t} + \beta_3 HDD_{i,t}^2 + \beta_4 CDD_{i,t}^2 + \beta_5 PostHEES\_1_{i,t} + \beta_6 PostHEES\_4_{i,t} + \beta_7 PostHEES\_7_{i,t} + \beta_8 PostHEES2\_1_{i,t} + \beta_9 PostHEES3\_1_{i,t} + \sum_{h=1}^{H} \beta_h^{SAE} \times Type\ h\ EE\ Saving_{i,t} + \varepsilon_{i,t}$$

Dummy Variable Model

$$kWh_{i,t} = \alpha_i + \gamma_t + \beta_1 HDD_{i,t} + \beta_2 CDD_{i,t} + \beta_3 HDD_{i,t}^2 + \beta_4 CDD_{i,t}^2 + \beta_5 PostHEES\_1_{i,t} + \beta_6 PostHEES\_4_{i,t} + \beta_7 PostHEES\_7_{i,t} + \beta_8 PostHEES2\_1_{i,t} + \beta_9 PostHEES3\_1_{i,t} + \sum_{h=1}^{H} \beta_h^{D\_EE} \times Type\ h\ EE\ Dummy_{i,t} + \varepsilon_{i,t}$$

Where

kWh_{it} is kWh consumption at site *i* in month *t*.

$Type\ h\ EE\ Saving_{i,t}$ is the ex ante energy efficiency savings from type *h* energy efficiency programs, where *h* can be Building Envelope (BE), HVAC (HV), Lighting (LT), Refrigerator

[40] Database for Energy Efficient Resources. 2008. See http://www.deeresources.com/.

(RF), Water Heater (WH), Other (OT)[41], and the give-away or direct-installed energy saving Kits (KT)[42].

$Type\ h\ EE\ Dummy_{i,t}$ is an indicator variable that equals to 1 for site *i* in month *t* where the estimated ex ante savings from other energy efficiency programs are non-zeros.

α_i is the site specific fixed effect.

γ_t is the time fixed effect.

β_1 is the impact on monthly electricity consumption of a one-unit increase in heating degree days (HDD)[43].

β_2 is the impact on monthly electricity consumption of a one-unit increase in cooling degree days (CDD).

β_3 is the impact on monthly electricity consumption of a one-unit increase in square term of heating degree days.

β_4 is the impact on monthly electricity consumption of a one-unit increase in square term of cooling degree days.

β_5 is the average monthly treatment effect from the HEES program in the first three months after HEES participation.[44]

β_6 is the change in the monthly treatment effect three months after taking the HEES survey. It has been documented in the evaluations for similar programs that it may take some time for the participants to install measures and to adjust their behaviors. Therefore, there might be a delay for the impacts from the HEES program really take effects, and hence it is expected that β_6 is statistically significant with a negative sign indicating for more savings.

---

41 The type OT includes, mainly, whole house retrofits and pool and spa related measures, such as pool pumps and pool heaters.

42 The give-away or direct-installed energy saving kits include CFLs, LED night lights, low-flow showerheads and faucet aerators. The savings from these measures can be grouped into type LT or WH. For Edison, however, these kits were directly installed for the on-site HEES participants and mailed to the telephone, mail-in and long online HEES participants. A few of the energy saving kits were also distributed through other programs implemented by Edison. Since more than 90% of the participants and less than 1% of the nonparticipants received the kits, these savings were highly correlated with the treatment effects from the HEES program. Therefore, these savings were grouped into type KT to ensure that the savings from type LT and WH could be estimated correctly.

43 The model specification estimated for this report includes heating and cooling degree days, and their squares, interacted with the three geographical locations. This specification was a better representation of the observation that the three districts had significantly different weather and resulting usage patterns. The models were also run excluding the square terms of HDD and CDD and the regression results were the same.

44 This and the subsequent treatment effect (or savings variables) were designed in such a way that a negative coefficient indicates savings attributable to the HEES program.

β_7 is the change in the monthly treatment effect a half year after taking the HEES survey. It might be positive, for those participants who fell back to their old behaviors, and it might also be negative for those participants who took further actions even after half year of participation. Note that the overall treatment effects from HEES after six months of participation should be the sum of β_5 through β_7.

β_8 is the savings induced by taking the HEES survey a second time.

β_9 is the savings induced by taking the HEES Survey a third time. This term is added only to Edison's model, because there were not enough participants in the other two utilities who had taken the HEES survey more than two times.

β_h^{SAE} is the share of ex ante energy efficiency savings observable in the billing data of the participants from type *h* of energy efficiency programs (included only in the ex ante savings model).

$\beta_h^{D\_EE}$ is the average monthly savings observable in the billing data of the participants from type *h* of energy efficiency program (included only in the dummy variable model).

2.2 Data Collection Activities

The data collected for this evaluation was gathered during a number of activities, including IOU data requests, KEMA data requests, Computer Assisted Telephone Interviews (CATI) conducted with HEES program participants, and HEES tracking data analysis.

2.2.1 Utility Data Requests

The research team sent a series of data requests to each utility to gather information relevant to the HEES program. Responses were received and included a variety of items, such as:

- Program Tracking data, including HEES recommendations[45],
- A file of all Solar customers,

As mentioned in the HEES evaluability assessment, the tracking databases provided to the evaluation team for the 2010-2012 evaluation cycle were significantly improved from prior program years. On average, 75% of program participants across all four utilities provided contact information (which was required to include the participant in the telephone survey sample frame). No patterns of missing contact information were detected and thus the missing contact information is assumed to be random. Utility tracking data also included the recommendations provided to the customer for nearly 95% of the surveys completed. Only

[45] Two rounds of HEES participant data were received. The first set of data was received in the summer of 2011 and was used as the basis for selecting the sample for the telephone survey. The second round of data came at the end of the summer of 2012 and was used for both reporting and removing more recent participants from the sample of nonparticipants used in the regression modeling.

PG&E[46] provided the ex-ante energy savings estimates associated with each of these recommendations (although they claimed no savings). This improved tracking data allowed for more robust samples to be selected and also allow for the inclusion of specific recommendation based telephone survey questions.

2.2.2 KEMA Data Requests

The research team sent a series of data requests to KEMA[47] to gather information required to complete the evaluation of the HEES program. Responses were received from KEMA and included the following data elements:

- Sample of CIS database, used to select nonparticipant samples,
- Participant and nonparticipant billing data,
- Other EE Program Participant Tracking Data

2.2.3 CATI Telephone Surveys

One of the primary data collection activities for this evaluation was a HEES participant telephone survey which supported both the self-reported estimation of survey recommendation adoption and attribution, and the two-stage billing regression model. A total of 1,028 computer-aided telephone interviews (CATI) were conducted with a random sample of HEES participants that participated in the HEES program between January 2010 and the middle of 2011. The sample for these surveys, which is described in more detail in the next section, was segmented by IOU and Program Delivery Method. Table 2-3 below shows the distribution of completed surveys across the various strata.

Table 2-3: Distribution of Completed Surveys Across Strata

IOU	Program Delivery Method		Total
	Mail	Online	
PG&E	0	250	250
SCE/SCG	250	251	501
SDG&E	25	252	277
Statewide	275	753	1,028

[46] SCE ex-ante energy savings claims were not based on the recommendations received rather they were estimated by the type of the HEES survey the customer completed (long or short online, mail-in, in-home or telephone).

[47] KEMA was the evaluator responsible for compiling all of the residential CIS, billing and EE tracking databases for the 2010-2012 evaluation cycle.

In addition to collecting data to support the estimation of gross and net HEES program impacts, the telephone surveys also gathered data on a number of process related issues. These issues included items such as sources of HEES awareness, reasons for taking HEES surveys, satisfaction with HEES recommendations, and familiarity or usage with any of the IOUs energy tracking or budgeting offerings (such as SCE's Budget Assistance Notifications, PG&E's Energy Alerts, or the CARE[48] program).

Additionally, this survey also collected data from SCE customers regarding the Home Energy Kits they received following their completion of the HEES survey[49]. As mentioned previously, this kit contained one or two CFLs, an LED night light, a low-flow showerhead, and three faucet aerators. Survey questions were asked to support the estimation of kit measure installation rates, and to determine installation locations, what the kit measure replaced (if anything) and whether or not the measures are still in place.

Sample Design

The sample for the 2010-2012 HEES evaluation participant telephone survey was designed at the level of the utility and survey delivery method. Table 2-4 below summarizes the utility tracking data records as of the summer of 2011 which were the basis of the sample pulled for telephone survey.

Table 2-4: HEES Tracking Data Overview

Utility	Delivery Method				
	Online	Mail	Telephone	In-Home	Total
PG&E	67,480	-	-	-	67,480
SCE/SCG	63,485	85,038	1,075	3,191	152,789
SDG&E	7,480	339	-	-	7,819
Statewide	138,445	85,377	1,075	3,191	228,088

A stratified random sampling approach was employed for the HEES participant telephone survey. This sampling approach produces savings estimates with a smaller Coefficient of Variation[50] than a simple random sampling method, thus making it a more efficient sample

[48] The California Alternative Rates for Energy offering provides gas bill discounts to qualified customers.

[49] SCE provided Home Energy kits to all HEES participants (except those who completed the short 5-minute online survey) included in the tracking data provided to the evaluation team (January 2010 through May 2011).

[50] The Coefficient of Variation (CoV) is a normalized measure of dispersion in the data. It is similar to the standard deviation but is normalized to be independent of the unit of measurement.

design. The strata used for this survey was utility (PG&E, SCE/SCG[51] and SDG&E) and survey delivery method. The sample design was derived to provide estimates of gross and net savings at a minimum of a 90/15 confidence/precision level by utility and by delivery method at the statewide level. This confidence/precision level estimate was based on a CoV of 1.4[52] on kWh savings which requires a minimum of 479 sample points.

Table 2-5: Telephone Survey Sample Design

IOU	HEES Delivery Method	Participants	Precision Target	Sample Size
PGE	Online	67,480	90/15	250
	Total	67,480	90/15	250
SCE/SCG	Online	63,485	90/15	250
	Mail	85,038	90/15	250
	Total	148,523	90/10	500
SDG&E	Online	7,480	90/15	250
	Mail	339	90/20	50
	Total	7,479	90/15	325
Statewide	Online	138,445	90/10	750
	Mail	85,377	90/15	300
	Total	223,822	90/10	1,050

Survey Disposition

Table 2-6 below shows the final disposition of the 41,070 HEES participants sampled for the HEES telephone survey. As this table shows, contact with 25% of the sample was attempted at least once and these contacts resulted in 1,028 survey completes. The survey center was unable to make contact with 3% of customers in the sample for a variety of reasons such as that: no one answered the phone, an answering machine picked up, or the phone line was busy. The phone numbers provided for 3% of the sample had problems such as being disconnected, blocked, an incorrect number, or a cell phone number.

[51] SCE and SCG are being evaluated together due to the extremely large overlap in the tracking data from these two utilities.

[52] The evaluation team does not have a sample of HEES surveys with estimated kWh savings per record which would allow for the calculation of the CoV on HEES kWh savings. In the absence of this data a CoV of 1.4 was estimated which was the lowest segment level CoV from the 04-05 NRA evaluation (the ranged from 1.4 to 4.6). Residential measure savings have far less variation than commercial and thus we feel this minimum value is a good proxy for a HEES CoV.

Table 2-6: Telephone Survey Call Disposition

Call Disposition	IOU			Total	
	PG&E	SDG&E	SCE	n	%
Sample Pulled	3,823	1,287	5,269	10,379	100%
Completes	250	277	501	1,028	10%
Refusal	152	155	296	603	6%
Unable to Reach	2,454	137	3,012	5,603	54%
Language Barrier	18	18	91	127	1%
Phone Number Issue	434	336	660	1,430	14%
Appointment Scheduled	54	0	198	252	2%
Unused Sample	120	51	97	268	3%
Moved	328	308	401	1,037	10%
Unaware of HEES	13	5	13	31	0%

Profile of Survey Respondents

Table 2-7 below shows the demographic distribution of telephone survey respondents. As this table shows the majority of HEES participants we spoke with were home owners (although the percentage of home owners in PG&E territory was significantly lower than for any of the other utilities). Over 50% of respondents resided in homes that were greater than 30 years old and a similar percentage resided in homes that were larger than 2,000 square-feet. PG&E respondents were the most likely to live in homes less than 1,000 square-feet which correlates with the increased likelihood of being a renter in PG&E territory. Across the board HEES online survey participants were younger than those who completed the HEES survey by mail. The average household income across all HEES participants was quite high averaging more than $90,000. Additionally, nearly 60% of survey respondents reporting having achieved a bachelors degree or higher.

Table 2-7: Demographic Distribution of Survey Respondents

Demographic Variable		PG&E	SCE		SDG&E		All
		Online	Online	Mail	Online	Mail	
		%	%	%	%	%	%
Home Owners		83%	99%	100%	95%	100%	94%
Home Type	Single Family Detached	83%	90%	95%	92%	96%	90%
Age of Home	Less than 10 years	15%	20%	10%	11%	4%	15%
	10 to 30 years	33%	29%	36%	37%	48%	33%
	More than 30 years	52%	51%	54%	52%	48%	52%
Home Size	Less than 1000 sqft	12%	3%	0%	4%	0%	5%
	>1000 and <=2000 sqft	49%	50%	41%	46%	48%	46%
	>2000 sqft	40%	47%	59%	50%	52%	49%
Age	Less than 55	63%	59%	29%	51%	29%	48%
	Older than 55	37%	41%	72%	49%	71%	52%
Average Household Income		$86,020	$89,335	$98,695	$101,960	$75,520	$92,105
Education Level	Less than Bachelors	47%	44%	37%	34%	40%	42%
	Bachelors or Greater	53%	56%	63%	66%	60%	58%

Analysis Weights

In order to collect data on a sizeable sample of HEES participants across both IOUs and HEES delivery mechanism the survey was stratified by these parameters. As a result, when looking at HEES results on a statewide or IOU basis it was necessary to weight the survey results by the population of HEES participants each survey sample represented. The HEES populations (at the time the survey was conducted), survey sample and resulting weights are provided in Table 2-8 below.

Table 2-8: Analysis Weights by Strata

Utility	Mail			Online			All	
	Pop'n	Survey	Weight	Pop'n	Survey	Weight	Pop'n	Survey
PG&E	0	0	n/a	67,480	250	269.92	67,480	250
SCE/SCG	85,038	250	340.15	63,485	251	252.93	14,8523	501
SDG&E	339	25	13.56	7,480	252	29.68	7,819	277
Statewide	85,377	275	n/a	138,445	753	n/a	223,822	1,028

3

Statewide HEES Results

3.1 Impact Evaluation Results

This section presents the results of the impact and process evaluations of the HEES program. It is important to note here that recommendations made through the HEES energy surveys that are then implemented through incentive programs[53] and thus the impact of these are claimed through the incentive program, and are not eligible for impact claims by the HEES program. This study completed a thorough analysis of incentive program tracking data to ensure measure savings were not double counted[54].

3.1.1 Verification of 2010-2012 Residential HEES Energy Surveys

On average, each HEES program participants received 15 recommendations across seven categories (PG&E provided an average of 28 recommendations per survey, while SCE/SCG provided 10 and SDG&E provided nine per survey). Due to the large number of recommendations made through the HEES program it was necessary to prioritize recommendations, thereby ensuring an adequate level of data collected for the most common recommendations or those having the greatest expected impact. The table below summarizes the distribution of recommendations across the recommendation categories by IOU based on the most recent tracking data extract provided to the evaluation team.

Recommendations made through the HEES program can be classified as either measure recommendations[55] or practice recommendations[56]. While measure recommendations require a participant to install a replacement or incremental EE measure, no such requirement exists for practice recommendations and thus participants may tend to over-report their behavioral

[53] Furthermore, SCE's HEES program provides a "kit" to customers who complete the survey, which includes CFLs, a faucet aerator, and a low-flow showerhead.

[54] This was conducted wherever possible. For upstream programs, for instance, it is impossible to identify individual purchasers due to the program delivery method.

[55] Measure recommendations require the installation of a new energy efficient measure such as insulation, CFLs, a dishwasher, etc.

[56] Process recommendations require behavioral changes such as turning off more lights around your home or lowering your thermostat set-point.

implementation of practice recommendations making these sources of energy savings much more difficult to quantify.

Table 3-1 below shows the percentage of recommendations provided through the HEES Program (by both recommendation category and IOU) that fall into either the measure or practice category. Statewide across the three IOUs, 38% of the HEES recommendations were measure focused versus 62% that were practice recommendations. SCE and SCG provided the highest percentage of practice recommendations (70%), while PG&E provided the lowest percent (55%). Please note this is the distribution of recommendations given, not the percentage of HEES participants that received a particular recommendation (those values are much higher since participants received an average of 15 recommendations per survey statewide).

Table 3-1: Distribution of HEES Measure and Practice Recommendations across Categories

Recommendation Type	Recommendation Category	IOU		
		PG&E	SCE/SCG[57]	SDG&E
Measure Recommendations	Building Envelope	7%	0%	18%
	HVAC	26%	17%	15%
	Hot Water	34%	17%	27%
	Kitchen	6%	12%	10%
	Laundry	9%	2%	0%
	Lighting	17%	44%	28%
	Pool	2%	8%	2%
	Percent of IOU Recommendations	**45%**	**30%**	**39%**
Practice Recommendations	Efficient Building Envelope Practices	11%	11%	17%
	Efficient Laundry Practices	12%	21%	17%
	Efficient Cooling Tips	11%	17%	10%
	Efficient Kitchen Appliance Tips	27%	2%	18%
	Efficient Home Heating Practices	15%	21%	14%
	Efficient Lighting Practices	1%	14%	0%
	Efficient Pool and Spa Practices	4%	4%	4%
	Efficient Water Heater Practices	14%	9%	9%
	Efficient Other Practices	6%	1%	12%
	Percent of IOU Recommendations	**55%**	**70%**	**61%**

[57] Due to the very large overlap between SCE and SCG customers, as well as the similarity of the surveys these two IOUs were evaluated together.

3.1.2 Self-Reported Gross Program Savings

Self-reported gross program savings were estimated based on HEES participants self-reported responses provided during the CATI telephone survey described previously. In order for a measure or practice to be counted towards gross program savings the customer had to first recall the recommendation was provided to them and then had to report implementing the recommendation on their own outside of any other utility energy efficiency programs. Measures installed or practices implemented by HEES participants that passed both of these criteria were considered gross adoptions. As stated previously, this evaluation did not attempt to estimate the actual energy savings (kWh) associated with these adoptions through the self-report method (that was done by the regression modeling work completed as part of this evaluation). The self-report analysis focused on quantifying the number of each type of recommendations that was taken and can be attributed to the program.

Recall of HEES Recommendations

As stated in the section above, the first step in estimating the gross program savings is quantifying the percentage of HEES participants who recalled receiving various recommendations. To do this the survey that was administered to each survey respondent was pre-loaded with three practice and three measure recommendations that, according to utility tracking data, their household received through the HEES program. Survey respondents were asked whether or not they recalled each one of these pre-loaded recommendations. This type of recall was considered "prompted" recall, since the surveyor prompted each survey respondent with the recommendation they supposedly received. Immediately prior to the prompted recall battery of questions, survey respondents were asked if they recalled any measure recommendations they received through the HEES program. This type of recall was considered "non-prompted" recall, since the respondent was asked to recall recommendations off the top of their heads. Results from the prompted and non-prompted recall are provided below. The prompted recall (including any prompted measure that was provided as a response during the initial non-prompted question) was used to calculate the self-report estimate of gross program savings. Non-prompted recall, while interesting since it provides a means of evaluating which types of recommendations were the most memorable to HEES participants, cannot be used to estimate program savings. It cannot be assumed that just because a HEES participant did not provide a recommendation to an open-ended question (non-prompted) that they necessarily would not have recalled it if they were prompted with the recommendation.

Prompted Measure Recommendation Recall

Table 3-2 below provides the overall measure recommendation prompted recall by utility and delivery method[58]. As this table shows measure recommendation recall averaged 44% statewide and was highest in SDG&E territory (57%) and lowest in PG&E territory (37%). It is not surprising that the rate was so low in PG&E territory as the average HEES audit resulted in 13 measure recommendations, compared to the four provided by SDG&E, and thus PG&E participants might be less likely to recall such a large number of recommendations. The table below also indicates that mail HEES participants were more likely, in both SCE/SCG and SDG&E service territories, to recall recommendations provided to them via mails surveys (although these differences are not statistically significant at the 90% level).

