Impact Evaluation of 2014 San Diego Gas & Electric Home Energy Reports Program (Final Report)

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1 EXECUTIVE SUMMARY

This report provides the results of DNV GL's impact evaluation of San Diego Gas & Electric's (SDG&E) Home Energy Reports (HER) program for 2014. The HER program provides residents a comparative report that contains a mix of energy consumption information, consumption comparison with similar neighbors, and customized tips for saving energy.

1.1 Background

SDG&E began sending residential energy usage reports to program participants in July 2011. After a three month initial period of monthly reports, SDG&E switched to sending reports bi-monthly.

The HER program uses a randomized controlled trial (RCT) experimental design. The RCT experimental design is widely considered the most effective way to establish causality between a treatment and its effect. In combination with the substantial numbers of households in both treatment and control groups, the approach produces an un-biased estimate of savings with a high level of statistical precision. Opower has used the RCT approach to support the credibility of program-related savings despite their relatively small magnitude of 1% to 3% of consumption.

DNV GL participated in the establishment of the RCT experimental design for the SDG&E HER Program. Opower identified a population of approximately 40,000 households that were eligible to take part in the program. DNV GL randomly assigned half of these households to a treatment group that received the reports. The remainder of the households did not receive reports.

1.2 Research questions and objectives

The primary objective of this evaluation was to provide independent verification of electricity and gas savings attributable to the HER program. Specific research questions included the following:

- What are the energy savings for SDG&E HER pilot wave?
- Are there downstream/upstream rebate program savings that could be jointly claimed by both the HER program and SDG&E rebate programs?

1.3 Study approach

To answer these research questions, DNV GL conducted an impact evaluation for the 2014 program year. This evaluation included calculating the different component of HER program savings. The different components are:

- *Overall unadjusted energy savings*. These savings measure the impact of the HER program on average household energy consumption. We estimated the unadjusted energy savings using a fixed effects regression model that compares the treatment group's pre- and post-program consumption difference to that of the control group. The energy savings reflect the overall program savings before applying any adjustment for joint savings achieved in conjunction with other rebate programs.
- *Joint savings*. Joint savings represent HER-induced savings derived from the increased uptake of SDG&E rebate programs. This estimate is normally produced for two areas:
  - *Downstream* joint savings occur due to increased participation by the HER treatment group versus the control group in SDG&E's tracked energy efficiency programs.

- *Upstream* joint savings occur due to the increase in purchases of CFL and LED bulbs by the HER treatment group versus the control group through the SDG&E-supported upstream lighting program.[1]

- *Final adjusted energy savings*. These savings represent the final program savings after deducting both the downstream and upstream joint savings. This adjustment eliminates the potential to double count savings already accounted for in the rebated programs.

1.4 Key findings

Table 1 shows the recommended savings for the 2014 HER pilot program. DNV GL found that the SDG&E HER program achieved 3,575 MWh and 124 thousand therms adjusted program savings in 2014.

Table 1. Program-level kWh and therms savings estimates for 2014

Evaluation Period	Source	Electric (kWh)	Gas (therms)[2]
January 2014 December 2014	Unadjusted Savings	3,861,592	121,651
	Tracked, Downstream Joint Savings	119,362	(433)
	Untracked, Upstream Lighting Joint Savings	167,476	(2,347)
	Adjusted Savings	3,574,754	123,998

Note: Average number of active households in the treatment group per month = 14,967.

Table 1 also shows the recommended downstream and upstream joint savings, which were subtracted from the unadjusted savings total to produce the adjusted savings; this adjustment was performed to address the potential for "double-counting" savings already claimed by other SDG&E programs. The double-counted savings accounted for 7% of the decrease in electric savings while gas savings increased by 2% after accounting for heating and cooling interactive effects associated with energy saving lighting measures. This adjustment is important because the replacement of inefficient lighting measures with more efficient lamps can increase heating load consumption due to lower heat emissions from CFLs and LEDs.

California recognizes the potential for interactive effects across fuels when assigning savings. Interactive effects are explicitly accounted for in the downstream rebate program tracking database. For the untracked upstream lighting program, a similar estimate of interactive effects for gas is calculated using the ratio of kWh and therms savings per watt from DEER. The approach directly estimates gas effect from the estimated upstream electric joint savings. The interactive effect produce negative gas joint savings and therefore increases the overall adjusted gas savings.

Table 2 provides the recommended estimates of unadjusted and adjusted savings at the household level as a fraction of the control group's average consumption in 2014. Over the full 12 months, unadjusted electric savings at the household level were 259 kWh, approximately 2.6% of electric consumption for that period.[3] Electric savings decrease to 240 kWh or 2.4% after removing joint savings. Unadjusted and adjusted gas savings are 8 therms and 8.2 therms per household, respectively, or about 2.0% of gas consumption, for that period.

[1] TRC, on behalf of the IOUs, produced the electric joint savings estimates and heating and cooling interactive effects associated with energy saving lighting measures from upstream programs.

[2] The aggregate downstream gas joint savings are slightly negative and not statistically different from zero. As a result, the total adjusted gas savings will not be adjusted with the downstream rebate program gas joint savings.

[3] Per customer savings are calculated by dividing the total aggregate savings by the average number of customers during that time period.

Table 2. Average savings per household as a percent of consumption

Evaluation Period	Fuel	Unadjusted Per Customer Savings	Adjusted Per Customer Savings	Average Per Customer Consumption	Unadjusted Savings as Percentage of Consumption	Adjusted Savings as Percentage of Consumption
January 2014 - December 2014	Electric (kWh)	258.8	239.6	9,904	2.6%	2.4%
	Gas (therms)	8.0	8.2	440	1.8%	1.9%

Note: Average number of active households in the treatment group per month = 14,967.

Electric savings per household has decreased by 8% from 282 kWh to 259 kWh while gas savings per household decreased by 29% from 11.3 therms to 8 therms from program years 2013 to 2014.

Similar to last year's evaluation, this evaluation did not obtain feedback from participants regarding the source of the savings, and thus the exact composition (behavioral or adoption of energy efficiency measures) of the savings is unknown. However, the joint savings results provide some insight into the magnitude and nature of the HER program effect on measures supported by energy efficiency program funds. Results show that there is limited evidence of increased uptake of rebate activities in 2014. The joint savings captured this year are primarily carryover savings from rebate activities induced by the HER program last year. The estimated joint savings are a relatively small portion of the overall measured savings.

2 INTRODUCTION

The California Public Utilities Commission (CPUC) engaged DNV GL to conduct an impact evaluation of the San Diego Gas & Electric's (SDG&E) Home Energy Reports (HER) program for calendar year 2014. This impact evaluation uses program tracking data and monthly consumption data provided to the CPUC by SDG&E. The evaluation provides independent verification of electricity and gas savings attributable to the HER program.

2.1 HER program description

SDG&E began sending energy reports to residents in the program in July 2011. After a three-month initial period of monthly reports, SDG&E switched to sending reports bi-monthly. The reports contain a mix of consumption information, comparison of energy usage with similar neighbors and customized tips for saving energy.

The HER program uses a randomized controlled trial (RCT) experimental design. The RCT experimental design is widely considered the most effective way to establish causality between a treatment and its effect. In combination with the substantial numbers of households in both treatment and control groups, the approach produces an un-biased estimate of savings with a high level of statistical precision. Opower has used the RCT approach to support the credibility of program-related savings despite their relatively small magnitude of one to three percent of consumption.

DNV GL participated in the establishment of the RCT experimental design for the SDG&E HER Program. Opower identified a population of approximately 40,000 households that were eligible to take part in the program. DNV GL randomly assigned half of these households to a treatment group that received the reports. The remainder of the households did not receive reports.

DNV GL conducted impact evaluation of the HER Program over the full 30 months of the program (July 2011 to December 2014). Table 3 shows the estimated unadjusted savings for calendar years 2012 to 2014.

Table 3. Unadjusted kWh and therms savings from 2012-2014

Year	Average no. of active households in the treatment group	Unadjusted kWh Savings per Household	Percent Savings	Unadjusted therms Savings per Household	Percent Savings
2012	18,096	246	2.4%	10.5	1.9%
2013	16,150	282	2.8%	11.2	2.0%
2014	14,967	259	2.6%	8	1.8%

SDG&E implemented another behavioral program known as Manage Act Save (MAS) pilot program in July 2013 and discontinued it in December 2013. The MAS program included 38% of the HER control group due to a processing error. Contamination complicates the evaluation by potentially biasing the results downward if the MAS program successfully motivates savings among the control group even after the program is discontinued.

In the 2013 evaluation, DNV GL used several approaches to assess the effect of MAS contamination but was unable to estimate the degree of MAS impact on the HER program. Savings reported from July 2013 and onwards are potentially lower than the true program savings because of lower baseline consumption due to MAS contamination. Since MAS program was already discontinued in 2013 and only a portion of the control group was contaminated, the evaluators do not expect a substantial influence of MAS contamination on the results of this impact evaluation. Consistent with the 2013 evaluation, DNV GL's impact evaluation of the 2014 HER program is based on the full sample.