Table 3-2: Self-Reported Measure Recommendation Recall by IOU and Delivery Method

IOU	Delivery Method	n	Recall %	Lower 90%	Upper 90%	Relative Precision
PG&E	Online	747	37%	34%	40%	5%
SCE/SCG	Online	545	45%	42%	49%	5%
	Mail	558	50%	46%	53%	4%
	Total	1,103	48%	45%	50%	3%
SDG&E	Online	655	57%	54%	60%	3%
	Mail	65	65%	55%	74%	9%
	Total	720	57%	55%	60%	3%
Statewide	Total	2,570	44%	42%	46%	3%

Table 3-3 below provides the self-reported measure recall by measure and weighted based on the recommendations given through the 2010-12 HEES program based on the most recent tracking data received. It is important to note that some of these measure level recall rates are based on relatively small sample sizes and thus the reader is cautioned not to misinterpret the precision of these estimates. They are provided to illustrate the variation and provide general guidance on the magnitude of recall rates across the measure recommendation categories. They should not be used for future program planning. The overall recall in the table below is higher than in the table above since a number of the measure recommendations that were recalled at high levels (such as

[58] These results are based on the strata weighted sample (with strata being utility and delivery method) of surveyed participants. They differ slightly from those presented in the executive summary and in the subsequent table which have been weighted back to the distribution of recommended measures and practices found in the final HEES tracking databases provided to the evaluation team.

CFLs and Insulate Water Heater) were given more frequently than the lower recalled measure recommendations (such as Heat Pumps and Heat Traps), thus driving the measure weighted average up. As this table shows, statewide participants were most likely to recall measures such as refrigerator recycling, CFLs, water heater insulation, and least likely to recall heating measure recommendations concerning heat pumps, heat traps and electronic ignitions on heating systems.

Table 3-3: Self-Reported Recall by Measure[59]

Recommended Measure	Recommendations Given	Recall Rate %[60]
Recycle Refrigerator	28,541	79%
CFLs	407,673	74%
Insulate Water Heater	168,062	71%
Pool Pump	54,858	69%
Recycle Freezer	10,597	61%
Whole House Fan	88,832	48%
Insulation	93,697	47%
Freezer	15,223	47%
Water Heater	87,512	42%
Refrigerator	21,196	41%
Furnace	19,653	41%
Showerheads and Faucet Aerator	250,524	40%
Heating System	66,929	40%
Dishwasher	30,789	39%
Motion Sensors for Lighting	74,871	37%
AC System	52,519	34%
Pool Heater	14,541	34%
Clothes Dryer	59,405	32%
Washing Machine	53,897	31%
Range	39,744	28%
Elec. Ignition on Heating System	36,421	15%
Heat Pump	51,209	13%
Heat Trap	86,431	12%
Total	1,813,124	49%

[59] Weighted by the number of recommendations given to HEES participants in each of the service territories.

[60] These measure level recall rates are based on relatively small sample sizes and thus provided to show general magnitude of recall across measure recommendations. They should not be used for future program planning.

Non-Prompted Measure Recommendation Recall

When survey respondents were asked whether or not they recalled receiving any HEES recommendations to replace an appliance or change equipment or a system in their home to save energy, 35% statewide indicated they did. The most frequently non-prompted measures recalled were to replace a refrigerator (42% of non-prompted recalls), replace a washing machine (17%), install a CFL (16%) or replace a dryer (15%). It is interesting that the rate of non-prompted recall of kitchen and laundry measures was so much higher than recall of systems (such as HVAC system) even though HVAC measures recommendations were given to a high proportion of HEES participants (19%) than kitchen or laundry measures (14%). In total, Refrigerator measure recommendations made up just over 1% of all recommendations given (and were provided to less than 7% of HEES participants).

Prompted Practice Recommendation Recall

Table 3-4 below shows that recall of practice recommendations was much higher (95%) than recall of measure recommendations (44%) statewide[61]. This may result from practice recommendations being somewhat more general in scope (such as turn down the heater thermostat in the evening or turn off the lights when a room is unoccupied) and thus more "common sense". Survey respondents may be more likely to recall such "common sense" recommendations and credit the HEES survey as their source of awareness.

[61] Again, these results are based on the strata weighted sample of surveyed participants. They differ slightly from those presented in the executive summary and in the following table which have been weighted back to the distribution of recommended measures and practices found in the final HEES tracking databases provided to the evaluation team.

Table 3-4: Self-Reported Practice Recommendation Recall by IOU and Delivery Method

IOU	Delivery Method	n	Recall %	Lower 90%	Upper 90%	Relative Precision
PG&E	Online	750	89%	87%	91%	1%
SCE/SCG	Online	770	96%	95%	98%	1%
	Mail	784	96%	95%	97%	1%
	Total	1,554	96%	95%	97%	1%
SDG&E	Online	744	92%	90%	93%	1%
	Mail	59	88%	81%	95%	5%
	Total	803	92%	90%	93%	1%
Statewide	Total	3,109	95%	94%	95%	0%

Table 3-5 below provides the self-reported recall of practice recommendations by practice recommendation grouping and weighted based on the recommendations given through the 2010-12 HEES program based on the most recent tracking data received. As this table shows, 96% of survey respondents reported recalling the Efficient Cooling Tips and Efficient Dishwashing Practice recommendations they received. The lowest level of recall was for Efficient Refrigerator and Freezer practices (87%).

Table 3-5: Self-Reported Practice Recommendation Recall

Recommended Practices	Recommendations Given	Recall Rate %
Efficient Dishwashing Practices	144,476	96%
Efficient Cooling Tips	417,083	96%
Efficient Clothes Washing Practices	175,459	95%
Efficient Pool and Spa Practices	112,342	95%
Efficient Clothes Drying Practices	305,020	93%
Efficient Lighting Practices	212,590	93%
Efficient Building Envelope Practices	327,903	93%
Efficient Water Heater Practices	328,075	92%
Efficient Home Heating Practices	514,444	90%
Efficient Refrigerator and Freezer Practices	262,612	87%
Other Practices	98,605	86%
Total	2,898,611	92%

As this table shows, Efficient Cooling and Dishwashing practices were the most commonly recalled practice recommendations (96%), while Efficient Refrigerator and Freezer practices were the least commonly recalled practice recommendations (87%). Overall these recall levels are extremely high which may result from these recommendations being more "common sense" in nature (such as raise your thermostat setting when the house is unoccupied and air dry dishes) and thus survey respondents report a higher awareness of these energy saving practices.

Self-Reported Measure Recommendation Uptake

One method of evaluating the HEES program success is to estimate the percentage of HEES participants that reportedly implemented the survey-recommended measures they received. Surveyed customers, who recalled receiving a specific measure recommendation as part of the HEES survey, were asked whether or not they had implemented that recommendation since completing the HEES survey. In order for the implementation of a measure recommendation to be attributable to the HEES program the following conditions had to be met:

- The implementation action had to be taken *after* the date the HEES survey was completed,
- The HEES participant could not have received any incentive from a utility energy efficiency program, and
- The measure implemented had to be a high efficiency measure (i.e. not standard efficiency).

Overall, roughly 20% of survey respondents who recalled receiving a specific measure recommendation reported the implementation of that measure that met the criteria listed above. Overall gross uptake of recommended measures, excluding those who did not recall receiving the recommendation, was estimated to be 17% statewide (8% of all surveyed). Table 3-6 below provides the gross uptake estimates by utility and HEES delivery method. As this table shows uptake was highest in SDG&E territory (35%) and lowest in SCE/SCG territory (11%). PG&E's uptake rate was 28%.

Table 3-6: Self-Reported Gross Measure Recommendation Uptake by IOU and Delivery Method

IOU	Delivery Method	n	Uptake %	Lower 90%	Upper 90%	Relative Precision
PG&E	Online	275	28%	24%	33%	10%
SCE/SCG	Online	247	11%	8%	14%	18%
	Mail	277	10%	7%	13%	17%
	Total	524	11%	8%	13%	13%
SDG&E	Online	374	35%	31%	39%	7%
	Mail	42	45%	32%	57%	17%
	Total	416	35%	31%	39%	7%
Statewide	Total	1,215	17%	15%	19%	7%

Table 3-7 below provides the gross uptake rates by recommendation measure and weighted by the estimated distribution of all recalled HEES measure recommendations given through the 2010-12 HEES program. It is important to note that some of these measure level uptake rates are based on relatively small sample sizes and thus the reader is cautioned not to misinterpret the precision of these estimates. They are provided to illustrate the variation and provide general guidance on the magnitude of uptake rates across the measure recommendation categories. They should not be used for future program planning. The overall uptake rate in the table below is significantly higher than in the table above since due to an under sampling of CFL measures in the survey (which had a very high uptake rate) which was corrected for in the table by applying population versus survey weights. As the table below shows, participants were significantly more likely to report implementing a CFL measure than any other measure recommended. CFLs were also the measure recalled the most frequently. Installation of Heat Pumps, Refrigerators, and Electronic Ignition on Heating System were all at or close to zero.

Table 3-7: Self-Reported Measure Recommendation Uptake by Measure

Recommended Measures	Recalled Recommendations	Uptake Rate %[62]
CFLs	299,652	81%
Showerheads and Faucet Aerator	100,633	33%
Heat Trap	10,615	29%
Motion Sensors for Lighting	28,014	20%
Washing Machine	16,539	18%
Water Heater	36,866	17%
AC System	17,950	14%
Recycle Refrigerator	22,424	14%
Freezer	7,164	13%
Insulate Water Heater	119,043	12%
Pool Pump	37,858	12%
Range	11,191	11%
Clothes Dryer	19,219	9%
Furnace	7,978	8%
Dishwasher	12,129	8%
Recycle Freezer	6,439	5%
Heating System	26,541	4%
Insulation	44,450	4%
Whole House Fan	42,900	4%
Pool Heater	4,940	4%
Heat Pump	6,486	1%
Refrigerator	8,625	0%
Elec. Ignition on Heating System	5,519	0%
Total	893,175	37%

Self-Reported Practice Recommendation Uptake

Statewide, self-reported practice recommendation uptake was estimated to be 19% amongst those who recalled receiving a specific practice recommendation. Table 3-8 below provides

[62] These measure level uptake rates are based on relatively small sample sizes and thus provided to show general magnitude of uptake rates across the measure recommendation categories. They should not be used for future program planning.

practice recommendation uptake estimates (out of the population who recalled the recommendation) by utility and delivery method. As this table shows, practice recommendation uptake was very similar across the IOUs. The only significant difference found was between SCE/SCG online and mail delivery methods, with the online HEES format resulting in significantly higher reported practice recommendation uptake.

Table 3-8: Self-Reported Practice Recommendation Uptake by IOU and Delivery Method

IOU	Delivery Method	n	Uptake %	Lower 90%	Upper 90%	Relative Precision
PG&E	Online	667	21%	18%	23%	8%
SCE/SCG	Online	741	22%	19%	24%	7%
	Mail	751	16%	13%	18%	8%
	Total	1,494	18%	17%	20%	5%
SDG&E	Online	683	18%	15%	20%	8%
	Mail	52	16%	8%	25%	32%
	Total	735	18%	15%	20%	8%
Statewide	Total	2,896	19%	17%	20%	4%

Table 3-9 below provides self-reported estimates of practice recommendation uptake by practice recommendation grouping and weighted by the estimated distribution of all recalled HEES practice recommendations given through the 2010-12 HEES program. It is important to note that some of these practice level uptake rates are based on relatively small sample sizes and thus the reader is cautioned not to misinterpret the precision of these estimates. They are provided to illustrate the variation and provide general guidance on the magnitude of uptake rates across the practice recommendation categories. They should not be used for future program planning. As this table shows, gross practice uptake was highest amongst Other Practices and Efficient Refrigerator, Freezer and Water Heater Practices and lowest for Efficient Lighting Practices.

Table 3-9: Self-Reported Practice Recommendation Uptake

Recommended Practices	Recalled Recommendations	Uptake Rate %[63]
Other Practices	85,021	32%
Efficient Refrigerator and Freezer Practices	228,900	29%
Efficient Water Heater Practices	300,823	28%
Efficient Building Envelope Practices	304,038	22%
Efficient Clothes Washing Practices	167,508	21%
Efficient Dishwashing Practices	139,108	16%
Efficient Clothes Drying Practices	284,206	16%
Efficient Home Heating Practices	463,942	16%
Efficient Cooling Tips	400,957	14%
Efficient Pool and Spa Practices	106,751	14%
Efficient Lighting Practices	197,823	13%
Total	2,679,077	19%

Self-Reported Estimates of Gross Measure and Practice Recommendation Implementation

Table 3-10 below provides participant self-reported estimates of the number of measure recommendations installed as a result of the HEES program. These estimates were derived by applying the recall and uptake rates by measure end-use category to the number of recommendations given by each of the IOUs through the HEES program based on the final tracking data received by the evaluation team. As this table shows, across all IOUs approximate 330,000 measure recommendations were implemented (out of 1.8 million measure recommendations given through HEES). This yields an overall gross implementation rate of 18%. The gross implementation rate was highest for SCE/SCG (24%), followed by SDG&E (20%) and PG&E (15%). As this table shows the relative precision for some of the measure end-use categories is quite high due to the small samples sizes surveyed. The reader is cautioned not to misinterpret the precision of the gross implementation rate estimates, as they are provided to illustrate the variation of gross implementation rates across the measure recommendation categories. They should not be used for future program planning.

[63] These practice level uptake rates are based on relatively small sample sizes and thus provided to show general magnitude of uptake rates across the practice recommendation categories. They should not be used for future program planning.

Table 3-10: Estimates of Gross Measure Recommendations Implemented by IOU

Utility	Measure End-use	Rec's Given	Recall Rate	Uptake Rate	Gross Rec's Implemented	Gross Imp Rate	90% Conf Int	Relative Precision
State-wide	Lighting	482,545	68%	76%	247,710	51%	+/- 6%	5%
	Hot Water	506,098	51%	21%	53,779	11%	+/- 8%	18%
	Pool	69,399	62%	11%	4,586	7%	+/- 8%	28%
	Kitchen	146,090	47%	9%	6,422	4%	+/- 5%	21%
	Laundry	113,302	32%	13%	4,768	4%	+/- 11%	39%
	HVAC	401,994	29%	8%	9,143	2%	+/- 4%	21%
	Building Envelope	93,697	47%	4%	1,869	2%	+/- 6%	44%
PG&E Total		1,110,764	46%	32%	161,485	15%	+/- 6%	10%
SCE/SCG Total		635,236	55%	44%	153,114	24%	+/- 4%	6%
SDG&E Total		67,124	54%	37%	13,679	20%	+/- 5%	7%
Total Statewide		1,813,124	49%	37%	328,278	18%	+/- 3%	4%

Table 3-11 below provides estimates of the number of gross practice recommendations implemented as a result of the HEES program. As this table shows out of the nearly 3 million practice recommendations given, more than a half million were reportedly implemented outside of other IOU programs. This represents an overall gross uptake rate of 18%. While the practice recommendation implementation rate was very similar across utilities (18% PG&E, 18% SCE, and 17% SDG&E) the volume of recommendations given in SDG&E territory was significantly lower resulting in only 4% of the practice recommendations being implemented in SDG&E territory, compared with 47% in PG&E territory and 50% in SCE territory. As this table shows the relative precision for some of the practice end-use categories is quite high due to the small samples sizes surveyed. The reader is cautioned not to misinterpret the precision of the gross implementation rate estimates, as they are provided to illustrate the variation of gross implementation rates across the practice recommendation categories. They should not be used for future program planning.

Table 3-11: Estimates of Gross Practice Recommendations Implemented Statewide

Utility	Practice End-use	Rec's Given	Recall Rate	Uptake Rate	Gross Rec's Implemented	Gross Imp Rate	90% Conf Int	Relative Precision
State-wide	Other Practices	98,605	86%	32%	27,485	28%	+/- 9%	14%
	Efficient Water Heater Practices	328,075	92%	28%	82,913	25%	+/- 4%	8%
	Efficient Refrigerator and Freezer Practices	262,612	87%	29%	66,320	25%	+/- 7%	13%
	Efficient Building Envelope Practices	327,903	93%	22%	66,883	20%	+/- 4%	10%
	Efficient Clothes Washing Practices	175,459	95%	21%	35,405	20%	+/- 5%	12%
	Efficient Dishwashing Practices	144,476	96%	16%	22,366	15%	+/- 5%	17%
	Efficient Clothes Drying Practices	305,020	93%	16%	44,722	15%	+/- 5%	15%
	Efficient Home Heating Practices	514,444	90%	16%	72,555	14%	+/- 3%	9%
	Efficient Cooling Tips	417,083	96%	14%	57,276	14%	+/- 5%	17%
	Efficient Pool and Spa Practices	112,342	95%	14%	14,897	13%	+/- 5%	20%
	Efficient Lighting Practices	212,590	93%	13%	25,741	12%	+/- 7%	26%
PG&E Total		1,344,144	89%	20%	240,753	18%	+/- 3%	8%
SCE/SCG Total		1,448,005	96%	19%	257,179	18%	+/- 2%	5%
SDG&E Total		106,462	93%	19%	18,631	17%	+/- 3%	8%
Total Statewide		2,898,611	92%	19%	516,562	18%	+/- 1%	4%

Self-Reported Estimates of Measure Recommendation Implementation through EE Program

During the telephone survey, HEES program participants were asked whether or not they received any incentive for installing a measure recommendation through an IOU energy efficiency program. Statewide, less than 1% of survey respondents reported doing so. The only measures reported by more than five survey respondents were Pool Pumps (seven survey respondents) and Refrigerator Recycling (nine respondents). All incentivized Pool Pumps were reported by SCE/SCG respondents and all incentivized Recycled Refrigerators were reported by SCE/SCG or SDG&E online survey respondents.

3.1.3 Self-Report Net Program Savings

HEES CATI telephone survey respondents who reported implementing a measure or practice recommendation were asked a number of questions (such as how influential was the HEES survey in your decision to implement measure or practice X, and how likely would you have been to take this implementation action if you had not completed the HEES survey[64]) to determine how influential the HEES program was to their resulting action. Based on self-reported responses to these questions an attribution level, or Net-to-Gross ratio, was estimated. Multiplying the number of gross measure and practice recommendations by this attribution rate results in the net number of HEES recommendations that can be attributed to the HEES program.

Self-Reported Measure Attribution

Overall, 42% of installed high efficiency HEES recommended measures (outside of other IOU EE incentive programs) were reported to be attributable to the HEES program (i.e. they would not have been implemented in the absence of the HEES program) based on customer self-reports from telephone survey. As Table 3-12 below shows, attribution levels were fairly consistent across utilities and delivery methods.

Table 3-12: Self-Reported Measure Recommendation Attribution by IOU and Delivery Method

IOU	Delivery Method	n	Attribution %	Lower 90%	Upper 90%	Relative Precision
PG&E	Online	275	39%	32%	46%	11%
SCE/SCG	Online	247	52%	42%	63%	12%
	Mail	277	43%	32%	53%	14%
	Total	524	47%	39%	54%	10%
SDG&E	Online	374	35%	29%	41%	10%
	Mail	42	42%	27%	56%	21%
	Total	416	36%	30%	41%	9%
Statewide	Online	1,215	42%	37%	46%	7%

Table 3-13 below provides the self-reported attribution rate (NTGR) by recommended measure and weighted by the estimated distribution of all implemented HEES measure recommendations resulting from the 2010-12 HEES program. It is important to note that these measure level attribution rates are based on small sample sizes and thus the reader is cautioned not to

[64] The HEES participant survey is included in Appendix Section 4.5 and the self-report recall, uptake and attribution algorithms are included in Appendix Section 4.6.

misinterpret the precision of these estimates. They are provided to illustrate the variation and provide general guidance on the magnitude of attribution rates across the measure recommendation categories. They should not be used for future program planning. As the table below shows, 100% of HEES participants surveyed that recycled a freezer outside of the utilities Appliance Recycling Programs attributed this action to the HEES program. Attribution rates were also high for installing a new AC System. Recommendations to install a new refrigerator and to install an electronic ignition on a heating system are not included in the table since none were reportedly implemented that met the HEES uptake criteria.

Table 3-13: Self-Reported Measure Recommendation Attribution by Measure

Recommended Measures	Implemented Recommendations	Attribution Rate %[65]
Recycle Freezer	324	100%
AC System	2,432	80%
Heat Trap	3,033	68%
Freezer	895	67%
Insulate Water Heater	14,005	65%
Whole House Fan	1,776	65%
Dishwasher	933	63%
Motion Sensors for Lighting	5,732	61%
Furnace	653	54%
Pool Heater	183	50%
Clothes Dryer	1,747	47%
Insulation	1,869	46%
Showerheads and Faucet Aerator	33,591	44%
Range	1,236	38%
CFLs	241,978	37%
Pool Pump	4,404	28%
Water Heater	6,183	22%
Washing Machine	3,021	19%
Recycle Refrigerator	3,033	18%
Heat Pump	96	8%
Heating System	1,154	7%

[65] These measure level attribution rates are based on small sample sizes and thus are provided to show general magnitude of attribution rates across the measure recommendation categories. They should not be used for future program planning.

Total	**328,278**	**39%**

Self-Reported Practice Attribution

Self-reported practice attribution was estimated to be 63% amongst those reported implementing a practice recommendation they received through the HEES program. Table 3-14 below provides the gross practice attribution estimates by utility and delivery method. As this table shows, practice attribution was very consistent across utilities.

Table 3-14: Self-Reported Practice Recommendation Uptake by IOU and Delivery Method

IOU	Delivery Method	n	Attribution %	Lower 90%	Upper 90%	Relative Precision
PG&E	Online	667	64%	60%	69%	4%
SCE/SCG	Online	741	63%	60%	66%	3%
	Mail	751	63%	59%	66%	3%
	Total	1,494	63%	60%	65%	2%
SDG&E	Online	683	60%	55%	64%	5%
	Mail	52	72%	60%	83%	10%
	Total	735	60%	56%	64%	4%
Statewide	Total	2,896	63%	61%	65%	2%

Table 3-15 below provides estimates of the self-reported practice attribution rate by practice recommendation grouping and weighted by the estimated distribution of all implemented HEES practice recommendations resulting from the 2010-12 HEES program. It is important to note that these practice level attribution rates are based on small sample sizes and thus the reader is cautioned not to misinterpret the precision of these estimates. They are provided to illustrate the variation and provide general guidance on the magnitude of attribution rates across the practice recommendation categories. They should not be used for future program planning. As this table shows, practice attribution was highest amongst Efficient Refrigerator and Freezer practices and lowest for Efficient Other practices.

Table 3-15: Self-Reported Practice Recommendation Uptake

Recommended Practices	n	Attribution Rate %[66]
Efficient Refrigerator and Freezer Practices	66,320	77%
Efficient Water Heater Practices	82,913	70%
Efficient Pool and Spa Practices	14,897	67%
Efficient Home Heating Practices	72,555	66%
Efficient Lighting Practices	25,741	63%
Efficient Clothes Drying Practices	44,722	59%
Efficient Cooling Tips	57,276	58%
Efficient Dishwashing Practices	22,366	57%
Efficient Clothes Washing Practices	35,405	57%
Efficient Building Envelope Practices	66,883	57%
Other Practices	27,485	41%
Total	**516,562**	**63%**

Self-Reported Estimates of Net Measure and Practice Implementation

Table 3-16 below provides estimates of the number of net measures installed as a result of the HEES program. These estimates were derived by applying the estimated attribution rates by measure end-use category to the gross estimated measure recommendations implemented. As this table shows across all IOUs nearly 130,000 recommended measures were implemented (out of 1.8 million measure recommendations given through HEES). This yields an overall net implementation rate of 7%. The net implementation rate was highest at SCE/SCG (9%) and lowest at PG&E (6%).

[66] These practice level attribution rates are based on small sample sizes and thus are provided to show general magnitude of attribution rates across the practice recommendation categories. They should not be used for future program planning.

Table 3-16: Estimates of Net Measure Implementation

Utility	Measure End-use	Rec's Given	Attribution Rate	Net Rec's Implemented	Net Imp Rate	90% Conf Int	Relative Precision
State-wide	Lighting	482,545	37%	92,017	19%	+/- 8%	11%
	Hot Water	506,098	47%	25,272	5%	+/-16%	25%
	Pool	69,399	29%	1,346	2%	+/-23%	53%
	Kitchen	146,090	39%	2,526	2%	+/-16%	31%
	Laundry	113,302	29%	1,378	1%	+/-26%	63%
	HVAC	401,994	61%	5,597	1%	+/-19%	28%
	Building Envelope	93,697	46%	866	1%	+/-28%	57%
PG&E Total		1,110,764	40%	65,049	6%	+/-11%	17%
SCE/SCG Total		635,236	39%	58,969	9%	+/-11%	17%
SDG&E Total		67,124	36%	4,984	7%	+/-8%	13%
Total Statewide		**1,813,124**	**39%**	**129,003**	**7%**	+/-6%	8%

Table 3-17 below provides estimates of the number of net practice recommendations implemented as a result of the HEES program. As this table shows, out of the nearly 3 million practice recommendations given, approximately 325,000 were reported implemented and attributed to the HEES program. This results in an overall net implementation rate of 11%.

Table 3-17: Estimates of Net Practice Implementation

Utility	Practice End-use	Rec's Given	Attribution Rate	Net Rec's Implemented	Net Imp Rate	90% Conf Int	Relative Precision
State-wide	Efficient Refrigerator and Freezer Practices	262,612	77%	50,786	19%	14%	16%
	Efficient Water Heater Practices	328,075	70%	58,176	18%	8%	9%
	Efficient Building Envelope Practices	327,903	57%	37,902	12%	10%	13%
	Other Practices	98,605	41%	11,400	12%	19%	28%
	Efficient Clothes Washing Practices	175,459	57%	20,104	11%	11%	16%
	Efficient Home Heating Practices	514,444	66%	48,018	9%	7%	11%
	Efficient Dishwashing Practices	144,476	57%	12,838	9%	14%	22%
	Efficient Pool and Spa Practices	112,342	67%	10,010	9%	18%	25%
	Efficient Clothes Drying Practices	305,020	59%	26,565	9%	12%	19%
	Efficient Cooling Tips	417,083	58%	33,489	8%	14%	22%
	Efficient Lighting Practices	212,590	63%	16,276	8%	23%	34%
PG&E Total		1,344,144	63%	152,210	11%	7%	10%
SCE/SCG Total		1,448,005	63%	162,003	11%	5%	7%
SDG&E Total		106,462	61%	11,351	11%	7%	10%
Total Statewide		2,898,611	63%	325,564	11%	3%	5%

Table 3-18 below shows the average number of recommendations implemented per audit by IOUI and recommendation type. This table shows that while PG&E gave significantly more measure and practice recommendations per audit their net implementation rates, for both measure and practice recommendations, were very similar. This resulted in a significantly higher number of recommendations implemented per HEES audit (2.5 recommendations implemented per audit in PG&E territory compared with 1.1 and 0.9 in SCE/SCG and SDG&E territories, respectively).

Table 3-18: Implemented Recommendations per HEES Audit

IOU	Total HEES Audits	Rec Type	Recs Given	Net Imp Rate[67]	Total Rec Implemented	Imp Rec per Audit
PG&E	86,255	Measure	1,110,764	6%	65,049	0.8
		Practice	1,344,144	11%	152,210	1.8
		Total	2,454,908	9%	217,259	2.5
SCE/SCG	209,171	Measure	635,236	9%	58,969	0.3
		Practice	1,448,005	11%	162,003	0.8
		Total	2,083,241	11%	220,972	1.1
SDG&E	19,048	Measure	67,124	7%	4,984	0.3
		Practice	106,462	11%	11,351	0.6
		Total	173,586	9%	16,335	0.9
Statewide Total	314,474	Measure	1,813,124	7%	129,003	0.4
		Practice	2,898,611	11%	325,564	1.0
		Total	4,711,735	10%	454,567	1.4

3.1.4 Regression Based Net Program Savings

This section discusses the findings from the regression analysis and insights that have resulted from this analysis.

As stated previously, the data used in this analysis included, for each IOU, the HEES tracking dataset, the EE tracking dataset, the CSI tracking dataset, the CIS data, the billing data, and the weather data. All these data sources were merged together to obtain the information needed for the analysis. The data were then cleaned carefully to remove any unreliable or invalid data points and/or sites. The detailed data preparation process is discussed in Section 4.1 along with the sample sizes used in each step of the analysis.

Summary of Findings and Insights

The Propensity Score Matching (PSM) and regression results are presented in this section for the HEES program evaluation. The PSM results include a visual presentation of the matching results. The regression results include estimates of impacts associated with the HEES program participation.

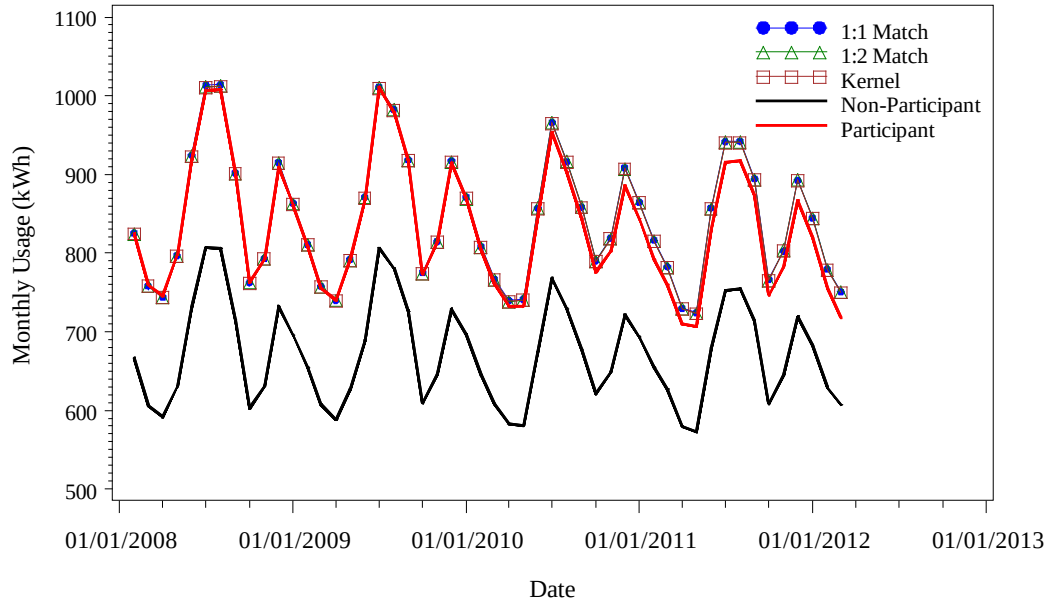
[67] Confidence and precision estimates on these values are provided in the preceding tables.

To summarize, participation in the HEES program within PG&E and SDG&E territories resulted in an average energy use reduction of 3.1% and 3.0%, respectively. Within Edison territory, the on-site and telephone surveys had the highest influence, with participants decreasing their energy usage by 5.6% and 6.5%, respectively[68]. The reduction in energy use resulting from Edison's mail-in surveys was lower at 2.1% and the online surveys had the lowest impacts (0.7% for the long online survey and no significant savings resulting from the short online survey).

Propensity Score Matching Results

Figure 3-4 through Figure 3-6 below illustrate for each of the utilities the monthly load profiles for the participants, the original sample of nonparticipants, and the matched sample of nonparticipants using 1:1 matching, 1:2 matching and 1:2 matching with Kernel weights. These figures show that the aggregate load shapes for the matched nonparticipants are very similar to those for the participants, compared to the original nonparticipant samples. It is also apparent in these graphs the growing separation between the participant and matched nonparticipants that begins around the second half of 2010 which illustrates the impacts among participants from the HEES program.

Figure 3-1: Monthly Load Profiles for PG&E Participants, Nonparticipants and Matched Nonparticipants



[68] This is also likely a result of Edison targeting their on-site and telephone surveys to their higher usage customers.

Figure 3-2: Monthly Load Profiles for SDG&E Participants, Nonparticipants and Matched Nonparticipants

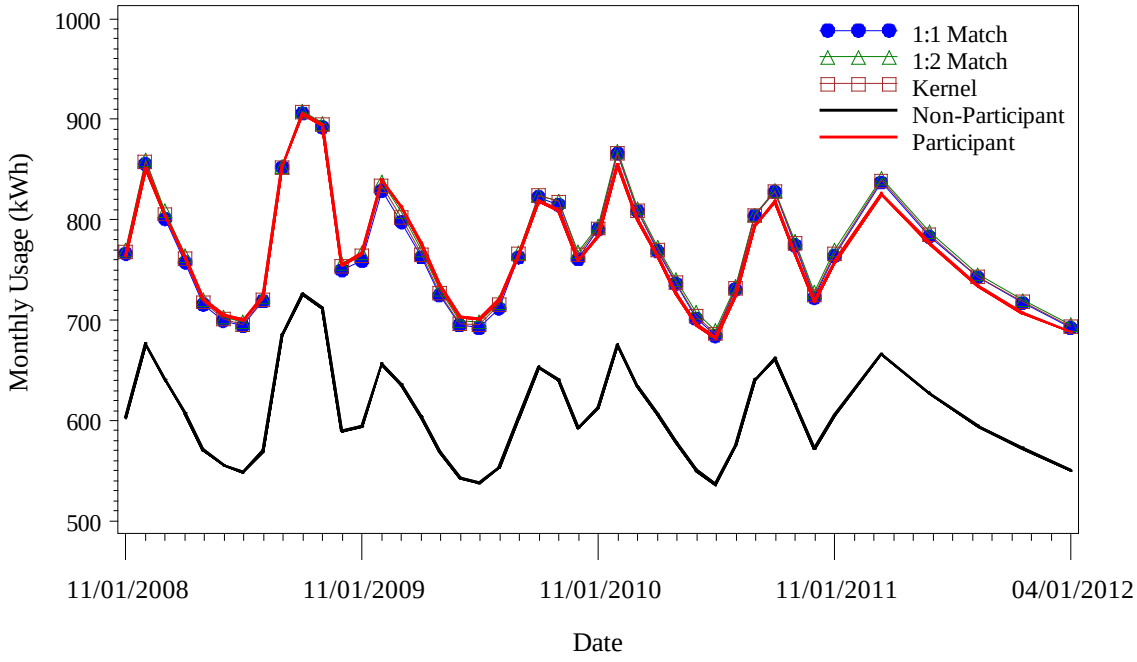


Figure 3-3: Monthly Load Profiles for Edison Participants, Nonparticipants and Matched Nonparticipants

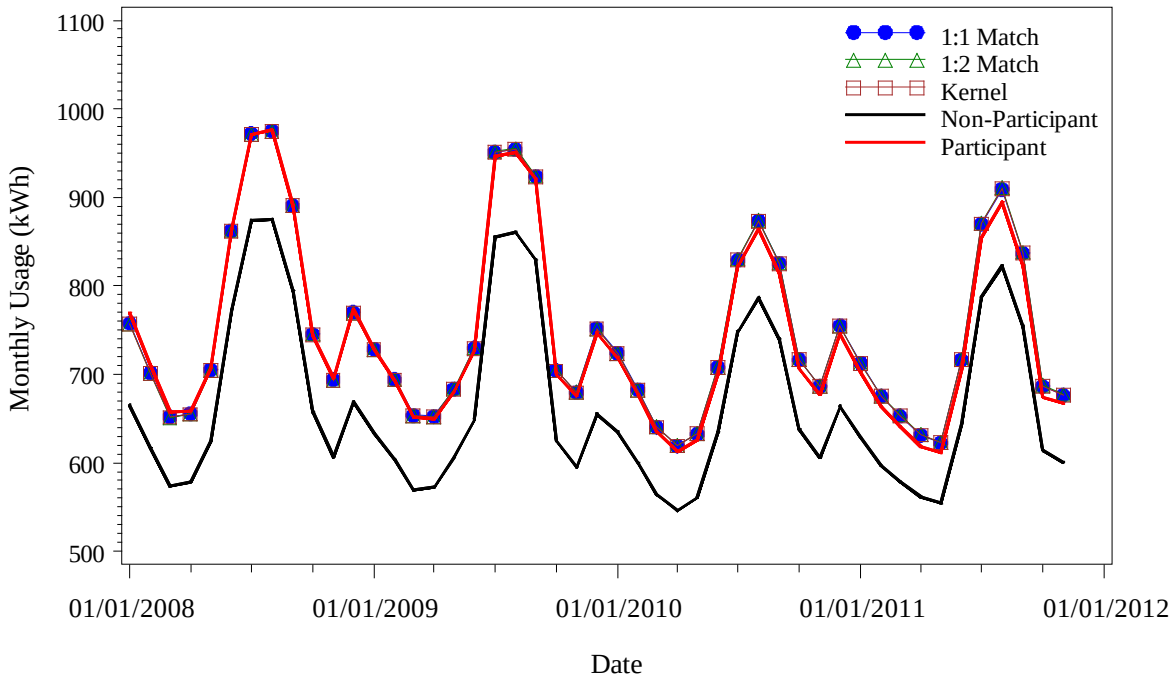


Table 3-19 below provides the t-test results for some selected variables before and after the propensity score matching process. The numbers in bigger Roman font are the averages of the selected statistics in design periods, and the smaller Italic font numbers are the p-values for the Welch's t-tests, testing the hypothesis that the participant sample and the corresponding nonparticipant sample are of the same mean[69]. The t-test results for other related variables all showed similar results and were listed in Section 4.4.

As the table below shows, the average monthly usage during the design period was 845 kWh for PG&E participants, 795 kWh for SDG&E participants, and 734 kWh for Edison participants. Each of these is significantly higher than the average monthly usage for the non-matched nonparticipant samples (which ranged from 620 kWh to 672 kWh). This may be an indication that HEES participants tended to opt-in and take the HEES survey in part due to their high electricity bills. After the PSM the mean usage values of the matched participants and nonparticipants at all three utilities come within 4 kWh of one another.

[69] Welch's t-test assumes that the variances of two samples are not the same. The t-test results assuming the same variance showed similar results, and available upon request.

The table below also shows that past EE participation rates were significantly higher for participants than for nonparticipants. This may indicate that participants have an increased focus on reducing their energy usage and thus are more likely to participate in other EE programs, or it may be that a customer's participation in the other EE programs introduced them to the HEES program. Whatever the cause, after the PSM, the difference for the PG&E and SDG&E samples falls to less than 0.5% (and is no longer significant). Although it is still significantly different for the Edison sample, the difference was drastically reduced. Across the entire Edison nonparticipant sample, only 1.8% of the households participated in an EE program (compared to a 6.5% EE participation rate in the participant sample), however in the matched nonparticipant sample 5.3% of the households had participated (a significant increase). As this table shows, before matching, the t-tests show significant differences between the participant sample and the nonparticipant sample, while after matching the majority of the differences are no longer statistically significant.

The propensity scores, based on which the matching was performed, were higher for the participants before matching and have no statistically significant difference after matching.

Table 3-19: Propensity Score Matching Results and t-Tests

	Participants	Non-Participants	Matched Participants	1 To 1 Matching	1 To 2 Matching	Kernel Matching
PG&E Whole Sample						
Mean Usage	845	672	846	847	846	846
		<.0001		*0.6475*	*0.9917*	*0.9715*
Past EE Participation	4.8%	2.1%	4.8%	4.6%	4.7%	4.6%
		<.0001		*0.1451*	*0.3299*	*0.1912*
Propensity Score	0.02	0.01	0.02	0.02	0.02	0.02
		<.0001		*0.9992*	*0.9992*	*0.9990*
SDG&E Whole Sample						
Mean Usage	795	620	794	787	791	789
		<.0001		*0.4879*	*0.8132*	*0.6371*
Past EE Participation	9.6%	3.4%	9.5%	9.8%	10.0%	10.1%
		<.0001		*0.6952*	*0.4538*	*0.4443*
Propensity Score	0.02	0.01	0.02	0.02	0.02	0.02
		<.0001		*0.9999*	*0.9982*	*0.9996*
Edison Whole Sample						
Mean Usage	734	661	734	737	737	737
		<.0001		*0.1292*	*0.1612*	*0.1845*
Past EE Participation	6.5%	1.8%	6.5%	5.3%	5.3%	5.3%
		<.0001		*<.0001*	*<.0001*	*<.0001*
Propensity Score	0.03	0.01	0.03	0.03	0.03	0.03
		<.0001		*0.9997*	*0.9995*	*0.9999*

Regression Results

The detailed regression results are reported in Section 4.4. This session presents the treatment effects from the HEES program and the savings realized from the other energy efficiency programs. The billing analysis was conducted by utilities, and the regression results are presented as such.

PG&E Results

Table 3-20 below presents the regression results for PG&E. The first two columns are the estimated coefficients and the p-values for the model that uses ex ante savings to control for the impacts from other EE programs, and the third and fourth columns are for the model that uses dummy variables. As shown in Table 3-20, the estimates of the HEES impacts were very similar in the two models. Both models found approximately 19 kWh of savings in the first three months after taking the HEES survey (PostHEES_1), and then an additional increase in savings of around 10 kWh per month starting three months after taking the HEES survey (PostHEES_4). These estimations are both statistically significant at 1% significance level. The PostHEES_7 variable is positive but not significant, showing no evidence of a further change in energy use six months after completing the HEES survey.