2.2 Evaluation objectives and approach

The primary objective of this evaluation was to provide independent verification of electricity and gas savings attributable to the HER program. Specific research questions included the following:

- What are the energy savings for SDG&E HER pilot wave (monthly, bi-monthly, and quarterly)?
- Are there downstream/upstream rebate program savings that could be jointly claimed by both the HER program and SDG&E rebate programs?

To answer these research questions, DNV GL conducted an impact evaluation for the 2014 program year.

This evaluation included calculating the different component of HER program savings. The different components are:

- *Overall unadjusted energy savings*. These savings measure the impact of the HER program on average household energy consumption. We estimated the unadjusted energy savings using a fixed effects regression model that compares the treatment group's pre- and post-program consumption difference to that of the control group. The energy savings reflect the overall program savings before applying any adjustment for joint savings achieved in conjunction with other rebate programs.
- *Joint savings*. Joint savings represent HER-induced savings derived from the increased uptake of SDG&E rebate programs. This estimate is normally produced for two areas:
  - *Downstream* joint savings occur due to increased participation by the HER treatment group versus the control group in SDG&E's tracked energy efficiency programs.
  - *Upstream* joint savings occur due to the increase in purchases of CFL and LED bulbs by the HER treatment group versus the control group through the SDG&E-supported upstream lighting program.[4]

Final adjusted energy savings. These savings represent the final program savings after deducting both the downstream and upstream joint savings. This adjustment eliminates the potential to double count savings already accounted for in the rebated programs.The results of these savings calculations are presented in Section 4.

[4] TRC, on behalf of the IOUs, produced the electric joint savings estimates and heating and cooling interactive effects associated with energy saving lighting measures from upstream programs.

3 METHODOLOGY

3.1 Energy savings

For this evaluation we used a fixed-effects regression model that is the standard for evaluating behavioral programs like HER. The fixed effects model specification calculates program savings by comparing consumption of the treatment group to the control group before and after program implementation. The change that occurs in the treatment group is adjusted to reflect any change that occurred in the control group, in order to isolate changes attributable to the program.

The fixed-effects equation is:

$$E_{it} = \mu_i + \lambda_t + \beta_t P_{it} + \varepsilon_{it}$$

Where:

E_{it} = Average daily energy consumption for account i during month t
P_{it} = Binary variable: one for households in the treatment group in the post period month t, zero otherwise
λ_t = Monthly effects
μ_i = Account level fixed effects
ε_{it} = Regression residual

This model produces estimates of average monthly savings using the following equation:

$$\bar{S}_t = \hat{\beta}_t$$

Where:

$\bar{S}_t$ = Average treatment related consumption reduction during month t
$\hat{\beta}_t$ = Estimated parameter measuring the treatment group difference in the post period month t

The model also includes site-specific and month/year fixed effects. The site-specific effects control for mean differences between the treatment and control groups that do not change over time. The month/year fixed effects control for change over time that is common to both treatment and control groups. The monthly post-program dummy variables pick up the average monthly effects of the treatment. Households that move are dropped from the model. The total savings are a sum of the monthly average savings combined with the count of households still eligible for the program in that month. Households that actively opt out of the program remain in the model as long as they remain in their house. In this respect, the treatment can be considered "intent to treat." This model is consistent with best practices as delineated in State and Local Energy Efficiency Action Network's Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations.[5]

[5] State and Local Energy Efficiency Action Network. 2012. *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations*. Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory. http://behavioranalytics.lbl.gov.

3.2 Downstream rebate joint savings

One possible effect of the HER program is to increase rebate activity in other SDG&E energy efficiency programs. The RCT experimental design facilitates the measurement of this effect. We compared the average savings from rebate measures installed by the treatment group with the savings from measures installed by the control group. An increase in treatment group rebate program savings represents savings caused by the HER program jointly with the rebate programs. While these joint savings are an added benefit of the HER program, it is essential that these joint savings are only reported once. The most common and simple approach is to remove all joint savings from the HER program savings rather than remove program-specific joint savings from all of the associated rebate programs. This has been the approach used historically to adjust the savings from the IOU HER programs.

The savings estimates from the fixed effects regressions include all differences between the treatment and control group in the post-report period. Joint savings are picked up by the regressions and included in the overall savings estimate. These joint savings are also included in SDG&E rebate program tracking databases and are claimed as part of those programs' savings unless further actions were taken to remove them. Savings from the HER program are adjusted using joint savings to avoid double counting of savings.

DNV GL applied the following approach for rolling up individual rebate's savings and calculating joint savings overall:

- Used accepted deemed savings values (those being used to claim the savings for the rebate program)
- Started accumulating savings beginning from the installation date moving forward in time
- Assigned daily savings on a load-shape-weighted basis (more savings when we expect the measure to be used more)
- Maintained the load-shape-weighted savings over the life of the measure

This approach takes the deemed annual savings values and transforms them into realistic day-to-day savings values given the installation of that measure. We determined the daily share of annual savings using hourly 2011 California Database for Energy Efficiency Resources (DEER) load shapes[6] for SDG&E. [7] These load shapes indicate when a measure is used during the year and, by proxy, when efficiency savings would occur.[8]

Savings for each installed measure start to accrue at the time of installation (or removal for refrigerator recycling). We calculated average monthly household rebate program savings for the treatment and control groups including zeroes for the majority of households that do not take part in any rebate program. An increase in average per-household tracked program savings among the treatment group versus the control group indicates joint savings.

3.3 Upstream joint savings

Upstream joint savings are similar to downstream joint savings, except that upstream savings are not tracked at the customer level. SDG&E upstream savings still represent a source of savings that HER program could potentially double count. Unlike tracked programs, it is not possible to directly compare all treatment

[6] DEER load shapes are in an 8760 hourly format. DNV GL aggregated the hourly shares to daily shares in order to estimate daily savings.

[7] http://deeresources.com/DEER2011/download/DEER2011-UpdatedImpactProfiles-v2.zip

[8] This is more accurate and equitable than subtracting out the first year savings values that are used in DEER, because most measures are not in place from the first day to the last day of the year.

and control group member activity. This makes it more challenging to determine if the HER program does increase savings in upstream programs.

The alternative to the downstream census-level approach is to do a comparison of treatment and control group uptake of the upstream program measures on a sample basis. This approach also takes advantage of the RCT experimental design, which provides the structure to produce an un-biased estimate of upstream savings. PG&E conducted in-home surveys in 2013 to assess uptake of upstream measures (specifically, CFLs and flat-screen TVs) due to HER. The surveys included samples of treatment and control customers from PG&E HER program. Because of the expected similarity between upstream savings between SDG&E and PG&E and the prohibitive cost of performing a similar survey for the relatively small SDG&E program, results from PG&E study were used as the basis for SDG&E estimate of upstream joint savings in previous evaluations.

For the 2014 evaluation, the IOUs engaged TRC to revise and update the assumptions used in the joint savings methodology in order to consider the changing structure of the IOUs' upstream lighting programs (ULP) and reflect more recent available data on IOU lighting programs. [9] DNV GL reviewed TRC's lighting study and worked with the IOUs and their consultants (TRC, Nexant, and AEG) to develop a more appropriate method to distribute the savings adjustment stream over the timeline of the HER program using existing input data from the PG&E Home Inventory report, inputs from the TRC study and other available data from Puget Sound Energy's (PSE) Home Energy Report telephone survey.[10]

The improved approach assumed an increasing efficient bulb uptake but at a decreasing rate while the assumption used in past SDG&E HER evaluations assumed that the HER program encouraged a 0.95 annual increase in CFL installation per household. The new assumption for the number of excess lamps due to HER was based on the results of PG&E in-home inventory study in 2013 and available data from PSE HER phone surveys.

[9] TRC. *Lighting Savings Overlap in 2014 IOU Residential Behavioral Programs*.TRC memo dated June 30, 2015.

[10] The improved methodology for joint savings calculation and upstream joint savings estimates for the 2014 HER is summarized in TRC's revised memo, *Proposed Changes to Draft ULP HER Lighting Savings Overlap for 2014*, dated October 22, 2015.

Table 4 presents the updated assumptions used in SDG&E 2014 HER joint savings calculation for upstream programs.

Table 4. Input assumptions used in SDG&E calculation for 2014 upstream joint savings

Assumptions	Input Values	Source
Excess lamps due to HER		
Year 1	0.95	2013 PG&E in-home survey
Year 2	0.4	Interpolated from PG&E ad PSE values (DNV GL)
Year 3	0.15	2013 PSE HER phone survey (DNV GL)
Year 4	0.08	2014 PSE HER phone survey (DNV GL)
Rebated sales fraction		
2011 CFL	57%	TRC estimate
2012 CFL	68%	TRC estimate
2013 CFL	40%	TRC estimate
2014 CFL	18%	Program tracking data (DEER 2013-14)
2014 LED	32%	Program tracking data (DEER 2013-14)
Annual savings per bulb		
2011 CFL	23.3	2010-12 ULP Evaluation (DNV GL, 2014)
2012 CFL	22.6	2010-12 ULP Evaluation (DNV GL, 2014)
2013 CFL	17.9	Program tracking data (DEER 2013-14)
2014 CFL	17.9	Program tracking data (DEER 2013-14)
2014 LED	21.8	Program tracking data (DEER 2013-14)
Fraction of CFL lamps in 2014	0.6	TRC estimate of total CFL and LED sold in territory
Fraction of LED lamps in 2014	0.4	TRC estimate of total CFL and LED sold in territory
Net-to-gross	0.61	2010-12 ULP Evaluation (DNV GL, 2014)
Installation rate	97%	2010-12 ULP Evaluation (DNV GL, 2014)
Assumed gas savings	-0.014	Program tracking data (DEER 2013-14)

Source: TRC memo on Proposed Changes to ULP HER Lighting Savings Overlap for 2014.