Row 4 of Table 3-20 shows that the PostHEES2_1 variable is negative and significant at 1% significance level, indicating participants who took the HEES survey for a second time saved an incremental 25 kWh per month, on top of the savings described above. Out of the 23,067 participants included in the regression, only 337 took the survey twice, 6 took the survey three times and one took the survey four times[70]. It is likely that those 344 participants were more eager to decrease their energy usages, and they took the survey again (and again) to find more ways to save, and it also because their eagerness, they saved significantly more than other participants. The coefficient estimates from the two regression models (the dummy variable and ex ante savings specifications) can then be used to calculate the average PG&E HEES participant's annual energy savings in the first year after completing the HEES survey. The savings are calculated in the following manner:

$$1^{st}\ Year\ Annual\ kWh\ Savings = PostHEES\_1 \times 12 + PostHEES\_4 \times 9 + PostHEES\_7 \times 6 + PostHEES2\_1 \times Weight^{2nd\ HEES}$$

Where $Weight^{2nd\ HEES} = \frac{\#\ participants\ who\ took\ the\ HEES\ survey\ twice}{\#\ participants}$

Using these calculations the average participant savings from the two model specifications were very similar. The dummy variable model specification yielded an average savings of 316 kWh in the first year and the ex ante savings model yielded 319 kWh in the first year after taking the

[70] If a participant took the survey more than one time, but within the same month, he or she would be counted as only taking the survey once. The survey had to be taken at least one month later than the previous one to be counted as another time.

HEES survey (savings from those who took the HEES survey for a second time increased the overall savings results by 4.5 kWh annually[71]).

Table 3-20: PG&E Regression Results for Selected Variables

Regression Variable	Ex Ante Savings Model		Dummy Variables Model	
	Estimation	p-Value	Estimation	p-Value
PostHEES_1	-18.74	*0.0000*	-18.58	*0.0000*
PostHEES_4	-9.89	*0.0001*	-9.80	*0.0002*
PostHEES_7	0.55	*0.8544*	0.63	*0.8330*
PostHEES2_1	-25.29	*0.0079*	-25.18	*0.0082*
HV	-0.46	*0.0014*	-18.61	*0.0116*
LT	0.05	*0.8930*	-6.88	*0.6343*
OT	-1.09	*0.0000*	-93.19	*0.0000*
RF	-0.67	*0.0000*	-43.53	*0.0000*
WH	-1.14	*0.0001*	-11.95	*0.0000*

The second half of Table 3-20 above presents the estimated impacts from the other utility EE programs. Take the HVAC measures as an example. The table above shows that the ex ante saving model found HVAC measures (row "HV") installed through other utility EE programs saved 46% of the ex ante savings (statistically significant at 1% significance level). The dummy variables model found the average savings from the HV measures to be 18.61 kWh per month (statistically significant at 5% significance level). While the significance levels on rows HV through WH in the table above are very consistent between the two models, it is not clear whether the estimations are similar or not. Table 3-21 below summarizes some of the statistics for the EE related variables, along with the regression results, in order to compare the two sets of results.

Table 3-21 below provides the number of sites that according to utility EE tracking data installed one or more measures falling into one of the EE program groupings. It also provides the average monthly ex ante kWh savings for the participants (PT), the nonparticipants (NP), and across the entire sample. As this table shows, overall, there were 6,056 households, about 13.4% of the participant sample, who had installed EE measures through a utility EE programs. Based on the average pre-HEES monthly usage of PG&E participants and nonparticipants (821 and 861 kWh

[71] Although customers who took HEES more than once increased their usage by 25 kWh per month, only 1.5% of the population did this and so the weighted average impact, using number of households as weight, did not change much.

per month) the EE measures saved 2.5% of electricity for the participants and 2.3% for the nonparticipants.

In order to compare the estimates of EE program savings from the two models, the predicted kWh savings was calculated for the ex ante savings model by multiplying the average ex ante monthly kWh savings (column 5 in the table below) by the modeled realization rate (column 7). Similarly, the predicted realization rate from the dummy variables model can be calculated dividing by the estimated kWh savings from the dummy variables model by the average ex ante kWh savings estimate. The realization rates and estimated kWh savings can then be compared between the two model specifications.

The two sets of results might look different, but there are actually no statistically significant differences, in that all of the kWh savings calculated from the ex ante saving model are within one standard deviation of the estimated kWh savings from the dummy variable model[72], except for HV, where the difference between the two equals 1.02 standard deviation of the estimated kWh saving.

Overall, as the table below shows, the dummy variables regression model found that households who participated in other EE programs saved on average 18.6 kWh per month from the installation of HVAC measures, 43.5 kWh per month from refrigeration measures, 12 kWh from water heating measures and 93.2 kWh per month from other measures (primarily pool pumps). The lighting savings were not statistically significant from zero. The ex ante saving model found that the HVAC measures saved 46% of the ex ante savings they claimed for, the refrigerators saved 67%, the water heater measures saved 114%, and the other measures saved 109%.

The estimated EE program savings reported here should be interpreted with caution, because the sample from which these results were derived was HEES program participants and the matched nonparticipants, not a random sample drawn from the population of EE program participants. The HEES participant sample was shown to be different than PG&E's overall customer base, and therefore, these results should not be generalized to be representative of the entire population of EE program participants.

[72] Please refer to Section 4.4 for the standard errors.

Table 3-21: PG&E Savings from other PG&E Energy Efficiency Programs

EE Program Participation	# Sites	Avg Ex Ante kWh Savings			Ex Ante Savings Model		Dummy Variables Model	
		Parts	NPs	Avg	Calc. kWh Saving	Est. RR	Est. kWh Saving	Calc. RR
HV	1154	24.1	24.3	24.2	11.1	0.46	18.6	0.77
LT	134	51.6	55.1	53.1	-2.5	-0.05	6.9	0.13
OT	197	79.1	82.1	80.6	87.7	1.09	93.2	1.16
RF	771	62.9	62.5	62.7	41.9	0.67	43.5	0.69
WH	4,265	6.7	6.6	6.7	7.6	1.14	12.0	1.80
Total	6,056	21.1	19.2	20.2				

SDG&E Results

Table 3-22 below presents the regression results for SDG&E. The normal fonts are the estimated coefficients and the italic fonts are the p-values. As stated previously in the methodology section, due to the smaller SDG&E samples available for the regression modeling, the regressions were run using all three matching methods (the 1:1 matched sample, the 1:2 matched sample and the 1:2 matched sample with Kernel weights). The results were not statistically different and thus the 1:1 results are shown below[73].

As shown in Table 3-22, the parameter estimates on the HEES variables were very similar in the ex ante saving model and the dummy variable model. Both models found approximately 23 kWh savings in the first three months after taking the HEES survey (PostHEES_1). The savings increased to 31 kWh per month starting three months after taking the HEES survey (PostHEES_4), and dropped back to 21-22 kWh per month six months after the survey was completed (PostHEES_7). These estimates are all statistically significant at 10% significance level or higher.

PostHEES2_1 in Table 3-22 is positive but not significantly different from zero, indicating no change in electricity consumption after taking the HEES survey for the second time. This result, however, should be interpreted with caution, because only 102 participants had taken the survey more than once, and none had taken it more than twice. With the small sample size, one or two outliers can significantly influence the results.

Calculating HEES impacts using the formula described above for PG&E (but excluding the PostHEES2_1 variable since it was not significant), the average SDG&E participant saved 294

[73] The regression results of the other two matching methods are available upon request.

kWh (dummy variable model, 299 kWh based on the ex ante saving model) in the first year after participating in the HEES program.

Table 3-22: SDG&E Regression Results for Selected Variables

Regression Variable	Ex Ante Savings Model		Dummy Variables Model	
	Estimation	p-Value	Estimation	p-Value
PostHEES_1	-23.21	*0.0000*	-22.97	*0.0000*
PostHEES_4	-7.70	*0.0561*	-7.62	*0.0581*
PostHEES_7	8.16	*0.0589*	8.40	*0.0523*
PostHEES2_1	3.78	*0.8447*	4.13	*0.8311*
HV	-0.20	*0.4540*	-8.30	*0.5001*
LT	-0.37	*0.6306*	-18.62	*0.1055*
OT	-0.15	*0.1476*	-19.31	*0.3994*
RF	-0.43	*0.0002*	-31.22	*0.0000*
WH	1.54	*0.1189*	8.26	*0.2525*

Table 3-23 below compares the regression results for SDG&E EE program savings between the ex ante savings model and the dummy variables model. Again, the estimates might appear different, but the calculated kWh savings estimates for each end use are within one standard deviation of one another, except for lighting, which are not statistically significant from zero.

Overall, the analysis found that the refrigerators saved 31.2 kWh per month, which is statistically significant at 1% significance level. The other measures, including whole house retrofit and pool pumps, saved 19.3 kWh per month, but only marginally significant at 15% significance level.

Saving from EE Lighting, HVAC and Water Heating measures were not found to be statistically significant. The lack of significant HVAC savings is likely caused by the two summers in the analysis period being quite mild, and hence little need for the HVAC measures. For Water Heating, only 280 households claimed any savings per month from WH measures (average claimed savings was 6.7 kWh, including dishwashers and washing machines). Such a small sample makes finding the savings from the billing data difficult and easily mixed among the error.

Table 3-23: SDG&E Savings from other SDG&E Energy Efficiency Programs

EE Program Participation	# Sites	Avg Ex Ante kWh Savings			Ex Ante Savings Model		Dummy Variables Model	
		Parts	NPs	Avg	Calc. kWh Saving	Est. RR	Est. kWh Saving	Calc. RR
HV	98	25.0	27.5	25.9	5.2	0.20	8.3	0.32
LT	136	12.7	16.1	13.8	5.1	0.37	18.6	1.35
OT	77	95.4	125.0	101.5	15.3	0.15	19.3	0.19
RF	286	59.7	56.2	58.2	24.7	0.43	31.2	0.54
WH	280	6.9	6.5	6.7	-10.3	-1.54	-8.3	-1.23
Total	746	40.2	34.5	37.8				

Edison Results

Edison had the largest HEES participant sample during the period of analysis. There were 186,978 households in the HEES tracking data, and 48,901 participants remained for the billing analysis after the data cleaning, merging and matching was completed[74]. During the 2010-2012 program cycle Edison also provided different types of surveys, including on-site surveys, telephone surveys, mail-in surveys, and long and short online surveys.

Table 3-24 below show the number of HEES participants along with their average monthly usage for each of the survey types by quarter of participation in 2010. As shown in this table, the average monthly usage across all quarters was 762 kWh for on-site HEES participants, 907 kWh for telephone HEES participants, and 824 kWh for mail-in HEES participants; far higher than the 482 kWh per month for the short online HEES participants and 624 kWh per month for the long online HEES participants. It seemed that Edison targeted the high usage customers using the on-site, telephone and mail-in surveys, whereas the online surveys were available to all households.

Also, it can be seen from Table 3-24 that the average monthly usage of participants who completed the HEES survey in the first quarter of 2010 is 878 kWh. The average monthly usage dropped to 777 kWh for participants who took the survey in the second quarter, 623 kWh for those who took it the third quarter and 690 kWh for those who completed it in the fourth quarter. This reduction in average monthly usage was driven in part by the change in the distribution of survey type across quarters, however this same pattern is also seen within the distinct survey types. This seems to indicate that higher usage customers were targeted more by the HEES program at the beginning of the 2010 than towards the end of the year.

[74] Please refer Section 4.1, Data Cleaning and Sample Preparation for details.

Table 3-24: Edison Sites and Average Monthly Usages by Survey Type and Participation Quarter

		Q1		Q2		Q3		Q4		Total	
		Parts	Avg Usage	Parts	Avg Usage	Parts	Avg Usage	Parts	Avg Usage	Parts	Avg Usage
Edison Survey Type	On-Site	687	813	168	545			5	1,114	860	762
	Telephone	99	909	484	907					583	907
	Mail-In	9,676	899	2,918	846	792	664	14,501	779	27,887	824
	Long	480	824	737	791	2,067	681	14,069	600	17,353	624
	Short	304	447	843	497	1,029	474	42	648	2,218	482
All Parts		11,246	878	5,150	777	3,888	623	28,617	690	48,901	737
Matched NonParts		10,986	887	5,109	774	3,864	622	27,731	697	47,690	743

Due to the differences that exist between customers who participated in the HEES program via the different delivery methods, as well as differences in the actual HEES survey experience for each of these methods, the evaluation team divided the Edison participant population into three survey types and then completed the regression analysis separately for each survey type grouping. The results for each of the three survey type groupings (on-site and telephone surveys, mail-in surveys and online surveys (both short and long)) are provided below.

An additional factor that had to be accounted for within the Edison analysis was the energy kits that were distributed to a large proportion of HEES program participants. During all of 2010, Edison distributed energy saving kits to all customers who completed a HEES survey via any method except the short online survey[75]. The energy saving kits included one or two CFLs, an LED nightlight, three faucet aerators and a low-flow showerhead. Since Edison claimed savings for the measures included in these energy saving kits through another EE program, ideally the impacts from these kits and those from the HEES survey would estimated separately. Doing this, however, proved to be difficult since the savings from the kits were highly correlated with

[75] SDG&E also distributed the energy saving kits to the customers who completed the survey, but SDG&E never claimed savings for these measures. SDG&E might also distribute the energy saving kits through other programs, but still, there were no records on the give-away measures. Therefore, the savings from such measures, if any, might have been (partly) attributed to the HEES program.

the impacts from the HEES program (nearly all participants received the kits[76] close to the same time as they took the HEES survey)[77].

The model specifications run for each of the Edison survey type groupings were similar to those completed for PG&E and SDG&E (including both the dummy variable model and the ex ante savings model) but included an additional Kit variable (KT) as one of the EE measure variables. These models were run on two distinct samples, one including the small sample of Edison nonparticipants who also received an energy savings kit, and one excluding these nonparticipants as well as the kit (KT) variable. The model that excluded the nonparticipants who received kits and the kit variable should, in theory, attribute all savings from the kits, if any, to the HEES program.

After reviewing the regression results across all of the different model specifications and samples, the evaluation team recommends using the results based on the samples that excluded the nonparticipants who received energy saving kits to calculate the impacts from the HEES program. These results were selected for a number of reasons. First, since the HEES impacts were highly correlated with the kits savings, the confidence to separate the two effects correctly is quite low. Even if the regression models attribute α% the savings to the HEES program and the other (1- α)% to the kits, confidence on the accuracy of this separation and the accuracy of the coefficient of the ex ante savings or dummy variable are worrisome. Secondly, the energy saving kits were unlikely to induce significant observable energy savings. The kits contained three faucet aerators and a low-flow showerhead, which according to customer self-report data, were only installed about 50% of the time, and when installed, resulted in gas savings. The LED night light and CFLs were more likely to contribute some electricity savings. Edison participants reported about 75% of the night lights received were still installed and 80% of the CFLs were still installed. However, nearly 50% of the LED nightlights installed did not replace another nightlight or lamp (thus resulting in a net electricity increase) and 15% of the CFLs replaced another CFL or were put into a new lamp, and thus would also not generate any electricity savings. Because the level of energy savings from these kits was so small, it could easily be mixed with other error terms, and would be very difficult to observe in the billing data.

Before estimating the regression models, one additional suppression was applied to the Edison samples. This suppression excluded households who installed water heater measures through the other EE programs. In total there were only seven participants and nine nonparticipants, and

[76] There were only a small number of nonparticipants who received the energy saving kit measures outside of the HEES program.

[77] For onsite customers, the energy saving kits were directly installed, and for other survey types, the kits were mailed out, and there might be a little bit delay between the participation time and the time the mailed out kits were received.

thus due to this small sample size, it would be very difficult to estimate the savings from these measures.

The results from this model specification are provided in the section below. Complete results from all final model specifications run are included in Section 4.4.

On-site and Telephone HEES Survey Results

Table 3-25 below presents the regression results for on-site and telephone survey sample. As can be seen from the table, the two sets of regression results are very consistent. There were 14 nonparticipants excluded from the sample because they had received an energy saving kit. Excluding these 14 sites did not make any significant change to the resulting impact estimates (regression results including these 14 nonparticipants are included in Section 4.4).

As discussed previously, the regression results of the dummy variable model were used to calculate the impacts from the HEES program. As shown in Table 3-25, on-site survey participants saved 44 kWh in the first three months after they participated in the HEES program. The savings increased to 73 kWh per month three months after completing the survey, and dropped back to 30 kWh per month six months after participation. The estimations are all statistically significant at 5% significance level.

The PostHEES2_1 variable in Table 3-25 is positive but not significantly different from zero, indicating participants who took the HEES survey more than once did not have a statistically significant increase or decrease in their electricity savings. There were 41 out of 1,443 participants who had taken the survey twice, and three who had taken the survey three times.

Calculating HEES impacts using the formula described above for PG&E and SDG&E (but again excluding the PostHEES2_1 variable since it was not significant), the average on-site participant saved 528 kWh (dummy variable model, 531 kWh based on the ex ante saving model) in the first year after completing the HEES survey.

The regression models estimated the average telephone survey participants saved 60 kWh per month after completing the HEES survey. There were no statistically significant increases or decreases to their saving three or six months after their participation. Therefore, it is estimated that the average telephone participant saved 720 kWh (dummy variable model, 721 kWh, ex ante saving model) in the first year after completing the HEES survey.

Table 3-25: Regression Results of Selected Variables for Edison On-Site and Telephone Samples

	Ex Ante Saving		Dummy Variables	
	Estimation	**p-Value**	**Estimation**	**p-Value**
PostOnSite_1	-43.66	*0.0001*	-43.76	*0.0001*
PostOnSite_4	-29.78	*0.0127*	-29.61	*0.0131*
PostOnSite_7	43.53	*0.0000*	43.87	*0.0000*
PostTel_1	-60.07	*0.0000*	-60.02	*0.0000*
PostTel_4	6.80	*0.4947*	7.14	*0.4731*
PostTel_7	12.00	*0.2211*	12.59	*0.1991*
PostHEES2_1	18.83	*0.3384*	14.59	*0.4827*
HV	-0.62	*0.0224*	-26.82	*0.5037*
LT	0.54	*0.1134*	18.56	*0.1925*
OT	-1.92	*0.0000*	-176.73	*0.0000*
RF	-0.48	*0.0140*	-43.28	*0.0000*

Table 3-26 below shows that there were 307 households that participated in one of the other utility EE programs, which is approximately 11% of the sample. HEES participants who also participated in another EE programs averaged 58.9 kWh savings per month, about 7% of their usage; and the nonparticipants averaged 53.1 kWh savings, about 6% of their monthly usage.

Table 3-26 below also compares the regression results on EE savings between the ex ante saving model and the dummy variable model. The HVAC savings estimated using the ex ante saving model is statistically significant at the 5% significance level, but not statistically significant in the dummy variable model. The point predictions for the HVAC savings from the two models, however, are very similar. The ex ante saving model predicted 37.4 kWh savings per month and the dummy variable model predicted 26.8 kWh per month. Considering the big standard error for the estimated kWh savings from the dummy variable model (40.1), these two numbers were of not significantly different. For this measure category, with only 21 sites that installed HVAC measures, errors from one site can influence the results a lot.

The biggest inconsistency between the two models was for refrigerator measures, for which the predicted kWh savings were 26.4 kWh per month from the ex ante savings model, and 43.3 kWh per month from the dummy variables model. The difference between these two results was not statistically significant.

The savings from the OT measures were also found to be statistically significant. The analysis found that the OT measures, including whole house retrofits, pool pumps and pool and spa related measures, saved 176.7 kWh per month, about 192% of the savings claimed by Edison. This result, however, should be interpreted with caution, since there were only 20 sites who installed measures under this category (and they are not representative of the entire Edison population of these measure participants).

Similar to PG&E and SDG&E, the saving from lighting measures were not found to be significant.

Table 3-26: Savings from the Other EE Programs for Edison On-site and Telephone Sample

EE Program Participation	# Sites	Avg Ex Ante kWh Savings			Ex Ante Savings Model		Dummy Variables Model	
		Parts	NPs	Avg	Calc. kWh Saving	Est. RR	Est. kWh Saving	Calc. RR
HV	21	53.8	70.3	59.9	37.4	0.62	26.8	0.45
LT	25	32.3	39.4	38.3	-20.7	-0.54	-18.6	-0.48
OT	20	74.1	82.4	78.4	150.5	1.92	176.7	2.25
RF	248	58.2	51.0	55.0	26.4	0.48	43.3	0.79
Total	307	58.9	53.1	56.1				

Mail-in HEES Survey Results

Table 3-27 presents the regression results for Edison's mail-in HEES survey participants. As discussed above, the two sets of the regression results that excluded the nonparticipants who received the energy saving kits were used to calculate the HEES impacts for the Edison program. As shown Table 3-27, HEES mail-in participants were found to save 18 kWh per month after completing the HEES survey. There were no additional statistically significant changes to this monthly impact three or six months after taking the survey.

The PostHEES2_1 variable in Table 3-27 is negative, but not significantly different from zero, indicating no incremental electricity savings after taking the HEES survey for a second time. There were 211 out of 27,886 participants included in the model who had taken the HEES survey twice, three had taken three times and one had taken four times.

Calculating HEES impacts using the formula described above for PG&E and SDG&E (but again excluding the PostHEES2_1 variable since it was not significant), the average mail-in participant

saved 210 kWh (based on the dummy variable model, 214 kWh based on the ex ante saving model) in the first year after completing the HEES survey.

Table 3-27: Regression Results of Selected Variables for Edison Mail-in Samples

	Ex Ante Saving		Dummy Variables	
	Estimation	**p-Value**	**Estimation**	**p-Value**
PostMail_1	-17.85	*0.0000*	-17.53	*0.0000*
PostMail_4	3.34	*0.4495*	3.40	*0.4437*
PostMail_7	1.96	*0.6645*	1.78	*0.6962*
PostHEES2_1	-6.43	*0.6644*	-5.97	*0.6888*
HV	-0.62	*0.0000*	-6.28	*0.4633*
LT	-0.04	*0.8164*	9.29	*0.4420*
OT	-1.82	*0.0000*	-121.32	*0.0000*
RF	-0.48	*0.0000*	-35.83	*0.0000*

Table 3-28 shows that there were 5,449 households that participated in another utility EE program, which equates to about 10% of the sample. HEES participants who also participated in another EE programs averaged 55.5 kWh savings per month, about 7% of their usage; and the nonparticipants averaged 53.8 kWh savings, about 6% of their monthly usage.

Table 3-28 below also compares the regression results on EE savings between the ex ante saving model and the dummy variable model. The HVAC savings estimated using the ex ante saving model is statistically significant at the 1% significance level, but not statistically significant in the dummy variable model. This was the same scenario that was found in the analysis of Edison's on-site and telephone sub-sample. But this time, the point predictions for the HVAC savings from the two models were found to be very different. The dummy variable model predicted only 6.3 kWh savings per month, whereas the ex ante saving model predicted 24.6 kWh savings per month. However due to the large standard errors surrounding these estimates, they are not statistically significant different from one another.

The models also found statistically significant savings for refrigerator measures, approximately 35.8 kWh savings per month, which was 48% of the claimed savings. The savings from the OT measures were also found to be statistically significant. The analysis found that the OT measures, including whole house retrofit, pool pumps and pool and spa related measures, saved 121.3 kWh per month, about 182% of the claimed savings. The savings from lighting measures were again not significant. These findings were consistent with the findings from the on-site and telephone sub-sample.

Table 3-28: Savings from the Other EE Programs for Edison Mail-In Sample

EE Program Participation	# Sites	Avg Ex Ante kWh Savings			Ex Ante Savings Model		Dummy Variables Model	
		Parts	NPs	Avg	Calc. kWh Saving	Est. RR	Est. kWh Saving	Calc. RR
HV	347	37.5	43.5	39.7	24.6	0.62	6.3	0.16
LT	410	48.4	35.1	36.2	1.6	0.04	-9.3	-0.26
OT	464	47.7	54.8	50.4	92.0	1.82	121.3	2.41
RF	4402	57.0	55.8	56.4	26.9	0.48	35.8	0.64
Total	5499	55.5	52.2	53.8				

Online HEES Survey Results

Table 3-29 presents the regression results for Edison online sample. The HEES savings found in this sample were smaller than from the two previous samples. The participants who took the long online HEES survey were found to save 4.9 kWh based on the ex ante saving model, and 4.4 kWh based on the dummy variable model. The former saving number was statistically significant at the 10% significance level and the latter number was only marginally significant at the 12% significance level. There were no statistically significant changes in energy savings three or six months after taking the HEES survey.

The short online HEES survey helped the participants to save 18 to 19 kWh per month, but the effect was not statistically significant. No significant savings were detected three or six months after taking the HEES short online survey either.

The PostHEES2_1 and PostHEES3_1 variables, as shown in Table 3-29, are negative but not significantly different from zero, indicating no significant change in electricity consumption across participants who took the HEES survey for more than one time. There were 351 out of 19,565 online HEES participants in the sample who took the HEES survey twice, 22 who took it three times and one who took it four times.

Therefore, it was estimated that a participant who took the online long survey saved approximately 53 kWh (based on the dummy variable model, 59 kWh based on the ex ante saving model) in the first year after taking Edison's long online HEES survey. As stated previously, the short online HEES survey was found to not produce any significant savings within the population who completed it.

Table 3-29: Regression Results of Selected Variables for Edison Online Samples

	Ex Ante Saving		Dummy Variables	
	Estimation	**p-Value**	**Estimation**	**p-Value**
PostLong_1	-4.91	*0.0837*	-4.38	*0.1242*
PostLong_4	4.62	*0.2546*	4.71	*0.2435*
PostLong_7	3.64	*0.3892*	3.36	*0.4219*
PostShort_1	-18.95	*0.1936*	-18.48	*0.2055*
PostShort_4	15.08	*0.1507*	15.34	*0.1447*
PostShort_7	3.09	*0.8559*	2.97	*0.8618*
PostHEES2_1	-4.88	*0.4012*	-5.09	*0.3785*
PostHEES3_1	-10.43	*0.6113*	-9.04	*0.6377*
HV	-0.34	*0.0068*	-22.70	*0.0063*
LT	-0.12	*0.3105*	4.36	*0.5824*
OT	-1.08	*0.0000*	-81.49	*0.0000*
RF	-0.47	*0.0000*	-36.94	*0.0000*

Table 3-30 below showed that there were 3,456 households that participated in another utility EE program, about 9% of the sample. HEES participants who also participated in another EE programs average 51.9 kWh of savings per month from these programs, about 8.5% of their usage; and the nonparticipants averaged 47.9 kWh savings from these programs, about 7.3% of their monthly usage.

The two models specifications (dummy variable and ex ante savings) were also consistent in their EE saving estimations. Both models found significant savings from HVAC, refrigerator and other measures, and both found lighting savings not statistically significant from zero. As shown in Table 3-30 the installation of HVAC measures were estimated to save 13.4 kWh per month (34% of the utility claimed savings) based on the ex ante savings model and 22.7 kWh per month, (58% of the utility claimed savings) based on the dummy variable model. Similarly, refrigerator measures were estimated to save 24.8 kWh per month (47% of claims, ex ante model) or 36.9 kWh per month (70% of claims, dummy variable model). OT measures were estimated to save between 54kWh per month (108% of claims, ex ante model) and 81.5 kWh per month (163% of claims, dummy variable model). However due to the large standard errors surrounding these estimates, they are not statistically significant different from one another.

All these findings were consistent with the findings from the other two Edison samples.

Table 3-30: Savings from the Other EE Programs for Edison Online Sample

EE Program Participation	# Sites	Avg Ex Ante kWh Savings			Ex Ante Savings Model		Dummy Variables Model	
		Parts	NPs	Avg	Calc. kWh Saving	Est. RR	Est. kWh Saving	Calc. RR
HV	241	38.1	43.4	39.3	13.4	0.34	22.7	0.58
LT	396	40.0	31.9	35.4	4.4	0.12	-4.4	-0.12
OT	204	48.5	52.3	49.9	54.0	1.08	81.5	1.63
RF	2698	53.7	52.2	53.1	24.8	0.47	36.9	0.70
Total	3456	51.9	47.9	50.3				

Table 3-31 below summarizes the impacts from the HEES programs across all utilities and delivery methods. The impacts shown here are the results from the dummy variable model. The HEES impacts for PG&E also included the savings generated by the participants who had taken the survey more than once. As shown in the table below Edison customers who participated in HEES through the on-site or telephone delivery methods had much larger impacts than the other Edison delivery methods (as well as the other IOU HEES programs.) Edison HEES telephone and onsite surveys were typically only offered to customers with extremely high usage or those who contacted Edison to complain of high bills. It is likely the combination of the personalized HEES delivery method along with the high pre-HEES usage that allowed these customers to achieve such high levels of savings from HEES.

For all samples, the average monthly usages decreased after participating in the HEES program. The HEES effects, as a percentage of pre-HEES usage were listed in the last column of Table 3-31. The HEES program was found to have similar impacts in PG&E and SDG&E territory, resulting in a reduction in participant energy use by 3%. Within Edison territory, the on-site and telephone surveys had the highest influence, with participants decreasing their energy usage by 5.6% and 6.5%, respectively. The reduction in energy use resulting from Edison's mail-in surveys was lower at 2.1% and the online surveys had the lowest impacts (0.7% for the long online survey and no significant savings resulting from the short online survey).

Table 3-31: Summary of HEES Impacts

Utility	Delivery Method	Average Monthly Usage		Annual HEES Impact	
		Pre-HEES	Post-HEES	kWh	%
PG&E	Online	841	811	316	3.1%
SDG&E	Online	782	749	294	3.1%
Edison	On-site	791	724	528	5.6%
	Telephone	930	874	720	6.5%
	Mail-In	838	800	210	2.1%
	Long Online	628	613	53	0.7%
	Short Online	486	474	0	0.0%
	Total	742	714	152	1.7%

The difference of the annual HEES energy savings across Edison's five survey types are likely due to differences related to the delivery of the survey, as well as the participants who completed the surveys via the different modes. On-site and telephone surveys allow participants to discuss their situation and concerns verbally with another person, and hence may have resulted in them received more tailored recommendations or additional support to assist them with implementation of these recommendations. Participants may also have been more likely to remember the suggestions due to the personal contact. Similarly, those who took the survey by mail might also be more likely to recall the HEES survey and recommendations due to the "pen-to-paper" involvement it required. In our highly computer dependant world, tasks done online may blend together or be easily forgotten. Participant self-report data (from the CATI phone survey) found higher rates of recommendation recall from participants who completed the survey via mail (50%) than those who completed in online (37%).

As stated previously, the populations of customers who took the various survey types were also different. The online long and short survey participants had average usage levels around 628 kWh and 486 kWh per month prior to taking the HEES survey. This was much less than the telephone survey participants, who used 930 kWh per month. Since the online HEES survey participants started from such a lower monthly consumption level, it may have been more difficult for them to reduce their energy consumption further.

The difference in the annual HEES impacts among the three IOUs may also result from the variance in the pre-HEES usage (PG&E and SDG&E online participants used around 800 kWh per month prior to taking the HEES survey, compared to the 628 kWh used monthly by the Edison participants who took the similar survey).

3.1.5 Energy Efficiency Kit Savings

As mentioned above, a portion of SCE and SCG customers who completed a HEES survey[78] received a free energy efficiency kit in the mail. This kit contained 3 faucet aerators, a low flow showerhead, one or two CFL light bulbs and an LED night light. According to program tracking data more than 130,000 kits were mailed to HEES participants between January 2010 and May 2011.

As part of the telephone survey, HEES program participants who according to program tracking data received energy kits were asked whether or not they recalled receiving each of the kit measures. As shown in Table 3-32 below, overall 86% of those surveyed recalled receiving one or more items in the energy savings kit. Recall of the kits was highest among Edison mail survey participants (90%) and lowest among SDG&E mail participants (36%, however small n). Amongst those who did recall receiving one or more of the kit items, showerheads and CFLs were recalled the most often (93%) and LED nightlights were recalled the least often (82%). Recall of faucet aerators fell roughly in the middle (89%).

Table 3-32: Recall of Kit Receipt by Strata

Strata	n	Kit Receipt %
Edison - Mail	250	90%
Edison - Online	251	82%
SDG&E - Mail	25	36%
SDG&E - Online	145	65%
Total	671	86%

Survey participants who recalled receiving kit measures were asked follow-up questions regarding whether or not they had installed the measure, whether it was still installed and what the measure replaced. Table 3-33 below provides the installation status of the kit measures across the population of customers who recalled receiving them. This table shows that across both utilities, CFLs and LED nightlights were installed most frequently and showerheads and faucet aerators were installed the least frequently.

[78] Customers who completed the short 5-minute online survey did not receive an energy savings kit.

Table 3-33: Installation Status of Kit Measures by Utility

Utility	Installation Status	Faucet Aerators	Showerhead	CFLs	LED Nightlight
SCE/SCG	Installed - All	48%	59%	85%	81%
	Installed - Some	13%	-	-	-
	Did Not Install	36%	40%	14%	18%
	Don't Know	3%	1%	1%	2%
SDG&E	Installed All	46%	51%	89%	64%
	Installed Some	13%	-	-	-
	Did Not Install	41%	49%	8%	36%
	Don't Know	1%	0%	3%	0%

Customers who reported they had installed the kit measures they received were asked whether or not they had removed any of the items. On the whole, across all kit measures and both utilities, survey respondents reported approximately 88% of installed measures have not been removed. Table 3-34 below shows the removal status by kit measure.

Table 3-34: Removal Status of Kit Measures by Utility

Utility	Removal Status	Faucet Aerators	Showerhead	CFLs	LED Nightlight
SCE/SCG	All Still Installed	94%	87%	84%	88%
	Some Removed	3%	-	-	-
	All Removed	2%	13%	7%	12%
	Don't Know	1%	-	8%	0%
SDG&E	All Still Installed	92%	83%	94%	78%
	Some Removed	2%	-	-	-
	All Removed	2%	17%	0%	22%
	Don't Know	4%	-	6%	0%

Table 3-35 below shows the distribution of the current status of kit measures. This table shows that CFLs are the kit measure reported most frequently to still be installed (overall 80% of the CFLs that survey respondents recalled receiving are still installed) and the majority of uninstalled CFLs are reported to be in storage and will likely be installed at a later date. Low-flow showerheads and faucet aerators are the kit measures least likely to currently be installed (only 50% of SCE and 42% of SDG&E were reportedly still installed).

Table 3-35: Current Status of Kit Measures by Utility

Utility	Current Status	Faucet Aerators	Showerhead	CFLs	LED Nightlight
SCE/SCG	Installed	50%	52%	80%	73%
	Discarded - Broken	1%	1%	5%	4%
	Discarded - Didn't Like	1%	3%	1%	1%
	In Storage	41%	34%	12%	17%
	Gave Away	6%	8%	1%	3%
	Don't Know	0%	2%	1%	3%
SDG&E	Installed	42%	43%	92%	50%
	Discarded - Broken	1%	1%	0%	7%
	Discarded - Didn't Like	1%	6%	0%	0%
	In Storage	47%	36%	8%	18%
	Gave Away	6%	10%	0%	7%
	Don't Know	2%	4%	0%	18%

Survey respondents who reported they had installed one of the lighting measures (a CFL or LED nightlight) they received in the energy efficient kit were asked what this measure replaced. As shown in Table 3-36 below, respondents indicated the CFLs provided in the kit most often replaced an incandescent bulb (82%). Thirteen percent indicated the CFL replaced another CFL and 1% indicated the CFL was installed in a new light fixture. The LED nightlights most frequently were installed as an incremental nightlight and did not replace another light source left on at night (48%). Nine percent of the LED nightlights installed replaced a lamp that was left on overnight and 41% replaced another nightlight.

Table 3-36: Lighting Measure Replacement by Utility

Lighting Measure	Replacement Status	SCE/SCG	SDG&E	Overall[79]
CFLs	Replaced Incandescent	82%	79%	82%
	Replaced CFL	13%	13%	13%
	New Lamp	1%	2%	1%
	Don't Know	4%	6%	4%
LED Nightlight	Replaced Nightlight	41%	50%	41%
	Replaced Lamp Left On	9%	6%	9%
	Replaced Nothing	48%	44%	48%
	Don't Know	2%	0%	2%

3.1.6 Process Results

Source of HEES Awareness

In order to determine what is driving residential customers to the HEES program and to gauge the success of various HEES marketing efforts, survey respondents were asked to report how they first learned about the HEES energy survey program, as well as other secondary sources of program awareness. This section discusses the most frequently reported sources of awareness.

As shown in Table 3-37 below, survey respondents across all three IOUs reported that utility bill inserts and the utility's website were the most common sources of initial program awareness (making up 64% of program awareness across all HEES surveys[80]). As one might expect, the IOU website was more often a source of HEES awareness for customers who completed an online survey, and IOU bill inserts were more often the source of awareness for customers who completed a mail survey. Utility emails, mailings and other flyers were also reported as significant sources of initial program awareness (18%). It is interesting to note that while completing a HEES survey is a statewide requirement of the California Solar Initiative Program (to help them assess their household energy usage prior to installing solar panels), SDG&E online HEES participants reported the CSI program as a significantly higher source of program awareness than participants from other utilizes or delivery methods (24% for SDG&E online HEES participants compared to 5% overall). This likely stems from the significantly smaller number of HEES program participants in SDG&E service territory (~7,500 vs. ~68,000 and

[79] The overall percentages are identical to the SCE/SCG percentages since overall the SCE/SCG kits made up 97% of the kits distributed during the analysis period.

[80] Responses in the All column are weighted back to the population of HEES surveys (by IOU and Delivery Method) that were completed as of mid-2011 when the survey sample was pulled.

~150,000 in PG&E and SCE/SCG service territories, respectively) and thus a higher probability of being a CSI participant in SDG&E service territory[81].

The table below also shows that survey respondents reported direct marketing efforts, such as the utility website, bill insert, and mailings/emails/flyers from the IOUs, were more often a source of HEES awareness than external marketing efforts such as radio/television/newspaper (2%) or social media (<1%). Word of mouth through family and friends was also reported as a moderate source of program awareness (4% statewide).

Table 3-37: Source of Initial HEES Awareness

How did you FIRST learn about the HEES program?	PG&E Online	SCE/SCG Online	SCE/SCG Mail	SDG&E Online	SDG&E Mail	All	
	%	%	%	%	%	n	%
IOU Bill Insert	15%	34%	56%	24%	41%	297	37%
IOU Website	51%	32%	5%	26%	14%	255	27%
IOU Email/Mailing/Flyer	7%	19%	28%	6%	14%	134	18%
CSI Program	8%	7%	1%	24%	0%	84	5%
Friend/family	6%	5%	3%	5%	5%	41	4%
Other IOU Source	5%	1%	3%	4%	28%	36	3%
Radio, TV, Newspaper	3%	0%	1%	3%	0%	17	2%
Contractor	1%	1%	0%	5%	0%	16	1%
Community event	2%	0%	0%	2%	0%	10	1%
Social Media	1%	0%	0%	0%	0%	1	0%
Other	2%	1%	3%	1%	0%	17	2%

Reason for Taking HEES Survey

In order to get a better understanding of the motivation that drives HEES program participant to take and survey, telephone survey respondents were asked what prompted them to complete and a HEES energy survey. Survey respondents across all IOUs reported that saving money and high energy bills were the largest motivational factors for taking the HEES survey. As shown in Table 3-38 below, saving money and lowering energy bills were reported by 53% of surveyed HEES participants. Within the population of SDG&E mail participants (n=24), 92% reported that these two factors were the primary motivation for taking the survey. This is likely an indication that SDG&E specifically targeted their mail surveys to a group of very high usage

[81] Multiplying the number of HEES participants by the percentage of respondents who cited CSI as a primary source of program awareness results in 5,400 PG&E customers, 5,300 SCE customers and 1,800 SDG&E customers who reported CSI as a primary source of awareness. These figures, in relation to the number of customers in each service territory and the number of CSI program participants, are of a similar magnitude.

customers. Customers' curiosity was also a dominant motivational factor for completing a HEES. Customers' curiosity includes responses such as curious about survey, wanted to participate, and took the survey after discovering it online. Combined, these reasons were reported by 16% of telephone survey respondents across all IOUs.

Other frequently reported motivational factors were a customer's concern for the environment or a desire to save energy (reported by 12% of survey respondents) and the incentive being offered (a gift card or energy savings kit, 7% statewide).