With regards to timing of purchase of efficient bulb, the old approach assumed that all bulbs were purchased at the beginning of the year while the new approach assumed that the excess efficient lamps due to HER were purchased evenly throughout the year. Lastly, the new approach also assumed that all additional bulbs installed prior to 2014 were all CFLs while some of the additional bulbs in 2014 include LEDs.

The general equations used in calculating electric joint savings from ULP are presented below:

$$\text{CFL(or LED)kWh joint savings per household} = \text{Excess CFLs(or LED)due to HER} \times \text{Number of years CFLs(or LED)have been installed} \times \text{CFL(or LED)rebated sales fraction} \times \text{NTG} \times \text{Installation rate} \times \text{Annual savings per CFL(or LED)}$$

$$\text{Total kWh joint savings from ULP} = \text{Number of households in the treatment group} \times (\text{CFL kWh joint savings per household} + \text{LED kWh joint savings per households})$$

California recognizes the potential for interactive effects across fuels when assigning savings. Interactive effects are explicitly accounted for in the downstream rebate program tracking database. For the untracked ULP, a similar estimate of interactive effects for gas is calculated using the ratio of kWh and therms savings per watt from DEER. The assumed gas savings per kWh savings from upstream lighting program are -0.014 therms per kWh based on TRC memo. The equation below is used to calculate the heating and cooling interactive effects associated with energy saving lighting measures:

$$\text{Therms savings due to interactive effects} = \text{Total kWh joint savings from ULP} \times (-0.014 \text{ therms per kWh})$$

The approach directly estimates gas effect from the estimated upstream electric joint savings. The interactive effect produce negative gas joint savings and therefore increases the overall adjusted gas savings. This adjustment is important because the replacement of inefficient lighting measures with more efficient lamps can increase heating load consumption due to lower heat emissions from CFLs and LEDs.

3.4 Data management

The impact evaluation relies on consumption data from the SDG&E monthly billing data system. Consumption data are closely tied to the billing function and are generally considered accurate. On the other hand, missed reads, estimated reads, and corrections do occur, and may undermine the validity of some readings. In non-RCT billing analysis evaluations, it is common to apply a range of consumption data checks in an attempt to limit invalid data. This can lead to the removal of customers from the analysis because of limitations in their billing data. In an RCT analysis, we would expect anomalies to appear in the same proportion in the treatment and control groups, and thus there is no need to remove such records. For this evaluation, the two primary groups removed from the analysis were net metering customers and customers with insufficient data.

For most cases, potential data issues are small and proportionally balanced between the treatment and control groups. These findings indicate that data issues are infrequent and that the treatment/control difference inherent in the RCT structure controlled for the majority of the issues that existed.

Table 5 provides an overview of the data issues identified in the billing data. The incidence of issues is small across treatment and control group and both fuel types. Zero reads do exist for both the electric and gas billing data. The zero reads for gas houses are not uncommon in the summer and are not real issues; they are included only for completeness. For large reads, extreme average daily consumption was observed in less than 30 households.

Table 5. Summary of billing data issues

Data disposition	Electric		Gas	
	Control	Treatment	Control	Treatment
Bad Read Dates	0.00%	0.00%	0.00%	0.00%
Zero Reads	1.94%	2.06%	1.04%	1.16%
Negative Reads	0.81%	0.87%	0.00%	0.00%
Missing Reads	0.00%	0.00%	0.00%	0.00%
Extreme Reads	0.05%	0.03%	0.00%	0.00%
No Issues	97.2%	97.1%	99.0%	98.8%

For most cases, potential data issues are small and proportionally balanced between the treatment and control groups. These findings indicate that data issues are infrequent and that the treatment/control difference inherent in the RCT structure controlled for the majority of the issues that existed.

Table 6 summarizes the count of households with respect to natural attrition due to change in occupancy. The below tables also provide the number of move-outs per month and the cumulative number of accounts used for both the treatment and control groups to determine active households. The count of active households for the treatment group was used to calculate total program savings.

Table 6. Move-outs based on electric account

Billing month	Treatment Group			Control Group		
	Open Accounts	Closed Accounts		Open Accounts	Closed Accounts	
		Cumulative	Monthly		Cumulative	Monthly
14-Jan	15,437	4,387	68	15,369	4,452	170
14-Feb	15,364	4,460	73	15,291	4,530	78
14-Mar	15,288	4,536	76	15,212	4,609	79
14-Apr	15,210	4,614	78	15,132	4,689	80
14-May	15,126	4,698	84	15,042	4,779	90
14-Jun	15,037	4,787	89	14,948	4,873	94
14-Jul	14,918	4,906	119	14,799	5,022	149
14-Aug	14,832	4,992	86	14,746	5,075	53
14-Sep	14,709	5,115	123	14,586	5,235	160
14-Oct	14,625	5,199	84	14,541	5,280	45
14-Nov	14,554	5,270	71	14,483	5,338	58
14-Dec	14,499	5,325	55	14,444	5,377	39

Note: The monthly counts provided exclude sites with net metering

The electric and gas accounts for a household do not always end on the same day. We used electric accounts read periods to establish the number of active households. The counts based on gas account information were similar and did not justify establishing a second set of household counts for the purpose of calculating total gas savings.

The estimates of savings produced by the fixed effects model reflect the consumption data of those households remaining in the program (treatment or control group). Unlike attrition due to move-outs, households that opted-out of the program remain in the treatment group despite the fact that they no longer receive the reports. Removing opt-out households would undermine the similarity between the two groups that is established by the RCT design.

Customers who installed solar panels and switched to net metering posed a dilemma for this evaluation. This is due to the way that net metering is addressed in the billing data, which creates challenges for either including them in the analysis or fully understanding the extent of the issue. For example, if the solar households were included in the analysis it would be necessary to incorporate household-level energy production data.[11] Otherwise, potential differences in solar energy production could be conflated with program-related savings, biasing the results up or down. For this evaluation, all net-metered customers were left out of the analysis.

[11] It is instructive to compare solar-installing households to HER opt-outs with respect to their effect on the analysis results. The removal of opt-outs from the treatment group would likely remove households with lower savings effects thus artificially increasing the savings estimate for those households remaining in the treatment group. This potential upward bias in the savings result is a clear reason for including these households despite their opting out. The solar-installing households have a less clearly defined HER program savings effect so it is more difficult to assess the effect of their removal on the HER savings of remaining households. More importantly, energy generated by solar systems would dwarf the amount of HER program savings at most households. The decision to remove these households is based on a lack of clear evidence of a biasing effect in the savings estimate and the concern that their inclusion would be practically speaking infeasible and would have the potential to introduce bias.

4 RESULTS

This chapter presents the final reported savings estimates for the 2014 SDG&E HER program.

4.1 Overall program savings estimates

Figure 1 and Figure 2 provide graphic illustrations of monthly electric and gas savings for 2014. The average monthly electric and gas savings follow a strong seasonal pattern. Monthly electric savings are all statistically significant and are highest during the summer months. Gas savings show no apparent savings during the summer when savings are not statistically different from zero. During the winter and spring months, gas savings increased up to around 2.25 therms in January.

Figure 1. Average monthly kWh savings per household

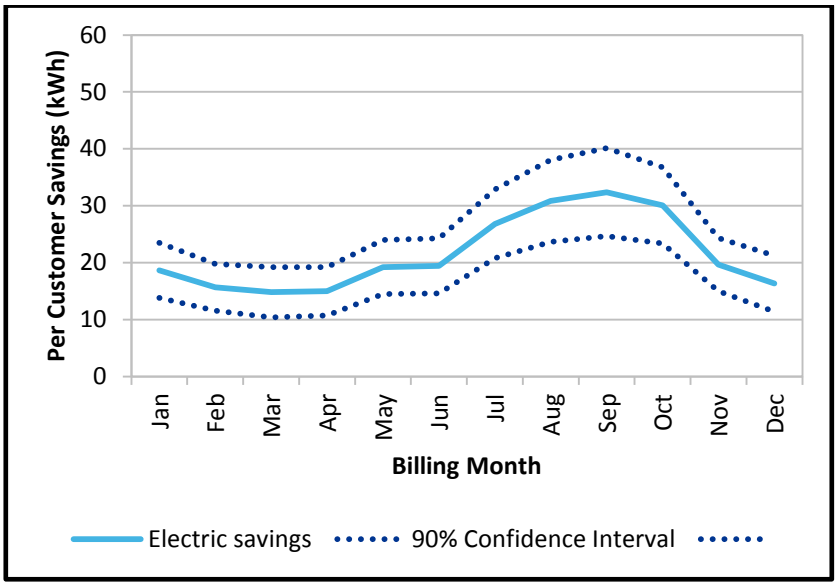
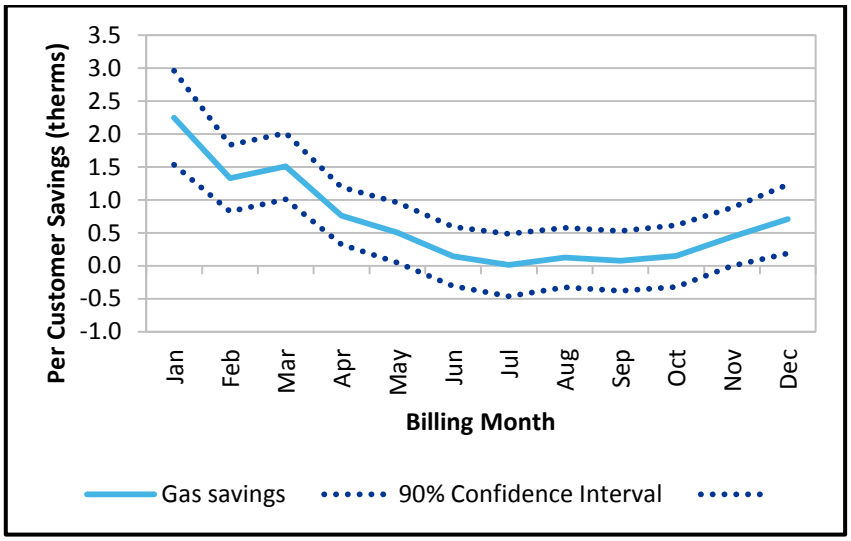


Figure 2. Average monthly therm savings per household



The reported program savings estimate for 2014 could be potentially lower than the true savings from the HER program because of the MAS program contamination in the control group. However, we expect the effect (if any) to be marginal because the MAS program was already discontinued in 2013 and only 38% of the initial control group were affected.

Table 7 and Table 8 provide monthly electric and gas savings in tabular form along with the count of treatment group households for each month. In combination, these numbers generate the total monthly estimated electric and gas savings for the HER Program. The total rows at the bottom of the tables provide the total annual savings along with confidence intervals at 90%.

Table 7. Average monthly and total kWh savings

Billing Months	Unadjusted Savings per Household (kWh)	Count of Treatment Group Participants	Program Unadjusted Savings (kWh)
14-Jan	18.6	15,437	287,487
14-Feb	15.7	15,364	240,506
14-Mar	14.8	15,288	226,318
14-Apr	15.0	15,210	227,873
14-May	19.2	15,126	290,905
14-Jun	19.4	15,037	292,115
14-Jul	26.8	14,918	399,952
14-Aug	30.9	14,832	457,664
14-Sep	32.4	14,709	476,414
14-Oct	30.0	14,625	439,461
14-Nov	19.7	14,554	286,230
14-Dec	16.3	14,499	236,667
2014 Program Savings			3,861,592
			90% Confidence Interval: (3,117,746 / 4,605,438)

Table 8. Average monthly and total therms savings

Billing Months	Unadjusted Savings per Household (therms)	Count of Treatment Group Participants	Program Unadjusted Savings (therms)
14-Jan	2.25	15,437	34,681
14-Feb	1.33	15,364	20,433
14-Mar	1.51	15,288	23,090
14-Apr	0.76	15,210	11,548
14-May	0.51	15,126	7,647
14-Jun	0.14	15,037	2,163
14-Jul	0.01	14,918	202
14-Aug	0.13	14,832	1,877
14-Sep	0.07	14,709	1,102
14-Oct	0.15	14,625	2,166
14-Nov	0.44	14,554	6,444
14-Dec	0.71	14,499	10,298
2014 Program Savings			121,651
			90% Confidence Interval: (63,517 / 179,785)

Consistent with previous SDG&E HER evaluations, the billing months are based on the month of the end dates of a billing cycle. The billing cycles in the consumption data used in the evaluations do not always conform to a calendar month and savings represented in each billing month may also include some savings from the previous month.

The HER program generated 259 kWh and 8 therms per household savings in 2014. Compared to the per household savings estimates in 2013, electric savings decreased by 8% while gas savings decreased by 29%. The large drop in gas savings per household can be attributed to a relatively milder winter and late temperature drops in 2014 relative to 2013. In December 2014, low temperatures were observed during the last few days of the month. The consumption data used in this analysis may not have included the last few days in December for many of the households because of how billing months were assigned. Some of the savings incurred during the last week of December will be reflected and credited to the 2015 program cycle.

Overall, the HER program achieved a total electric savings of 3,862 MWh and total gas savings of 121,651 therms. The total program savings in 2014 were lower than 2013 program savings due to the combined effect of lower per household savings and customer attrition.

Table 3 shows a comparison of the HER savings per household from 2012 to 2014.

4.2 Joint savings: downstream programs

Downstream joint savings are identified by comparing savings of the treatment and control from downstream program installations. These savings from measure installations build up over time in the post-treatment period. If the HER program also motivates increased participation in other SDG&E programs, then the treatment group downstream savings will accrue faster than the control group. The difference in savings between the treatment and control groups represents the savings jointly attributable to both the HER program and other downstream programs.

Figure 3 and Figure 4 show the monthly downstream electric and gas savings, respectively. The electric savings for the treatment group increases faster than the control group during 2012, the first year of the program indicating an increase in activity due to the reports. Similar to findings in 2013 evaluation, there was very little evidence of increased uptake in downstream program participation in the treatment group in 2014. As illustrated below, the difference in savings between treatment and control groups in December for all years are more or less similar. This observation suggests that program participation between the control and treatment groups are comparable in 2014 and joint savings attributed to HER program were mostly due to energy efficiency measures installed prior to 2014.

Figure 3. Treatment and control group kWh savings from rebate programs

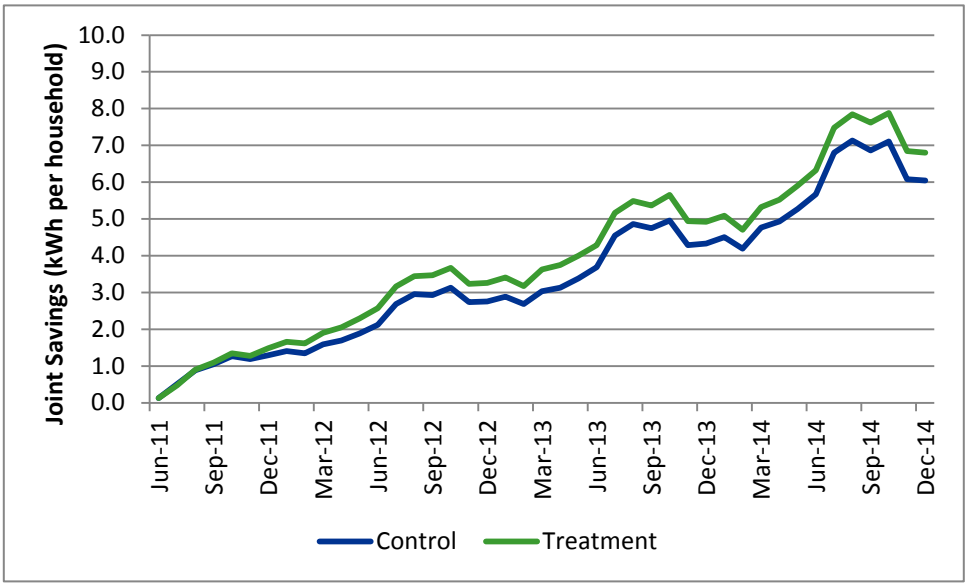
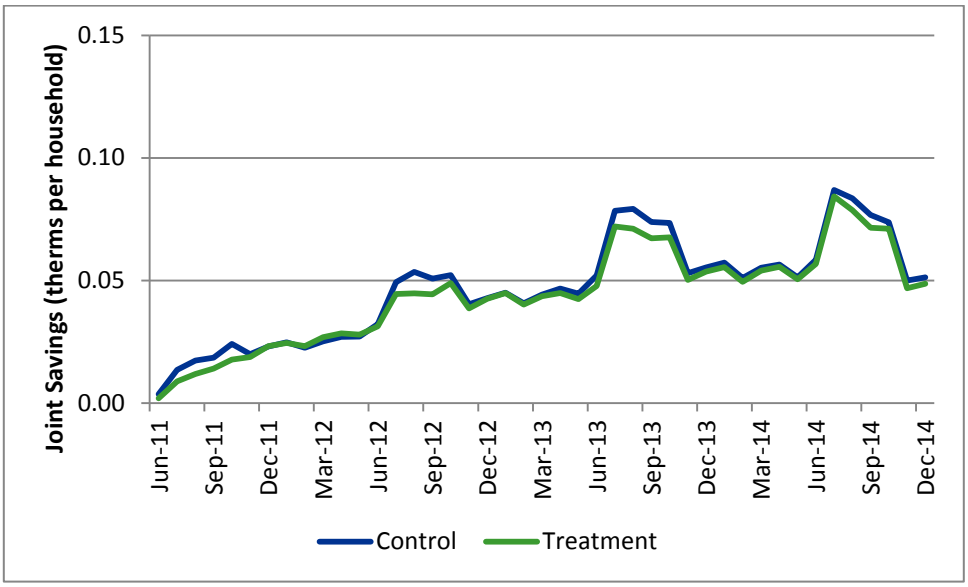


Figure 4. Treatment and control group therms savings from rebate programs



Contrary to joint savings results for electric, downstream gas savings are negative. The negative joint savings suggests that gas savings from downstream rebate and HER are higher for the control group. However, savings are not statistically significant.