Table 3-38: Motivation for Completing HEES Survey

What specifically prompted you to complete an energy survey?	PG&E Online	SCE/SCG Online	SCE/SCG Mail	SDG&E Online	SDG&E Mail	All	
	%	%	%	%	%	n	%
Save Money	28%	26%	27%	21%	29%	242	27%
High energy bills	38%	19%	23%	25%	63%	256	26%
Curiosity	17%	13%	17%	26%	4%	171	16%
Concern for the Environment/Save Energy	8%	12%	14%	8%	4%	100	12%
Incentive (Gift Card/Energy Kit)	0%	15%	7%	1%	0%	55	7%
To find out about EE Programs	4%	8%	7%	10%	0%	65	6%
Recommendation (Friend/Contractor/Utility Rep)	2%	2%	3%	2%	0%	19	2%
New Home / Remodeling Home	2%	3%	2%	1%	0%	18	2%
CSI Program	1%	2%	0%	6%	0%	22	1%

Awareness of Other HEES Delivery Methods

During the 2010-2012 program cycle SCE, SCG and SDG&E offered HEES surveys to their customers via a number of different delivery methods. The distribution of the HEES surveys completed program cycle to date is shown in Table 3-39 below. As this table shows, statewide 58% of HEES surveys were completed online, 41% were completed via mail, and the remaining one percent was completed by SCE or SCG customers via the telephone or an in-home survey. At SCE, mail surveys made up 59% of all surveys completed.

Table 3-39: HEES Surveys Completed by Delivery Method

Utility	Online	Mail	Telephone	In-Home	Total
PG&E	86,255	-	-	-	86,255
SCE/SCG	82,039	122,442	1,140	3,550	209,171
SDG&E	12,841	6,207	-	-	19,048
Total	181,135	128,649	1,140	3,550	314,474
	58%	41%	0%	1%	

During the telephone survey, respondents who had completed their HEES survey via the mail were asked whether or not they were aware the survey could have been completed online. Statewide less than one-third of respondents reported being aware of this option (awareness was higher for SCE participants than for SDG&E participants, 32% and 18% respectively). Those who were aware of the online option were asked a follow-up question regarding their reasoning for completing the survey by mail as opposed to online. As shown in Table 3-40 below, the most frequently provided reason was that the paper format was the most convenient/preferred (61%). Twenty percent of customers reported that they did not complete the survey online due to internet reasons (lack of internet access, not wanting to share personal information online, not internet savvy). As utilities move more towards the UAT, they may move away from mail surveys. This presents a problem for customers that are unwilling or unable to complete a HEES survey online.

Table 3-40: Reason for Completing HEES survey via Mail

Why did you decide to complete the energy survey by Mail as opposed to Online?	All	
	N	%
Was the most convenient/preferred paper format	40	61%
Internet Issues	15	20%
Received Survey in the mail	8	13%
Needed to walk around house to complete	1	2%

HEES online users are generally younger than HEES mail users according to survey data. As shown in Table 3-41, the most common age group amongst HEES online participants who responded to the telephone survey is 45 – 54 years old (60% were younger than 55 years old), whereas the most common age group amongst HEES mail participants who responded to the telephone survey is 65 years old and above (only 29% were younger than 55 years old). Ninety-eight percent of telephone survey respondents younger than 35 years of age completed their

HEES survey online. As HEES transitions to the UAT, it is important to make sure they are able to continue to reach the various demographics less likely to complete an online HEES survey.

Table 3-41: Distribution of Telephone Survey Respondents

Please indicate your Age	PG&E Online	SCE/SCG Online	SCE/SCG Mail	SDG&E Online	SDG&E Mail	All	
	%	%	%	%	%	n	%
Under 25 Years	1%	0%	0%	0%	0%	3	0%
25 To 34	18%	15%	1%	8%	0%	102	10%
35 To 44	20%	20%	6%	17%	8%	159	15%
45 To 54	23%	24%	21%	27%	21%	241	23%
55 To 59	13%	14%	13%	15%	21%	140	13%
60 To 64	6%	9%	13%	10%	25%	102	10%
65 Years Or Older	18%	18%	45%	24%	25%	266	29%

Satisfaction with HEES Recommendations

During the HEES telephone survey respondents were asked to provide feedback regarding their satisfaction with the recommendations they received through the HEES survey, as well as the energy savings they realized as a result of implementing one or more of the HEES recommendations. Survey respondents were asked to rate their satisfaction with the HEES recommendations and energy savings on a scale of 0 to 10, where 0 is completely dissatisfied and 10 is completely satisfied. Table 3-42 below provides the mean satisfaction ranking, by strata, to these two questions. Overall, participants reported being generally satisfied with both the recommendations they received and energy savings generated by the implementation of these recommendations (6.9 and 7.0, respectively). In service territories offering both mail and online surveys, the online survey scores notably higher with respect to both recommendation and savings satisfaction. Among the online surveys, SCE/SCG respondents provided higher satisfaction scores than both PG&E and SDG&E. It is interesting to note here that while PG&E provided nearly three times the number of recommendations to HEES participants (28 versus approximately 10) which seemed to lead to lower levels of both measure and practice recommendation recall (69% overall recall for PG&E versus 78% for SDG&E and 83% for SCE), it did not seem to significantly affect the participants satisfaction with the recommendations in general. PG&E participants reported only slightly lower usefulness and satisfaction rankings than the weighted statewide average.

Table 3-42: Mean Satisfaction with HEES Recommendation and Energy Savings

		PG&E Online	SCE/SCG Online	SCE/SCG Mail	SDG&E Online	SDG&E Mail	All (Wt'd)
Found Recommendations Useful	Mean	6.4	7.5	6.9	6.1	5.7	6.9
	N	246	250	246	249	24	1,015
Satisfied with Energy Savings	Mean	6.6	7.6	6.8	6.8	6.0	7.0
	N	213	239	231	207	22	912

Survey respondents who scored their satisfaction with the recommendations they received less than a five were asked to describe in more detail the reason for their dissatisfaction. The primary reasons expressed by telephone survey respondents for their dissatisfaction with the HEES was that they had not noticed any energy savings in their bills as a result of implementing one or more of the recommendations or that they felt the recommendations were too generic or did not apply to them because they their equipment was already efficient. Many participants also made the comment that follow up activity after the energy survey would have helped them with the process.

Another significant hurdle participants faced concerned the affordability of the recommended measures. Some claimed they did not have the money to make the recommended changes and others would have liked more detailed information on the recommendations, such as payback, to assist them with their decision. Without knowing the return on investment, many participants did not perceive the recommendations as worthwhile projects.

Other responses to the open-ended question included answers such as:

- Different recommendations needed for renters,
- No mention of measures such as evaporative coolers, which are very EE.
- Recommendations too generic would prefer a "real" survey.

As mentioned above, the primary driver of dissatisfaction with energy savings is the lack of noticeable bill savings post implementation of HEES recommendations. Survey respondents were asked to report whether or not they had detected any gas or electricity savings in their energy bills following their completion of the HEES survey. Table 3-43 below shows that roughly equal numbers of survey respondent reported that their energy use went down, as reported their energy use stayed about the same (45% and 48%, respectively). Fewer SCE HEES mail respondents reported a noticeable energy savings (39%) in their bill. A few survey respondents (4%) reported that their utility bills had decreased but attributed that decrease to

another change such the implementation of other energy measures like solar equipment[82]. These customers likely completed the HEES survey because of the CSI Program requirement.

Table 3-43: Changes to Energy Bill Since Taking the Energy Survey

Have you noticed a change to your utility bill since HEES?	PG&E Online	SCE/SCG Online	SCE/SCG Mail	SDG&E Online	SDG&E Mail	All	
	%	%	%	%	%	n	%
Energy Use went down	50%	48%	39%	51%	55%	472	45%
Energy Use has stayed about the same	45%	44%	53%	36%	46%	447	48%

SmartGrid Enabled Programs

SmartMeter technology enables customers to be alerted if their energy usage is moving towards a higher-priced electric tier. PG&E and SCE customers can set alerts if their usage is causing them to exceed their targeted budget. Another option is to receive alerts on a regular basis. Customers can be notified by email, phone, or text. SCE's Budget Assistant can also calculate summer and winter monthly bill averages to assist customers set realistic budgets.

PG&E and SCE/SCG HEES participants were asked during the telephone survey whether or not they had taken advantage of any of the energy alerts or notifications offered by their utility to assist them in managing their household energy consumption. As shown in Table 3-44 below, overall 15% of respondents reported that they had signed up to receive this assistance. As one might expect, HEES participants who completed the HEES survey online were significantly more likely to receive the energy alerts than those who completed the HEES survey via mail (22% versus 7%, respectively). Two-thirds of those who signed up for energy alerts stated they did so on a date after their HEES survey date, 10% did so on a date prior to their HEES survey date, and the remaining were unsure of when they signed up for the energy alert.

Table 3-44: Utilized IOU's Energy Consumption Management Tools

Received IOU Alerts	Online/PG&E		Online/SCE		Mail/SCE		All	
	N	%	N	%	N	%	N	%
Yes	51	21%	47	22%	16	7%	114	15%
No	192	79%	167	78%	230	93%	589	85%

All telephone survey respondents were asked whether anyone in their household had checked the online energy usage summaries on their utilities website to track their energy use. As shown in Table 3-45 below, 38% of survey respondents statewide indicated they had taken such actions.

[82] This response was found to be common amongst open-ended responses. As such, a category for solar was created in the data.

Again, not surprisingly the tendency to use the online tracking tools is notably higher among online HEES participants who by taking the HEES survey online have demonstrated familiarity with their utilities online tools (53% of online HEES participants vs. 13% of mail HEES participants). PG&E online HEES participants were the most likely to use the online tracking tools (61%). Across all customers who reported they had used the IOU tools to track their energy usage, 31% reported doing so less than once a month, 45% reported doing so approximately once a month and 21% reported doing so more than once a month.

Table 3-45: Usage of Online Energy Consumption Tracking Tools

Online Usage Tracking	PG&E Online		SCE/SCG Online		SCE/SCG Mail		SDG&E Online		SDG&E Mail		All	
	N	%	N	%	N	%	N	%	N	%	N	%
Use IOU online tools to track energy use	151	61%	115	46%	31	13%	94	38%	6	25%	397	38%
Frequency of Use:												
* Less than Once a Month	58	39%	26	23%	7	24%	33	36%	1	17%	125	31%
* Once a Month	54	36%	67	59%	13	45%	39	42%	3	50%	176	45%
* More than Once a Month	34	23%	19	17%	7	24%	19	20%	2	33%	81	21%
* Other	4	3%	1	1%	2	7%	2	2%	0	0%	9	3%

CARE Program

The CARE Program provides a monthly discount on energy bills for income-qualified households and housing facilities. Qualifications are based on the number of persons living in the residence and total gross annual household income. SCE/SCG customers who potentially qualified for the CARE program typically received a HEES survey recommendation[83] to follow-up with their utility to get more information on the CARE program. Among the 377 surveyed participants who received this recommendation and were queried about it, 29% reported that they had followed up on the CARE recommendation with their utility. As shown in Table 3-46 below, survey respondents who had taken an online HEES survey reported a significantly higher rate of following up on this recommendation than those who had taken the HEES survey by mail (44% versus 17%). Within the population of survey respondents who followed-up on the CARE recommendation, 50% reported signing up for the CARE program, 43% reported they were not eligible for this program, and 7% reported they were not interested in the program after finding

[83] CARE recommendation was: "You may qualify for the California Alternate Rates for Energy (CARE) program. This program provides a 20% discount on your gas bill at your primary residence. You may also qualify for a 60% discount on your service establishment charge (initial connection charge) if you are qualified for the CARE program within 90 days of starting new gas service. To find out more about CARE program qualifications, call 1-800-427-2200."

out more. Overall 15% of survey respondents who were queried about the CARE recommendation reported that they ended up signing up for CARE (6% of mail respondents and 24% of online respondents).

Table 3-46: Referrals to the CARE Program

CARE Recommendation	SCE/SCG Mail		SCE/SCG Online		All	
	n	%	n	%	n	%
Received, but didn't follow-up on CARE	152	84%	109	56%	261	71%
Followed-up on CARE	30	17%	86	44%	116	29%
* Signed up for CARE	11	38%	47	56%	58	50%
* Didn't Sign up - Wasn't Eligible	14	48%	34	41%	48	43%
* Didn't Sign up – Not Interested	4	14%	3	4%	7	7%

4

Appendices

4.1 Data Cleaning and Sample Preparation for the Billing Analysis

This section describes the step by step process of creating the datasets that were used to conduct the HEES billing analysis. The steps included in the preparation of the billing analysis samples were the following, first, the information from all sources is gathered and merged together, including the HEES Tracking dataset, the CIS dataset, the CSI tracking data, the weather data, the billing data, and the EE Tracking data. Accounts with missing information were dropped from the sample. Second, the billing dataset was cleaned, and the unreliable and invalid observations were dropped from the sample. Third, the propensity score matching process was used to match the nonparticipants to the participant sample. Finally, the regression variables were created and the final cleaning was completed to remove outliers or other unreliable data points. Table 4-1 and Table 4-2 below present information on the development of the participant and nonparticipant samples used for the billing analysis.

Table 4-1: Participant Sample Preparation Process

	PG&E	SDG&E	Edison
Data Gathering and Merging			
HEES Tracking Data[84]	43,895	7,480	186,978
Merging CIS and billing	41,176	7,279	130,003
Merging Solar	38,028	3,922	120,476
Billing Data Cleaning			
-Duplicated Billing Data	38,028	3,860	120,476
-Inconsistent Bill Date Information	38,028	3,798	120,476
-Negative Reads	37,850	3,798	120,426
-Gaps and Overlaps	37,801	3,794	120,270
-Zero Usages	37,552	3,773	119,670
-Infrequent Reads	37,552	3,773	119,629
-Not Enough Pre or Post Data	23,989	2,312	50,424
-Consecutive Low Usages	23,742	2,287	49,971
-Too Much Change	23,255	2,254	49,284
-Excessive Usages	23,080	2,244	48,937
-Not Enough Design Period		2,151	
Propensity Score Matching			
Sites Matched	23,078	2,145	48,912
Final Cleaning			
Excessive EE Saving	23,067	2,140	48,901

As shown in Table 4-1 above, the participant data cleaning process started from the HEES participant tracking data. After merging to the CIS and billing data, the fourth row in the table above shows the number of HEES survey participants that with CIS and billing data. The majority of the PG&E and SDG&E participants remained in the sample after this merge, but about 30% of the Edison participants were dropped. This reason Edison dropped so many records in this step is because for Edison the final evaluation HEES tracking database was used to define the HEES participants, but the initial HEES tracking database was used to pull the billing data (due to time constraints). For PG&E and SDG&E the initial HEES tracking databases were used to define both the participants and to pull the billing data and therefore the match was much higher. Edison instructed the evaluation team to use the final HEES tracking

[84] The HEES tracking data samples for PG&E and SDG&E are from the original HEES data request and thus include HEES participants from January 2010 through April or May of 2011. The Edison tracking data was taken from the final HEES data request due to issues with the original data file. It contained participants from January 2010 through July of 2012. Many of these participants were dropped from the modeling due to inadequate post-period data (recent participants).

database as the official data since the initial file was provided by the program implementer and was less trusted.

The cleaning process also excluded all the solar customers from the sample. This was done for two reasons. First, because the electricity consumptions of the solar customers was more than the kWh billed, and would require additional information to construct; and secondly, all three utilities, PG&E, SDG&E and Edison, required customers to complete a HEES survey prior to CSI participation. This implies that these CSI HEES participants might be different from the other HEES participants, and including them in the sample might introduce additional error into the model. Therefore, the CSI tracking datasets were merged on in order to exclude the solar customers from the sample. After this step, PG&E and Edison lost roughly 8% of the participant sample and SDG&E lost 46%[85].

In the second cleaning step, the billing data was scrubbed to remove duplicate observations, sites with the bill date and last bill date inconsistent with the bill days, sites with negative reads, and/or sites with gaps and overlaps in their billing period, as such issues indicated that the data might not be valid. Sites were also dropped if there were zero reads, the bill days longer than two entire months, low monthly usages[86], and/or consecutively low monthly usages[87]. These issues might indicate that the residences changed, or customers were out of the town for an extended period of time. Either way, including them could introduce unobserved errors to the model. Too much change[88] in the electricity consumption of a site might also indicate a change in residences, and as such these sites were also dropped from the sample.

As discussed in the methodology session, it is required that a site must have twelve months of design period data (pre-HEES) and at least twelve months of analysis period data (post-HEES). Sites that did not have a sufficient amount of data were removed from the sample. This was the primary reason sites were excluded from the sample. Among the samples remaining at this step of the data cleaning, PG&E lost 36% of the sites, SDG&E lost 39%, and Edison lost 58%. The reason for the significant Edison drop was that billing data was not available after December 2011. Therefore, all Edison sites who participated during or after December 2010 would have insufficient post-period billing data and thus were dropped from of the analysis.

---

85 Another indication of the large proportion of SDG&E HEES participants that took the survey due to the CSI requirement.

86 The cut-off point was 40 kWh per month. A 2008-2010 Energy Star refrigerator uses 500 kWh per year, and a CEE Tier 3 uses 425 kWh per year. Therefore, it was assumed that an occupied unit uses at least 40 kWh per month, and if the monthly usage was lower than that, the unit was very likely to be empty.

87 The cut-off point was 80 kWh for three months. So if a site had usage below 80 kWh for three consecutive months, it would be dropped out of the sample.

88 The cut-off point was 2.2 times for SDG&E and 2.3 times for PG&E and Edison. So if the maximum usage over a consecutive twelve months was more than 2.2-2.3 times that of the minimum usage over a consecutive twelve months, the site was dropped from the sample.

The last row of Table 4-1 above was suppression for SDG&E only. SDG&E sub-sample four and sub-sample five contained participants who enrolled in the last quarter of 2010 and the first quarter of 2011, and their design periods were from October 2009 to September 2010 and January 2010 to December 2010, respectively. As discussed in the methodology session, for these two sub-samples, the design period also includes the summer period of 2009, from July 2009 to September 2009 to capture the response of the usages to the high temperatures. Any sites that did not have billing data for those three months were dropped from the sample.

The third step in preparing the billing analysis datasets was the Propensity Score Matching (PSM) process. If a match was not found for a participant within one-quarter of a standard deviation of the propensity scores, the participant would be dropped from the sample for lack of a valid match. As can be seen from Table 4-1, more than 99% of the participants were successfully matched. More details on the PSM process are included in Section 4.2 below.

The final step in preparing the datasets for the regressions was to drop sites where their ex ante kWh savings claimed from other energy efficiency programs exceeds 50% of their average usages. In this step, 11 PG&E sites, five SDG&E sites and 11 Edison sites were dropped. It is indicated in the literature that the ex ante energy efficiency kWh savings are not very good estimations of the savings, and may introduce more error into the model. For these 27 sites, it was obvious that the kWh claimed savings were incorrect, and therefore, these sites were dropped to avoid introducing additional error.[89]

Table 4-2 below provides the details for the nonparticipant sample preparation process. As this table shows the process was nearly identical to that of the participant sample except that is started with a random sample of non-HEES customers, as opposed to a sample of HEES participants.

[89] While errors are likely in many of the ex ante estimates removing them all is infeasible in the absence of more detailed site level information. This step, while not perfect, allowed for the removal of the accounts with the most obvious errors.

Table 4-2: Nonparticipant Sample Preparation Process

	PG&E	SCE	SDG&E
Data Gathering and Merging			
CIS and Billing Data	775,089	87,777	1,655,047
Merging Solar	766,998	86,845	1,318,816
Merging HEES Tracking	759,294	84,082	1,318,816
Billing Data Cleaning			
-Duplicated Billing Data	757,919	83,800	1,318,653
-Inconsistent Bill Date Information	757,919	83,300	1,318,653
-Negative Reads	756,204	83,300	1,318,622
-Gaps and Overlaps	755,181	82,597	1,308,107
-Zero Usages	740,450	81,748	1,286,912
-Infrequent Reads	740,450	81,745	1,286,288
-Not Enough Pre or Post Data	467,268	50,699	953,981
-Consecutive Low Usages	450,246	48,548	927,936
-Too Much Change	438,244	47,485	905,418
-Excessive Usages	435,251	47,255	897,077
-Not Enough Design Period		44,368	
Propensity Score Matching			
Sites Matched	22,064	3,994/2,120	46,896
Final Cleaning			
Excessive EE Saving	22,054	3,993/2,119	46,876

4.2 Propensity Score Matching Graphs

This section provides the PSM graphs for each of the utility sub-samples. As defined in the methodology section the sub-samples were defined by the quarter of HEES participation. The periods between the dotted vertical lines in the figures below are the design periods (the 12 months prior to HEES participation), and it was based on these periods, that the PSM was implemented. The area to the right of the right dotted line is the analysis period, in which the effects from the HEES program were revealed.