Figure 5 and Figure 6 provide graphic illustrations of the monthly estimates of average joint electric and gas savings per customer in kWh and therms, respectively. These figures simply provide a graphical illustration of the difference in savings between the treatment and control groups along with the corresponding confidence intervals.

Figure 5. Average monthly kWh joint savings per household

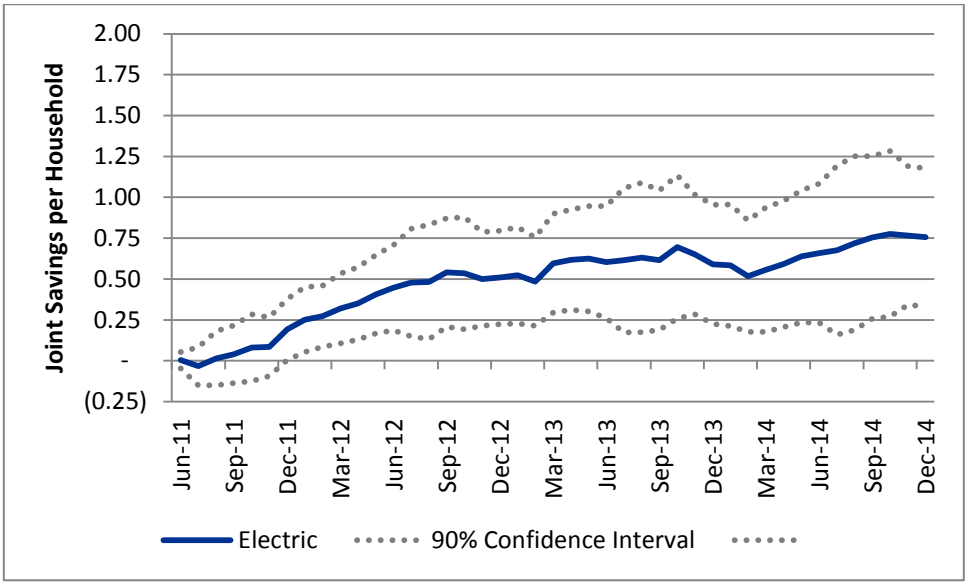
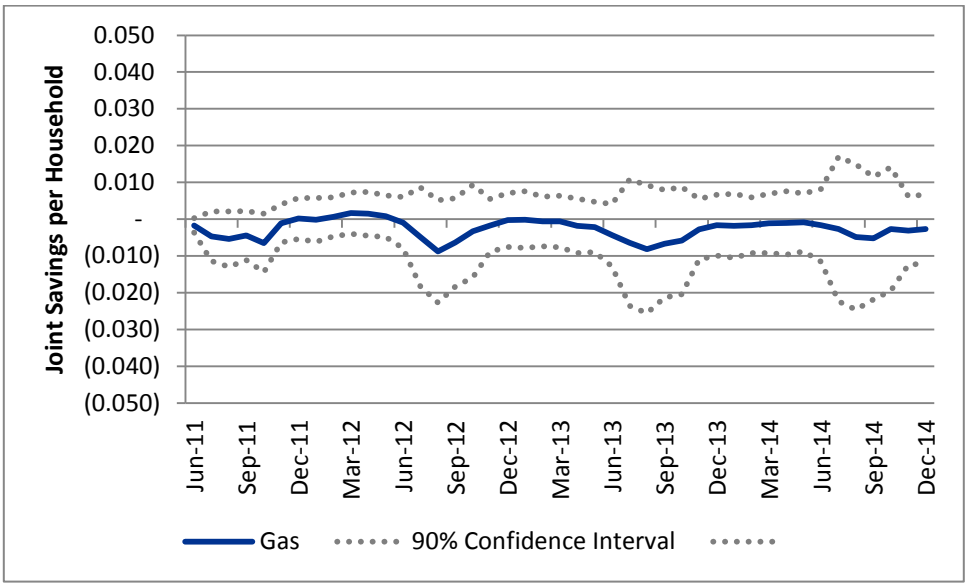


Figure 6. Average monthly therms joint savings per household



The addition of the confidence intervals illustrates that electric joint savings are significantly different from zero while gas joint savings are not. However, as noted above, electric joint savings in 2014 are mostly from carryover savings during the previous years.

Table 9 and Table 10 provide the tabular joint savings for electric and gas along with the monthly count of treatment group customers in kWh and therms. The monthly joint savings are the combination of the average per customer savings and the customer counts.[12] The overall savings estimates are provided along with confidence intervals. The downstream joint savings will be removed from the overall electric and gas savings estimates for the HER program.

[12] If a household installs a downstream program measure and then subsequently moves out, the savings accrue to the point of the move-out and then are removed. This is consistent with how a particular customer's data enter into the fixed effects regression.

Table 9. Monthly kWh joint savings

Month	Joint Savings per Household - Tracked /Downstream Programs (kWh)	Count of Treatment Group Participants	Program Tracked Joint Savings (kWh)
14-Jan	0.58	15,437	9,027
14-Feb	0.52	15,364	7,960
14-Mar	0.56	15,288	8,522
14-Apr	0.59	15,210	8,990
14-May	0.64	15,126	9,649
14-Jun	0.66	15,037	9,897
14-Jul	0.68	14,918	10,086
14-Aug	0.72	14,832	10,677
14-Sep	0.75	14,709	11,100
14-Oct	0.78	14,625	11,351
14-Nov	0.77	14,554	11,146
14-Dec	0.76	14,499	10,956
2014 Savings			119,362
			90% Confidence Interval (43,820 / 194,904)

Table 10. Monthly therms joint savings

Month	Joint Savings per Household - Tracked /Downstream Programs (therms)	Count of Treatment Group Participants	Program Tracked Joint Savings (therms)
14-Jan	0.00	15,437	-28
14-Feb	0.00	15,364	-25
14-Mar	0.00	15,288	-18
14-Apr	0.00	15,210	-15
14-May	0.00	15,126	-13
14-Jun	0.00	15,037	-25
14-Jul	0.00	14,918	-40
14-Aug	0.00	14,832	-72
14-Sep	-0.01	14,709	-76
14-Oct	0.00	14,625	-39
14-Nov	0.00	14,554	-45
14-Dec	0.00	14,499	-38
2014 Savings			-433.42
			90% Confidence Interval (-2,456 / 1,590)

The aggregate downstream gas joint savings are slightly negative but not statistically different from zero. As a result, the overall gas savings estimate for the HER program will not be adjusted with the downstream rebate program gas joint savings.[13]

4.3 Joint savings: upstream programs

Table 11 provides the upstream joint savings inputs for CFLs and LEDs. The total upstream joint savings per household in 2014 were 11.1 kWh per year for CFLs and 0.1 kWh per year for LEDs or a total upstream joint savings per household of 11.2 kWh per year.

Table 11. Upstream kWh joint savings inputs for CFL and LED

	CFL				LED
Inputs	2011	2012	2013	2014	2014
No. of excess bulb per year	0.95	0.40	0.15	0.05	0.03
No. of excess bulbs/month	0.08	0.03	0.01	0.00	0.00
No. of bulbs installed due to HER	0.48	0.68	0.28	0.07	0.04
Year bulbs have been installed in 2014	1.00	1.00	1.00	0.50	0.50
Deemed kWh savings per bulb	23.30	22.60	17.90	17.90	21.80
CFL rebated sales fraction	0.57	0.68	0.40	0.18	0.32
Net-to-gross	0.61	0.61	0.61	0.61	0.61
Installation rate	0.97	0.97	0.97	0.97	0.97
kWh joint savings	3.7	6.1	1.2	0.1	0.1
Total annual kWh joint savings per household for CFL (or LED)				11.1	0.1

Joint savings values are calculated as the product of the number of bulbs installed due to HER, year lamps have been installed in 2014, deemed savings per bulb, CFL (or LED) rebated sales fraction, net-to-gross ratio and installation rate. For example, the portion of 2014 joint savings from CFLs installed in 2011 is calculated as 0.48 bulbs x 1 year x 23.3 kWh/bulb x 0.57 rebated CFLs x 0.61 CFL savings attributed to ULP x 0.97 installation rate or 3.7 kWh per household. The total annual joint savings from all CFLs and LEDs installed since the start of the HER program were 11.1 kWh per household and 0.1 kWh per household, respectively.