Figure 4-7 shows the results of the PSM matching for PG&E's sub-sample 1. This sub-sample included participants who first took the HEES survey in the first quarter of 2010, and hence the design period includes the twelve months from January 2009 to December 2009. The plot shows that during this period, the matched nonparticipant sample looks almost exactly the same as the participant sample. After the design period the participant and the matched nonparticipant

sample diverge which illustrates the net savings that are likely attributable to the HEES program, or other energy efficiency programs. It will be the objective of the regression analysis to differentiate these impacts whenever possible. The savings are "net" in the sense that the matched nonparticipants were used as a proxy for what the participants would do without enrolling into the HEES program

Figure 4-1: Monthly Load Profiles for PG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 1 – HEES Survey Q1-2010

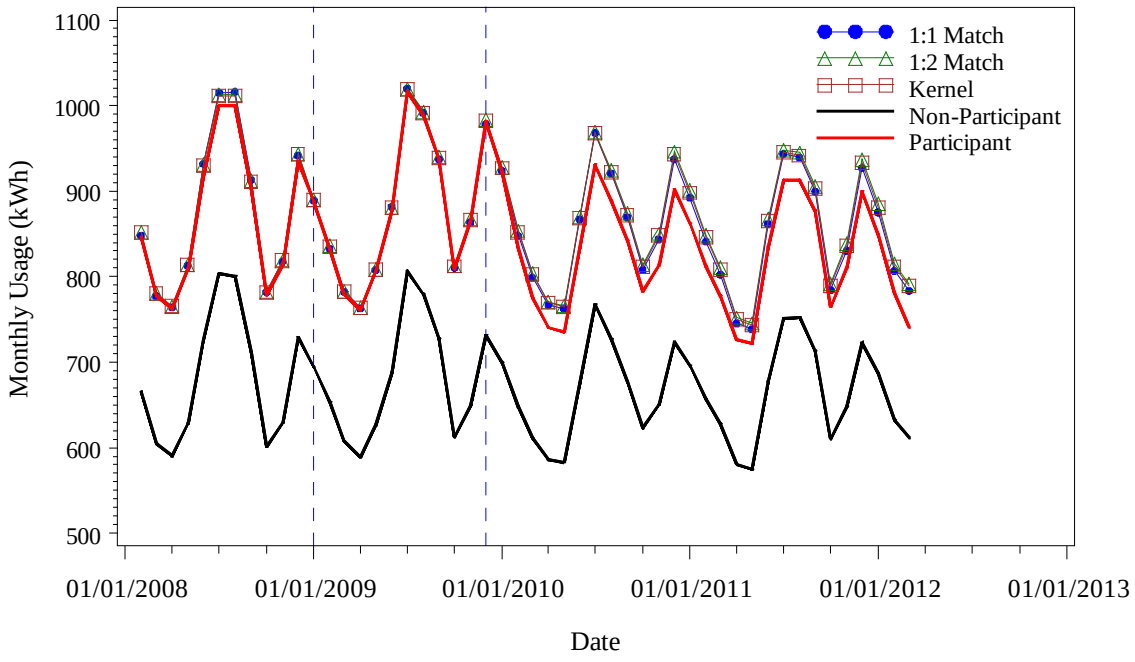


Figure 4-2 through Figure 4-5 below show the PSM results for PG&E sub-samples two through five.

Figure 4-2: Monthly Load Profiles for PG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 2 – HEES Survey Q2-2010

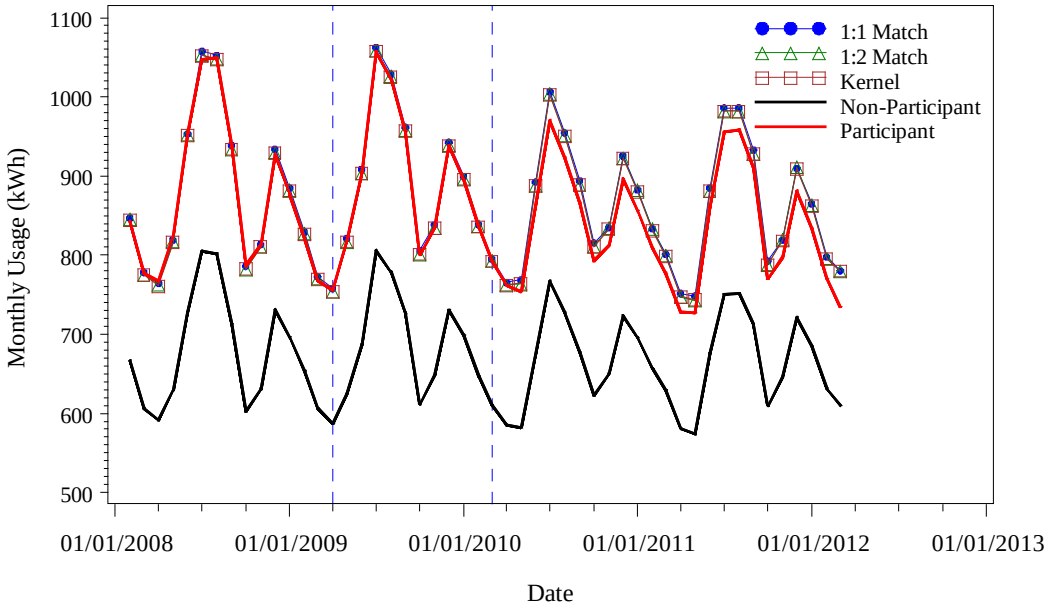


Figure 4-3: Monthly Load Profiles for PG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 3 – HEES Survey Q3-2010

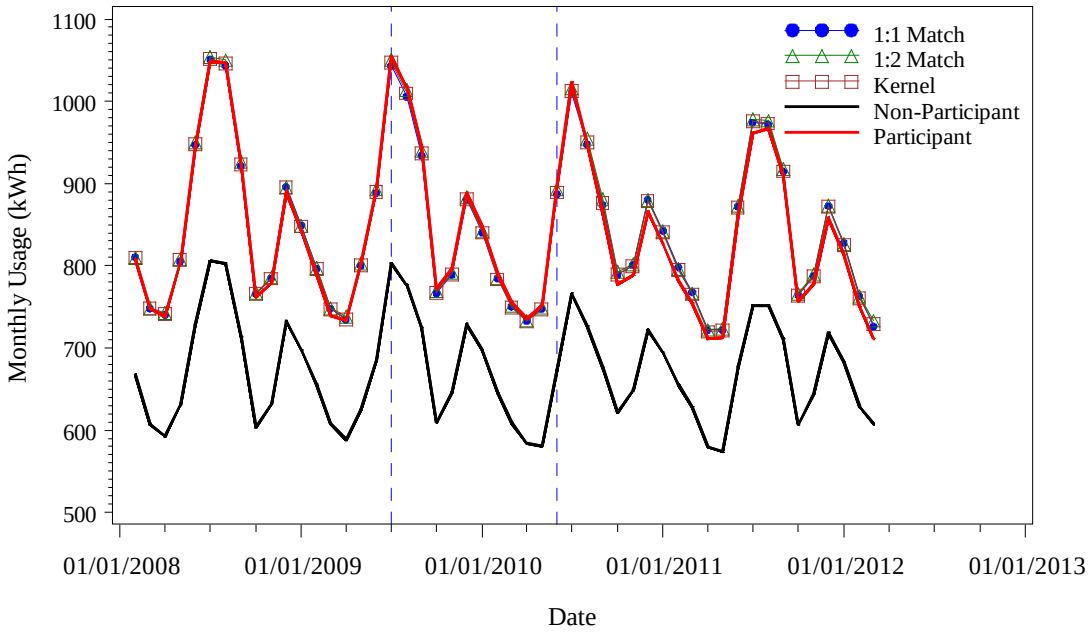


Figure 4-4: Monthly Load Profiles for PG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 4 – HEES Survey Q4-2010

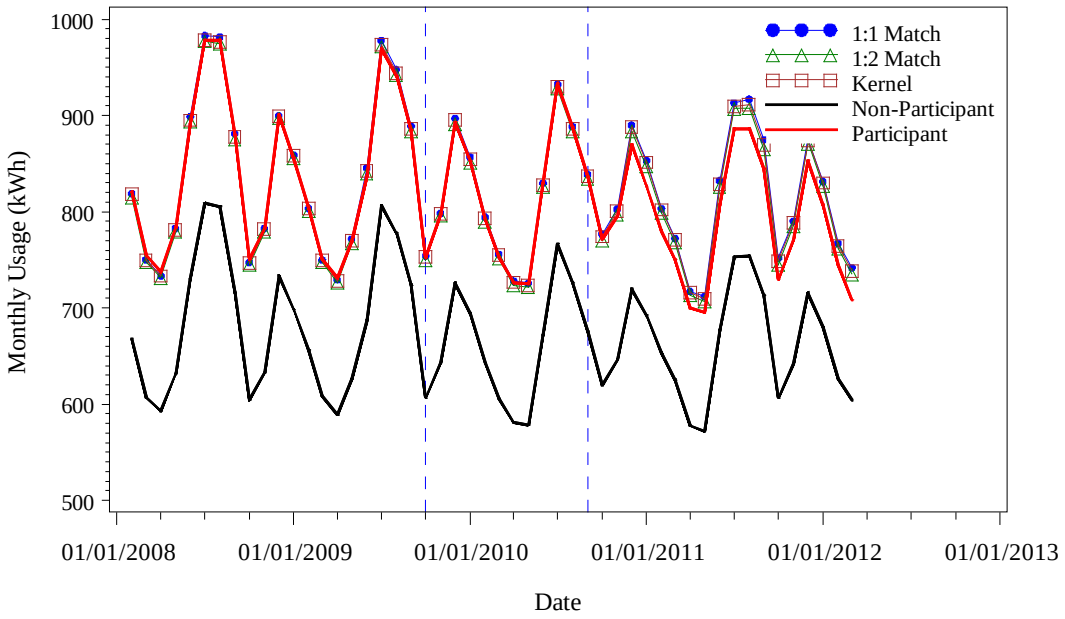
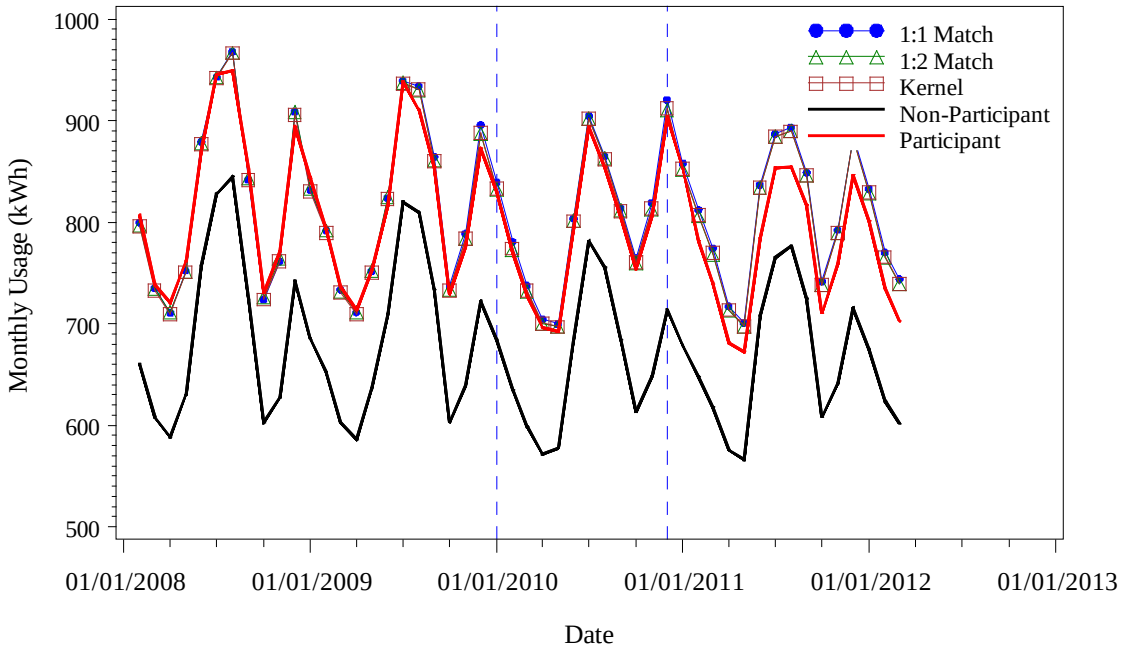


Figure 4-5: Monthly Load Profiles for PG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 5 – HEES Survey Q1-2011



The SDG&E participants were not as closely matched as the other two utilities. This might result from the small SDG&E sample size, and thus one outlier can affect the results in a large way.

In Figure 4-9 and Figure 4-10, it can be found that the design period is longer. Figure 4-9 is for the participants who participated in the fourth quarter of 2010, and hence the design period should include October 2009 to September 2010. Yet as shown in the plot, the summer months from July 2009 to September 2009 were also included into the design period. As explained in the methodology session, this is because that the summer of 2010 was mild in the territory of SDG&E, and hence the previous summer was included to capture the responses of the usages to the change of summer temperatures. It is the same for Figure 4-10, which is for the sub-sample of participants who enrolled in the first quarter of 2011. Originally the design period is from January 2010 to December 2010, and to capture the effects of extreme weathers on the electricity consumptions, the summer months of 2009 were added to the design period, too.

Each of the figures below shows that the summers of 2010 and 2011 were mild. It can be seen that the monthly usages in the summer of 2009 were much higher than the usages in the summer months of 2010 and 2011. For the participants, the average usage for August 2009 was 905 kWh, and for August in 2010 and 2011, the usages were 818 kWh, and for the nonparticipants, the usages were 726 kWh, 653 kWh and 662 kWh for the three Augusts respectively.

Figure 4-6: Monthly Load Profiles for SDG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 1 – HEES Survey Q1-2010

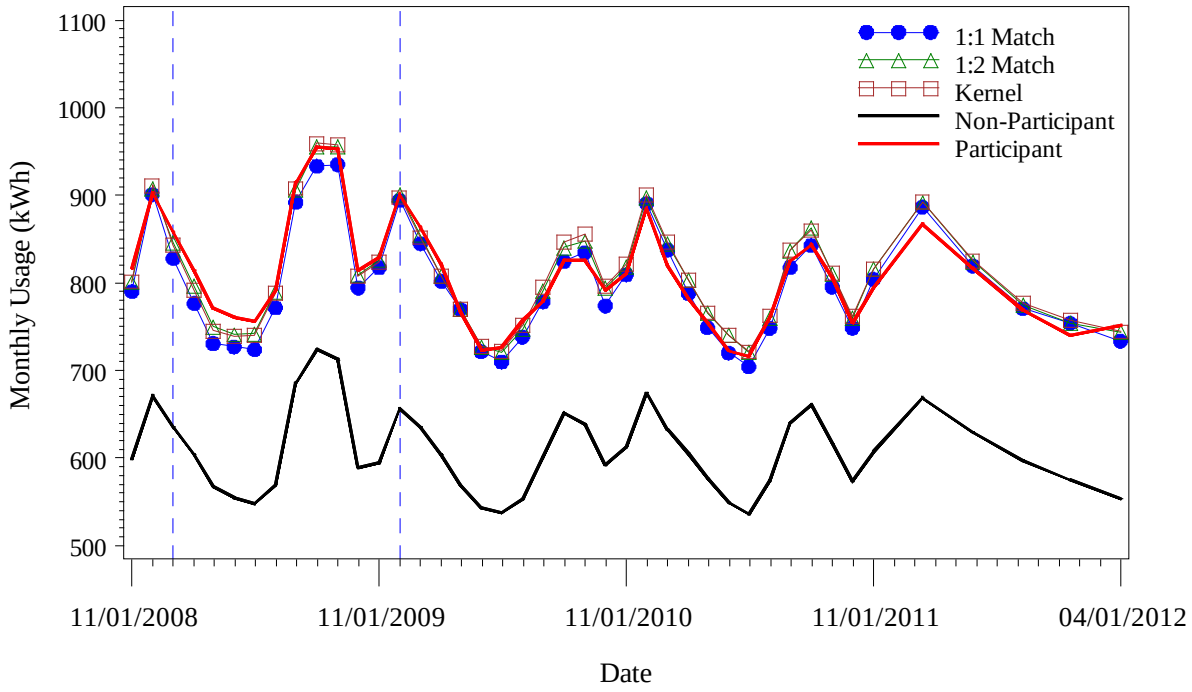


Figure 4-7: Monthly Load Profiles for SDG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 2 – HEES Survey Q2-2010

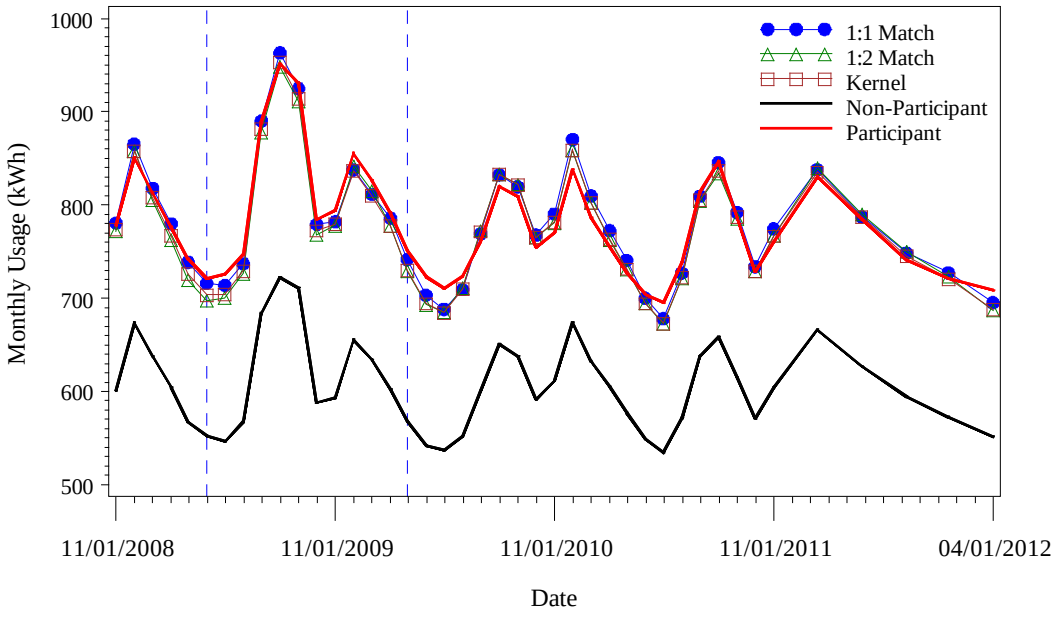


Figure 4-8: Monthly Load Profiles for SDG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 3 – HEES Survey Q3-2010

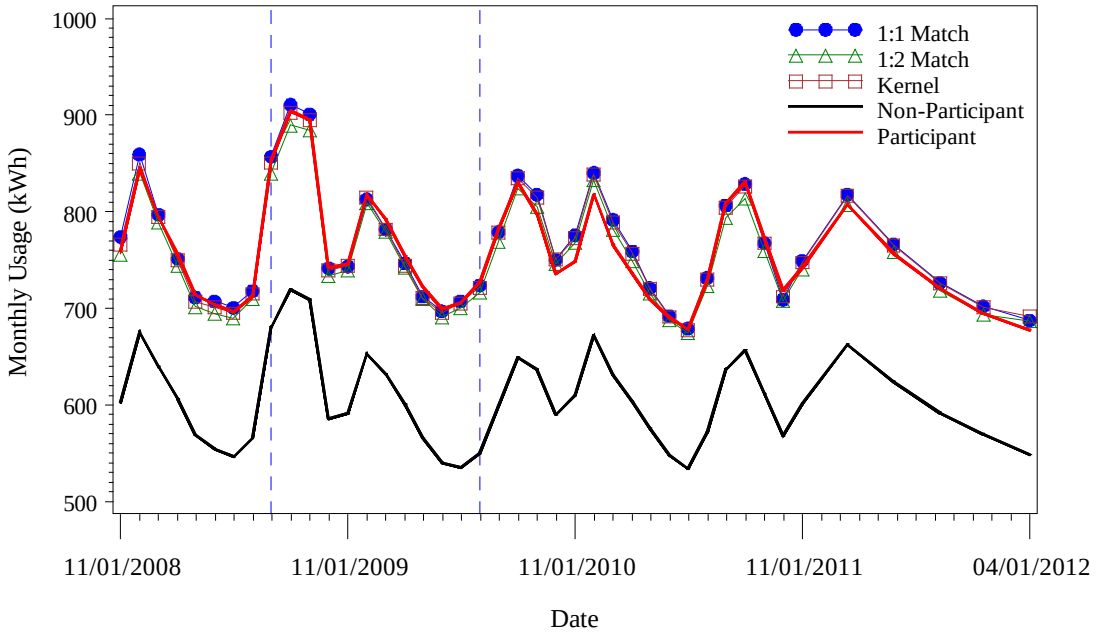


Figure 4-9: Monthly Load Profiles for SDG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 4 – HEES Survey Q4-2010