Table 12 combines the monthly per bulb upstream joint savings estimate with the monthly treatment group counts to generate an estimate of upstream joint savings for the duration of the program. Overall, the total program joint savings estimate due to participation in upstream program was 167.5 MWh.

13 Because the downstream joint savings estimate is census-based (that is, the full set of treatment group installations are compared to the full set of control group installations), the lack of statistical significance is a valid basis for not removing the gas joint savings. This is in contrast to the upstream savings which are removed despite estimated joint savings that are highly non-statistically significant. The sample-based upstream approach makes the attainment of statistical significance challenging.

Table 12. Monthly upstream kWh savings from lighting programs

Month	CFL Joint Savings per Household	LED Joint Savings per Household	Count of Treatment Group Participants	Program Joint Savings (kWh)
14-Jan	0.9	0.01	15,437	14,395
14-Feb	0.9	0.01	15,364	14,327
14-Mar	0.9	0.01	15,288	14,256
14-Apr	0.9	0.01	15,210	14,183
14-May	0.9	0.01	15,126	14,105
14-Jun	0.9	0.01	15,037	14,022
14-Jul	0.9	0.01	14,918	13,911
14-Aug	0.9	0.01	14,832	13,831
14-Sep	0.9	0.01	14,709	13,716
14-Oct	0.9	0.01	14,625	13,638
14-Nov	0.9	0.01	14,554	13,572
14-Dec	0.9	0.01	14,499	13,520
2014 Savings				167,476

Note: Monthly CFL (or LED) joint savings per household are calculated as 11.1 kWh for CFLs (or 0.1 kWh for LEDs) divided by 12 months.

California recognizes the potential for interactive effects across fuels when assigning savings. Interactive effects are explicitly accounted for in the rebate program savings tracking database. For the untracked, upstream program savings we need to establish a similar estimate of interactive effects for gas. Similar to the tracked rebate program joint savings, the interactive gas effects have the opposite sign of the joint savings. In the case of the ULP, there are no gas joint savings. Rather than diminishing the effect of other gas joint savings, the interactive effect produce negative gas joint savings. In the context of ULP joint savings, interactive savings increase the HER program gas savings as measured in the billing analysis.

To calculate this value we use the ratio of kWh and therms savings per watt from DEER[14]. The relationship is described in the following equation.

$$Therm\ effect = \frac{\frac{-0.02Th}{w}}{\frac{1.44\ kWh}{w}} * kWh\ effect = {}^{-0.02Th}/_{1.44kWh} * kWh\ upstream\ savings$$

This approach directly estimates the gas effect from the estimated untracked, upstream electric joint savings that are removed as potential double counting from HER program unadjusted electric savings. The only additional assumption contained herein is that DEER offers the correct relationship between CFL savings and gas interactive effects. This is the best source for this relationship at this time. This approach assumes that SDG&E HER program treatment group members, all of which are dual-fuel households, have gas heat.

Table **13** provides the stream of ULP interactive effects through the months of the program.

[14] http://deeresources.com/DEER2011

Table 13. Monthly upstream interactive effects

Month	Joint Savings per Customer - Untracked / Upstream Programs (therms)	Count of Treatment Group Participants	Program Joint Savings (therms)
14-Jan	(0.01)	15,437	-202
14-Feb	(0.01)	15,364	-201
14-Mar	(0.01)	15,288	-200
14-Apr	(0.01)	15,210	-199
14-May	(0.01)	15,126	-198
14-Jun	(0.01)	15,037	-196
14-Jul	(0.01)	14,918	-195
14-Aug	(0.01)	14,832	-194
14-Sep	(0.01)	14,709	-192
14-Oct	(0.01)	14,625	-191
14-Nov	(0.01)	14,554	-190
14-Dec	(0.01)	14,499	-189
2014 Savings			-2,347

4.4 Per household savings and total program savings

This section combines the results in the prior three sections to provide the final savings estimates for the program. Program savings reported in this section may not reflect the true program savings due to the control group's exposure to the MAS behavior program. We expect that due to the contamination, the savings may be lower due to a lower baseline in the control group to the extent that MAS successfully reduced electric and gas consumption.

Table 14 lists the unadjusted HER electric savings along with the two forms of joint savings that we removed from the unadjusted savings. The adjusted savings column provides the monthly household-level savings for the HER program with all potentially double-counted savings removed. Overall program adjusted savings are calculated using the monthly count of active treatment group participants.

Table 14. Combined monthly kWh savings

Month	kWh per Household				Count of Treatment Group Participants	Adjusted Program Savings (kWh)
	Unadjusted Savings	Joint Savings - Tracked	Joint Savings - Untracked	Adjusted Savings		
		Downstream Programs	Upstream Programs			
14-Jan	18.6	0.6	0.93	17.1	15,437	264,065
14-Feb	15.7	0.5	0.93	14.2	15,364	218,219
14-Mar	14.8	0.6	0.93	13.3	15,288	203,540
14-Apr	15.0	0.6	0.93	13.5	15,210	204,700
14-May	19.2	0.6	0.93	17.7	15,126	267,152
14-Jun	19.4	0.7	0.93	17.8	15,037	268,196
14-Jul	26.8	0.7	0.93	25.2	14,918	375,955
14-Aug	30.9	0.7	0.93	29.2	14,832	433,156
14-Sep	32.4	0.8	0.93	30.7	14,709	451,598
14-Oct	30.0	0.8	0.93	28.3	14,625	414,472
14-Nov	19.7	0.8	0.93	18.0	14,554	261,513
14-Dec	16.3	0.8	0.93	14.6	14,499	212,190

Table 15 provides the same set of data for HER program gas savings. Joint savings from downstream are negative for gas and are not statistically different from zero. There are no upstream, untracked gas savings in the SDG&E portfolio and the negative values for upstream joint savings are due to interactive effects with the upstream lighting programs.

Table 15. Combined monthly therms savings

Month	therms per Household				Count of Treatment Group Participants	Adjusted Program Savings (therms)
	Unadjusted Savings	Joint Savings /Downstream Programs	Upstream Interactive Effects	Adjusted Savings		
14-Jan	2.25	0.00	-0.01	2.26	15,437	34,883
14-Feb	1.33	0.00	-0.01	1.34	15,364	20,634
14-Mar	1.51	0.00	-0.01	1.52	15,288	23,290
14-Apr	0.76	0.00	-0.01	0.77	15,210	11,747
14-May	0.51	0.00	-0.01	0.52	15,126	7,845
14-Jun	0.14	0.00	-0.01	0.15	15,037	2,360
14-Jul	0.01	0.00	-0.01	0.02	14,918	397
14-Aug	0.13	0.00	-0.01	0.14	14,832	2,070
14-Sep	0.07	-0.01	-0.01	0.08	14,709	1,294
14-Oct	0.15	0.00	-0.01	0.16	14,625	2,357
14-Nov	0.44	0.00	-0.01	0.45	14,554	6,634
14-Dec	0.71	0.00	-0.01	0.72	14,499	10,488

Aggregate savings are reported in Table 16. The downstream, tracked gas savings are included here as a true zero to be consistent with aggregate results. Adjusted savings represents the HER program savings net of any savings claimed by any other SDG&E energy efficiency programs.

Table 16. Program-level savings estimates

Evaluation Period	Source	Electric (kWh)	Gas (therms)
January 2014 - December 2014	Unadjusted Savings	3,861,592	121,651
	Tracked, Downstream Joint Savings	119,362	(433)
	Untracked, Upstream Lighting Joint Savings	167,476	(2,347)
	Adjusted Savings	3,574,754	123,998

Table 17 presents the unadjusted and adjusted savings as a fraction of control group, post-period consumption.[15] Percentage savings are widely used to describe Opower program savings across utilities. As reported in other venues, these percentages may be adjusted or unadjusted savings. These results are consistent in magnitude with savings reported by other Opower programs.

Table 17. Savings per household as a percent of kWh and therms consumption

Evaluation Period	Fuel	Unadjusted, Per Customer Savings	Adjusted, Per Customer Savings	Per Customer Consumption	Unadjusted Savings as Percentage of Consumption	Adjusted Savings as Percentage of Consumption
January 2014 - December 2014	kWh	258.8	239.6	9,904	2.6%	2.4%
	therms	8.01	8.2	440	1.8%	1.9%

APPENDIX B shows DNV GL's additional analysis of HER per household savings by CARE and non-CARE and APPENDIX C presents the historical electric and gas saving per household for the HER program across IOUs.

[15] Per customer savings are calculated by dividing the total aggregate savings by the average number of customers during that time period.

5 CONCLUSIONS

This evaluation finds that the HER program continues to produce electric and gas savings that are statistically significant. The HER program achieved an unadjusted savings of 259 kWh per household and 8 therms per household in the third year. The electric savings remain at a level similar to previous years while gas savings were relatively lower.

The results from joint savings analysis for downstream programs showed that the HER program increased participation of other rebate programs for electric measures. However, these joint savings remain almost static since the first year of the program suggesting that joint savings observed in 2014 are mostly carryover savings from rebate participation in the previous years.