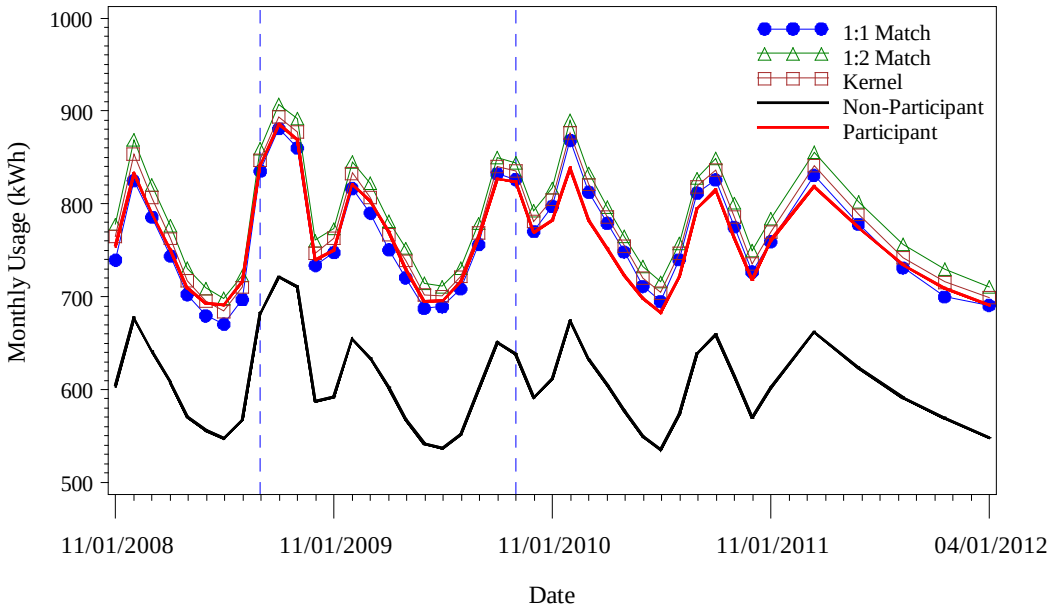
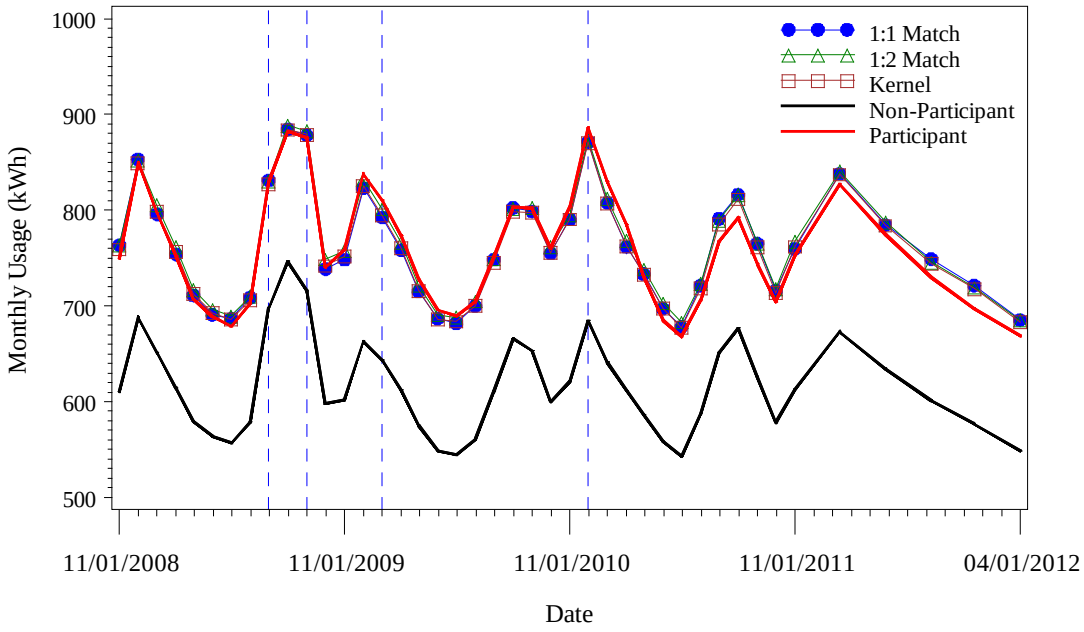


Figure 4-10: Monthly Load Profiles for SDG&E Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 5 – HEES Survey Q1-2011



The matching worked well for the Edison sample as well. As evidenced in the figures below the three matched nonparticipant samples almost coincided entirely with the participant sample during the design period. In the analysis periods, the participants' usages are a little bit lower than the matched nonparticipants, indicating possible savings from the HEES program.

When viewing the figures below, please notice that although the shapes of different plots are similar the vertical axes are not. The average monthly usages of the participants are 880 kWh and 779 kWh for the first two sub-samples (Q1and Q2 of 2010), much higher than those for sub-samples 3 and 4 (Q3 and Q4 of 2010), which are 625 kWh and 698 kWh, respectively. On the other hand, the average usage of a nonparticipant with valid billing data long enough to match to each of the participant sub-samples ranged from 663 kWh to 666 kWh per month. This is because Edison targeted bigger consumers at the very beginning of the HEES program, providing mainly on-site, telephone and mail-in surveys. In the second half of year 2010, Edison's HEES program started to attract smaller participants, and the types of survey provided are mainly mail-in and online surveys. More on this issue is discussed in the main body of the report.

Figure 4-11: Monthly Load Profiles for Edison Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 1 – HEES Survey Q1-2010

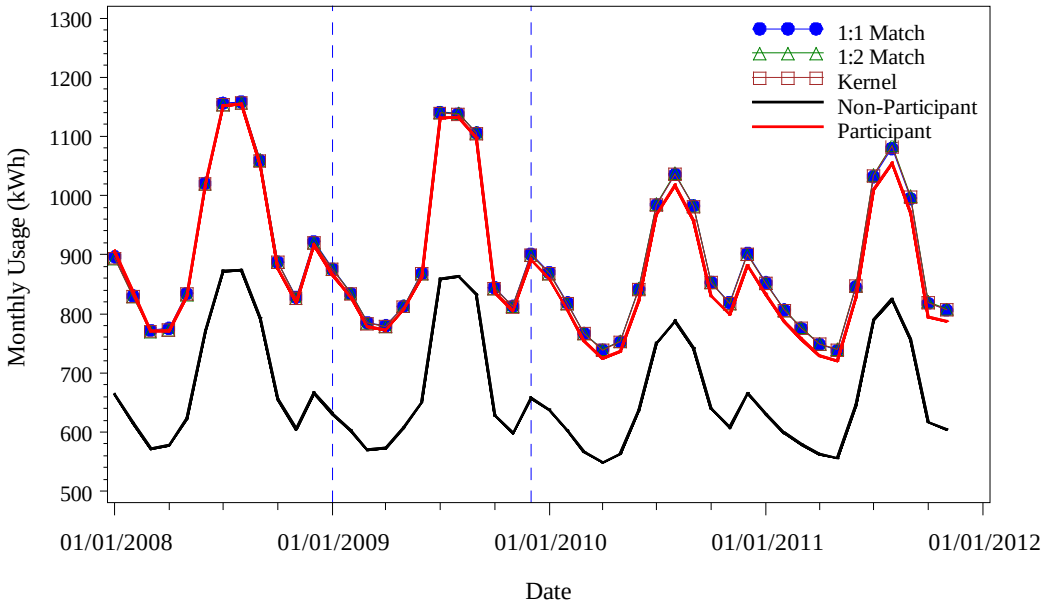


Figure 4-12: Monthly Load Profiles for Edison Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 3 – HEES Survey Q2-2010

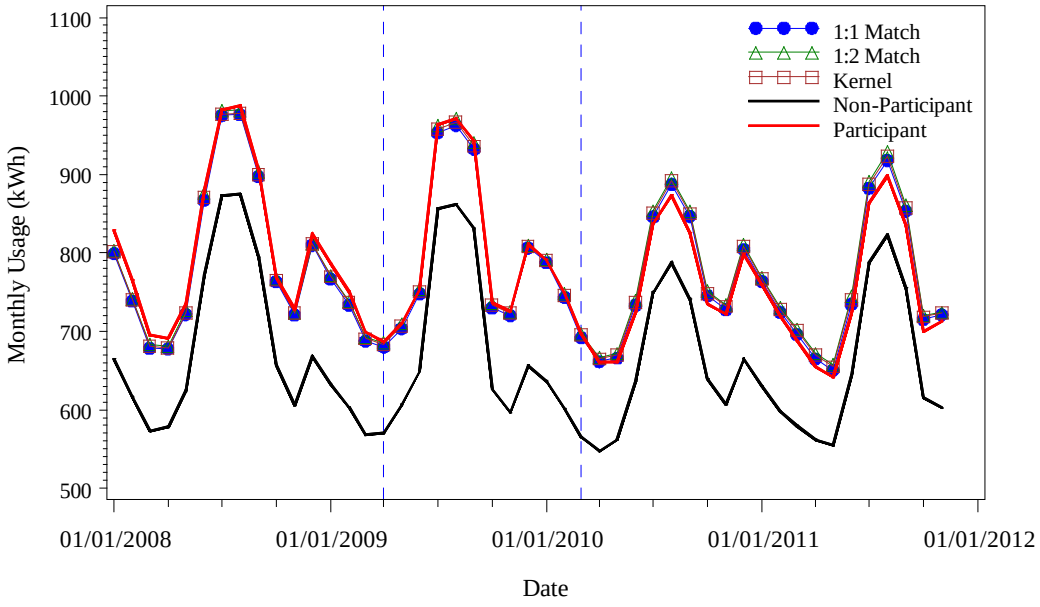


Figure 4-13: Monthly Load Profiles for Edison Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 3 – HEES Survey Q3-2010

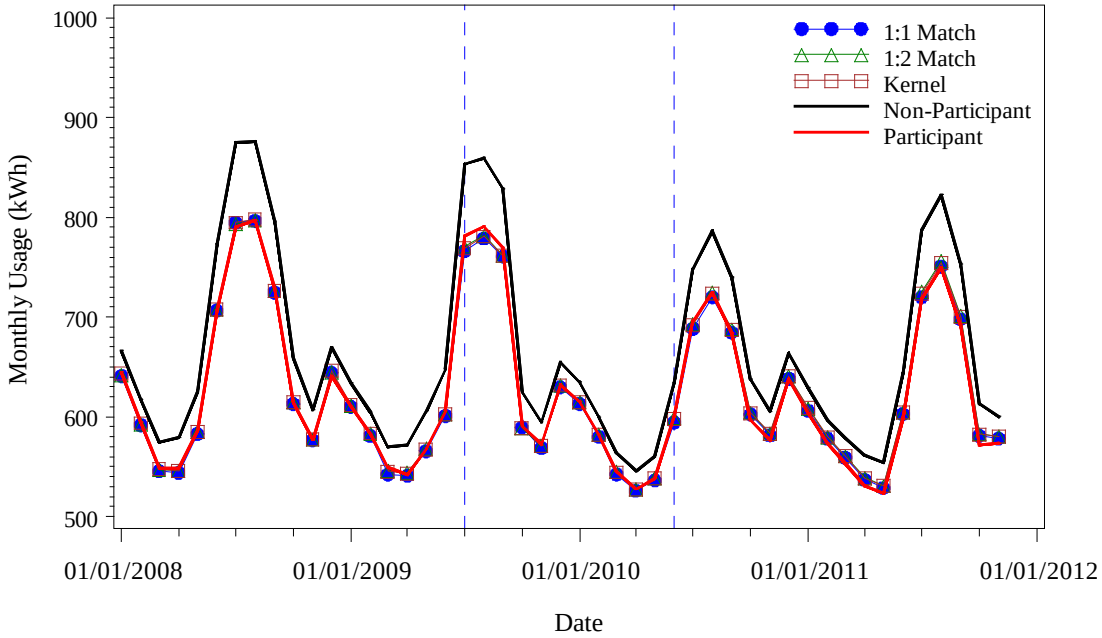
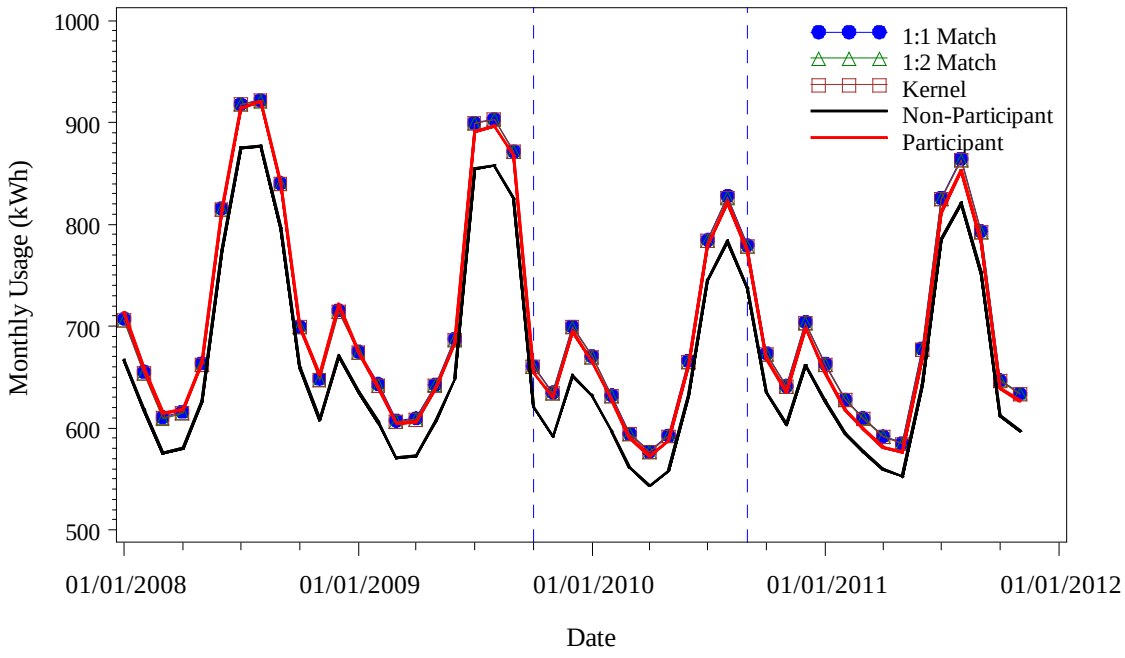


Figure 4-14: Monthly Load Profiles for Edison Participants, Nonparticipants and Matched Nonparticipants – Sub-Sample 4 – HEES Survey Q4-2010



4.3 Propensity Score Matching T-Test Results

The complete PSM t-test results are included in the attached file.

Microsoft Office
Word 97 - 2003 Docu

4.4 Detailed Regression Results

The detailed regression results including the multiple matching methods tested for SDG&E (1:1, 1:2, and 1:2 with kernel weights), the multiple NP samples for Edison (with and without NP Kit recipients) are included in the attached file.

Microsoft Office
Word 97 - 2003 Docu

4.5 CATI Telephone Survey Instruments

Microsoft Office
Word 97 - 2003 Docu

4.6 Self-Reported Recall, Uptake and Attribution Algorithms

The algorithms used to calculate self-reported measure recall, uptake and attribution based on the customer telephone surveys are described below. Similar algorithms were used to calculate practice recall, uptake and attribution using the practice specific survey questions.

4.6.1 Self-Reported Recall

Self-Reported Measure Recall

HEES measure recommendation recall was determined as follows for measure X:

If R0_X = 1 or missing then RECALL_X = 1;

Where:

R0_X = "According to our records you received a recommendation to [MeasREC_X]. Do you recall this recommendation?" = 1 ("Yes")

And R0_X = . if the survey respondent recalled (non-prompted) in question 02 that they recalled receiving a recommendation to install measure X (and thus they were not asked R0_X.

4.6.2 Self-Reported Uptake

Self-Reported Measure Uptake

In order for a recalled HEES measure recommendation to be considered a valid HEES measure implementation it had to pass the following criteria:

- The measure recommendation had to be recalled (as defined above),
- The measure had to be installed,
- The installed measure had to be high efficiency,
- The installed measure had to be purchased without receiving an incentive from a utility EE program, and
- The measure had to be installed after completing the HEES survey.

HEES measure recommendation uptake was determined as follows for measure X:

If Recall_X=1 and Uptake_X=1 and UpTakeHighEE_X=1 and UpTakeNoEE_X=1 and UpTakeAfter_X=1 then ValidUpTake_X=1;

Where:

Recall_X=1 is as defined above,

Uptake_X=1 if:

- R0_XA="Since <AUDIT_MONTH> in <AUDIT_YEAR> have you installed X?" = 1 ("Yes"), OR
- R1_X="Have you done this?" = 1("Yes") , OR
- R1CFL_X="Aside from the CFL you may received from your utility in the Home Energy Saving Kit,"] Have you installed any CFLs in your home since taking the energy survey?" = 1 ("Yes"), OR
- R1A_X="Read "Earlier you mentioned you received a recommendation to [X]. Have you done this?" = 1 ("Yes"), OR
- R1ACFL_X="Have you installed any CFLs in your home since taking the energy survey?" = 1 ("Yes").

UpTakeHighEE_X=1 if:

R7_X = "Is the new equipment high efficiency or a standard unit?"~= 2 (not equal to "Standard Unit")[90]

UpTakeNoEE _X=1 if:

R6_X = "Was this rebate was provided by [UTILITY]?" ~= 1 (not equal to "Yes")

UpTakeAfter_X=1 if:

R4_X = "In what month/yr did you install [X]?" ~= After the date of the HEES survey or date of measure implementation is unknown.

[90] This question was only asked for measures that could be standard or high efficiency. Some measures such insulation, CFLs, low-flow showerheads, etc. were assumed always be a high efficiency measures.

4.6.3 Self-Reported Attribution

Self-Reported Measure Attribution

An estimate of HEES program attribution (ranging from 0 to 1, where 0 is no program attribution and 1 is complete program attribution) for a recalled implemented HEES measure recommendation was calculated as follows:

If decision to install measure X was made after taking the HEES survey (R3B_X ~= 1) then Attribution_X = (Influence_X + Likelihood_X + NTG_X)/3[91];

Else Attribution_X = 0;

Where:

Influence_X =

If R8_X= 1 ("Very Influential") then Influence_X = 1;

If R8_X= 2 ("Somewhat Influential") then Influence_X = 0.5;

If R8_X= 3 ("Not at all Influential") then Influence_X = 0;

Where:

R8_X = "How influential would you say the energy survey was in your decision to install measure X?"

Likelihood_X == (10 - R9_X)/10

Where:

R9_X = "Using a 0 to 10 likelihood scale, where 0 is not at all likely and 10 is extremely likely. If you hadn't completed the energy survey, how likely is it that you would have taken this action anyway?"

NTG _X =

If R9_X=11 OR (R9_X~=11 AND (NTG1_X=1 OR NTG2_X=3)) then NTG_X = 1;

[91] If any of the attribution parameters (Influence, Likelihood or NTG) were missing, the attribution score was calculated as the average of the valid attribution parameters.

Else If R9_X~=11 AND NTG1_X~=1 AND NTG2_X=2 then NTG_X = 0.5;

Else If R9_X~=11 AND NTG1_X~=1 AND NTG2_X=1 then NTG_X = 0;

Where:

R9_X = “Using a 0 to 10 likelihood scale, where 0 is not at all likely and 10 is extremely likely. If you hadn’t completed the energy survey, how likely is it that you would have taken this action anyway?”NTG1_X = “If you had not taken the energy survey would you have bought a standard measure X (NTG1_X=1) or bought an energy efficient measure X (NTG1_X=2)?”

NTG2_X = “If you had not taken the energy survey would you have installed measure X at the same time (NTG2_X=1), within a year (NTG2_X=2), or more than a year later (NTG2_X=3)?”