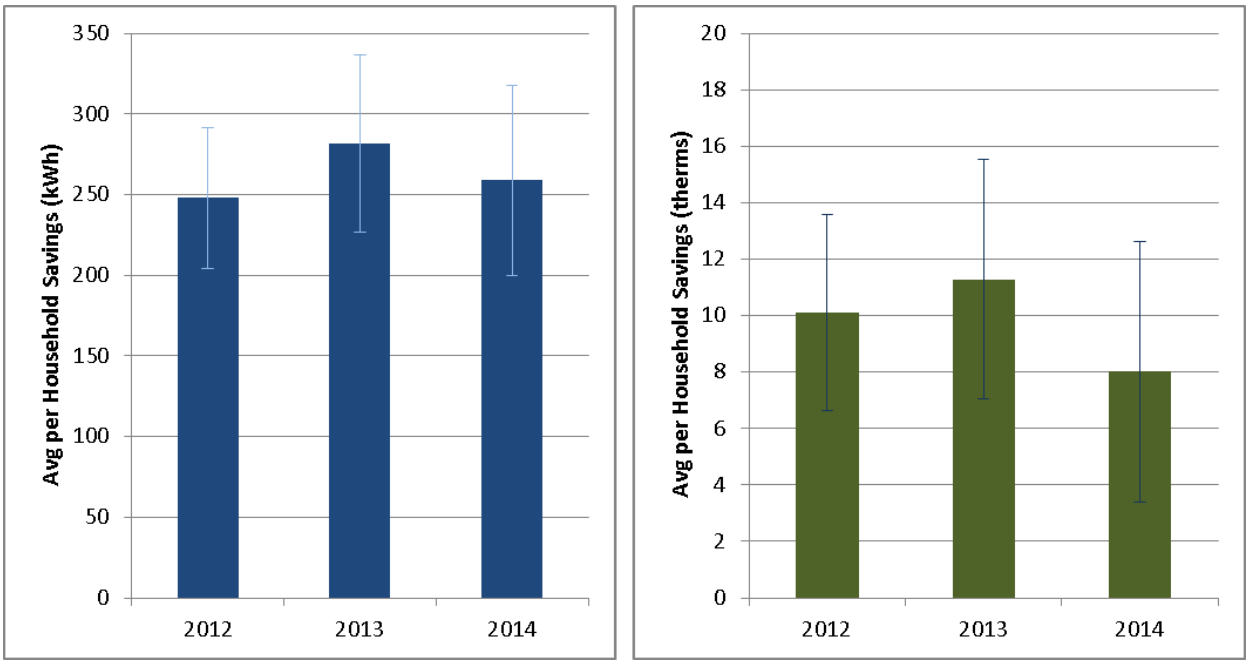
Similar to 2013 HER evaluation, DNV GL recognizes that the 2014 HER program savings estimates may not reflect the true program savings because of the enrollment of some control sites in another behavioral program. However, we expect the influence of MAS program to be very small (if any) and cease through time because the program was offered only for a short period of time, already discontinued in 2013 and contaminated only one-third of the HER control participants.

Overall, the HER program produced an aggregate adjusted savings of 3,575 MWh and 124 thousand therms in 2014. SDG&E may use these results to support savings claims for the 2014 HER Program.

APPENDIX A. 2012-2014 SDG&E HER PROGRAM SAVINGS

The figure in this appendix shows a graphical illustration of the average savings per household for the HER program from 2012 to 2014.

Figure 1. HER unadjusted savings from 2012 to 2014



APPENDIX B. CARE VS. NON-CARE

The Energy Division asked DNV GL to compare savings between CARE and non-CARE customers. Because customers were marked as CARE or non-CARE at a monthly level, we created three different thresholds to assign customers to the CARE or non-CARE categories.

The three definitions were:

- Customers with a CARE rate for at least 1 billing month in 2014
- Customers with a CARE rate for at least 6 billing months in 2014
- Customers with a CARE rate for at least 10 billing months in 2014

Table 1 shows how the CARE and non-CARE customers are distributed using the three different thresholds. Results show that the proportions of CARE and non-CARE customers are more or less balanced between the treatment and control groups for all three CARE thresholds.

Table 1. Count of CARE and Non-CARE customers

HER sample	No of households		% of households	
	Control	Treatment	Control	Treatment
CARE definition: Customers with CARE rate for at least 1 billing month in 2014				
CARE	1,950	1,924	12%	12%
Non-CARE	14,130	14,147	88%	88%
Total	16,080	16,071		
CARE definition: Customers with CARE rate for at least 6 billing months in 2014				
CARE	1,603	1,602	10%	10%
Non-CARE	14,477	14,469	90%	90%
Total	16,080	16,071		
CARE definition: Customers with CARE rate for at least 10 billing months in 2014				
CARE	1,361	1,373	8%	9%
Non-CARE	14,719	14,698	92%	91%
Total	16,080	16,071		

Figure 1 and Figure 2 provide a comparison of savings between CARE and non-CARE customers for electric and gas. Based on the results, the average electric savings are statistically significant for CARE and non-CARE customers. CARE customers showed higher electric savings per household than the non-CARE customers. On the average, CARE customers produced 4% electric savings while non-CARE customers produced 2% electric savings. For gas, savings from non-CARE customers are statistically significant while CARE customers showed no evidence of savings. On the average, CARE customers produced 1% gas savings while non-CARE customers produced 2% savings.

Figure 1. Per household unadjusted electric savings from CARE and non-CARE customers

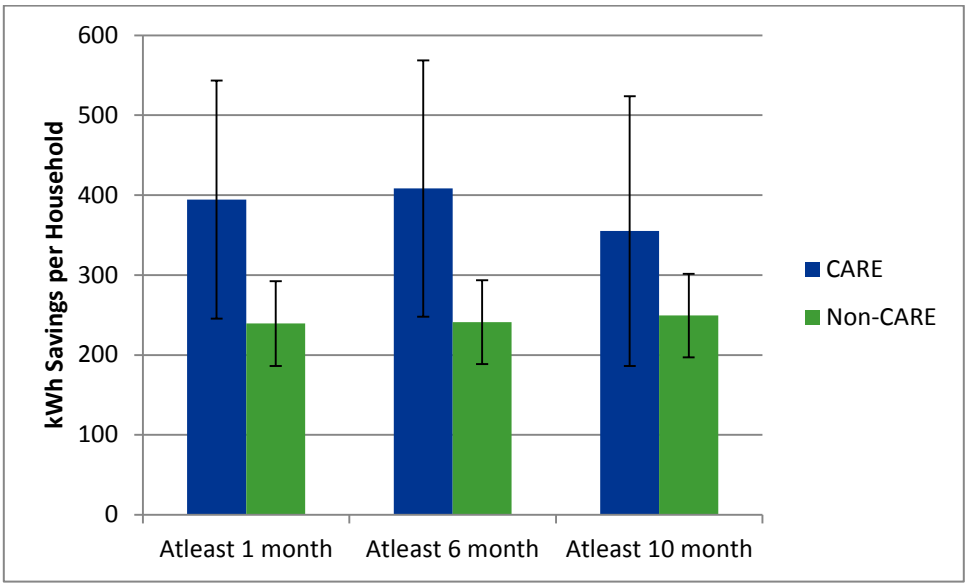
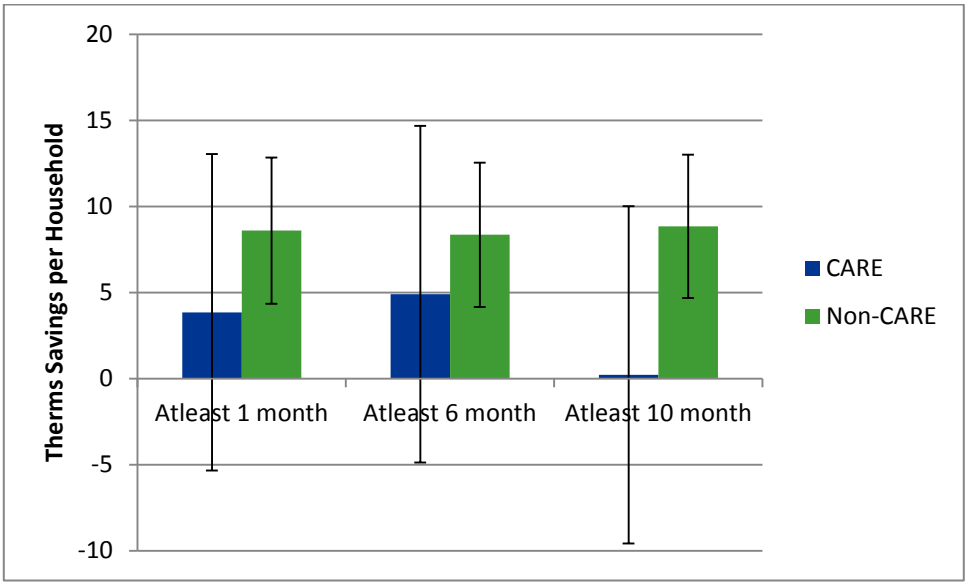


Figure 2. Per household unadjusted gas savings from CARE and non-CARE customers



APPENDIX C. HER SAVINGS BY IOU (2011-2014)

Table 1. Historical HER kWh and therms savings per household across IOUs from 2011 to 2014

IOU	Wave	No. of treatment months	Unadjusted kWh Savings per Household	Percent kWh Savings	Unadjusted therms Savings per Household	Percent therms Savings
2011-12						
PG&E	Beta	17	234	1.5%	10	0.9%
	Gamma Dual Standard	14	90	1.1%	3	0.6%
	Gamma Dual Reduced	14	74	0.9%	4	0.6%
	Gamma Electric only	14	111	1.4%		
	Wave One Dual	11	77	1.1%	1	0.4%
	Wave One Electric only	11	85	1.1%		
SDG&E	Pilot	18	310	2.0%	12	1.5%
2013						
PG&E	Beta	12	221	2.1%	8	1.0%
	Gamma Dual Standard	12	112	1.5%	2	0.5%
	Gamma Dual Reduced	12	101	1.4%	2	0.5%
	Gamma Electric only	12	118	1.7%		
	Wave One Dual	12	112	1.5%	3	0.6%
	Wave One Electric only	12	128	1.6%		
	Wave Two Area 7	11	52	0.9%	3	0.6%
	Wave Two Not Area 7	11	60	0.9%	3	0.7%
	Wave Three	6	27	0.8%	1	0.6%
SCE	Opower1	12	140	1.3%		
SDG&E	Pilot	12	282	2.8%	11	2.0%
2014						
PG&E	Beta	12	222	2.2%	5	0.8%
	Gamma Dual Standard	12	121	1.7%	2	0.6%
	Gamma Dual Reduced	12	99	1.4%	2	0.6%
	Gamma Electric only	12	105	1.5%		
	Wave One Dual	12	117	1.7%	3	0.7%
	Wave One Electric only	12	129	1.6%		
	Wave Two Area 7	12	92	1.4%	3	0.8%
	Wave Two Not Area 7	12	86	1.5%	3	0.8%
	Wave Three	12	69	1.0%	3	0.8%
	Wave Four	10	37	0.7%	1	0.2%
	Wave Five	3	10	0.4%	1	0.6%
SCE	Opower2	9	52	0.8%		
SDG&E	Pilot	12	259	2.6%	8	1.8%

Appendix AA. Standardized High Level Savings

The tables in Appendix AA summarizing natural gas savings make use of the unit MTherms – 1,000 Therms – rather than MMTherms – 1,000,000 Therms – for formatting purposes.

Gross Lifecycle Savings (MWh)

Report Name	PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
RES 3.1	PG&E	Home Energy Reports					
RES 3.1	**PG&E**	**Total**					
RES 3.1		***Statewide***					
RES 3.2	SCE	Home Energy Reports					
RES 3.2	**SCE**	**Total**					
RES 3.2		***Statewide***					
RES 3.3	SDG&E	Home Energy Reports					
RES 3.3	**SDG&E**	**Total**					
RES 3.3		***Statewide***					
RES 3.4	MCE	Home Utility Reports					
RES 3.4	**MCE**	**Total**					
RES 3.4		***Statewide***					

Net Lifecycle Savings (MWh)

Report Name	PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
RES 3.1	PG&E	Home Energy Reports		107,704						
RES 3.1	**PG&E**	**Total**		**107,704**						
RES 3.1		***Statewide***		***107,704***						
RES 3.2	SCE	Home Energy Reports		3,496						
RES 3.2	**SCE**	**Total**		**3,496**						
RES 3.2		***Statewide***		***3,496***						
RES 3.3	SDG&E	Home Energy Reports		3,575						
RES 3.3	**SDG&E**	**Total**		**3,575**						
RES 3.3		***Statewide***		***3,575***						
RES 3.4	MCE	Home Utility Reports		0						
RES 3.4	**MCE**	**Total**		**0**						
RES 3.4		***Statewide***		***0***						

Gross Lifecycle Savings (MW)

Report Name	PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
RES 3.1	PG&E	Home Energy Reports					
RES 3.1	**PG&E**	**Total**					
RES 3.1		***Statewide***					
RES 3.2	SCE	Home Energy Reports					
RES 3.2	**SCE**	**Total**					
RES 3.2		***Statewide***					
RES 3.3	SDG&E	Home Energy Reports					
RES 3.3	**SDG&E**	**Total**					
RES 3.3		***Statewide***					
RES 3.4	MCE	Home Utility Reports					
RES 3.4	**MCE**	**Total**					
RES 3.4		***Statewide***					

Net Lifecycle Savings (MW)

Report Name	PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
RES 3.1	PG&E	Home Energy Reports		19.5						
RES 3.1	**PG&E**	**Total**		**19.5**						
RES 3.1		***Statewide***		***19.5***						
RES 3.2	SCE	Home Energy Reports		0.8						
RES 3.2	**SCE**	**Total**		**0.8**						
RES 3.2		***Statewide***		***0.8***						
RES 3.3	SDG&E	Home Energy Reports								
RES 3.3	**SDG&E**	**Total**								
RES 3.3		***Statewide***								
RES 3.4	MCE	Home Utility Reports								
RES 3.4	**MCE**	**Total**								
RES 3.4		***Statewide***								

Gross Lifecycle Savings (MTherms)

Report Name	PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
RES 3.1	PG&E	Home Energy Reports					
RES 3.1	**PG&E**	**Total**					
RES 3.1		***Statewide***					
RES 3.2	SCE	Home Energy Reports					
RES 3.2	**SCE**	**Total**					
RES 3.2		***Statewide***					
RES 3.3	SDG&E	Home Energy Reports					
RES 3.3	**SDG&E**	**Total**					
RES 3.3		***Statewide***					
RES 3.4	MCE	Home Utility Reports					
RES 3.4	**MCE**	**Total**					
RES 3.4		***Statewide***					

Net Lifecycle Savings (MTherms)

Report Name	PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
RES 3.1	PG&E	Home Energy Reports		3,017						
RES 3.1	**PG&E**	**Total**		**3,017**						
RES 3.1		***Statewide***		***3,017***						
RES 3.2	SCE	Home Energy Reports								
RES 3.2	**SCE**	**Total**								
RES 3.2		***Statewide***								
RES 3.3	SDG&E	Home Energy Reports		124						
RES 3.3	**SDG&E**	**Total**		**124**						
RES 3.3		***Statewide***		***124***						
RES 3.4	MCE	Home Utility Reports								
RES 3.4	**MCE**	**Total**								
RES 3.4		***Statewide***								

Gross First Year Savings (MWh)

Report Name	PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
RES 3.1	PG&E	Home Energy Reports					
RES 3.1	**PG&E**	**Total**					
RES 3.1		***Statewide***					
RES 3.2	SCE	Home Energy Reports					
RES 3.2	**SCE**	**Total**					
RES 3.2		***Statewide***					
RES 3.3	SDG&E	Home Energy Reports					
RES 3.3	**SDG&E**	**Total**					
RES 3.3		***Statewide***					
RES 3.4	MCE	Home Utility Reports					
RES 3.4	**MCE**	**Total**					
RES 3.4		***Statewide***					

Net First Year Savings (MWh)

Report Name	PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
RES 3.1	PG&E	Home Energy Reports		107,704						
RES 3.1	**PG&E**	**Total**		**107,704**						
RES 3.1		***Statewide***		***107,704***						
RES 3.2	SCE	Home Energy Reports		3,496						
RES 3.2	**SCE**	**Total**		**3,496**						
RES 3.2		***Statewide***		***3,496***						
RES 3.3	SDG&E	Home Energy Reports		3,575						
RES 3.3	**SDG&E**	**Total**		**3,575**						
RES 3.3		***Statewide***		***3,575***						
RES 3.4	MCE	Home Utility Reports		0						
RES 3.4	**MCE**	**Total**		**0**						
RES 3.4		***Statewide***		***0***						

Gross First Year Savings (MW)

Report Name	PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
RES 3.1	PG&E	Home Energy Reports					
RES 3.1	**PG&E**	**Total**					
RES 3.1		***Statewide***					
RES 3.2	SCE	Home Energy Reports					
RES 3.2	**SCE**	**Total**					
RES 3.2		***Statewide***					
RES 3.3	SDG&E	Home Energy Reports					
RES 3.3	**SDG&E**	**Total**					
RES 3.3		***Statewide***					
RES 3.4	MCE	Home Utility Reports					
RES 3.4	**MCE**	**Total**					
RES 3.4		***Statewide***					

Net First Year Savings (MW)

Report Name	PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
RES 3.1	PG&E	Home Energy Reports		19.5						
RES 3.1	**PG&E**	**Total**		**19.5**						
RES 3.1		***Statewide***		***19.5***						
RES 3.2	SCE	Home Energy Reports		0.8						
RES 3.2	**SCE**	**Total**		**0.8**						
RES 3.2		***Statewide***		***0.8***						
RES 3.3	SDG&E	Home Energy Reports								
RES 3.3	**SDG&E**	**Total**								
RES 3.3		***Statewide***								
RES 3.4	MCE	Home Utility Reports								
RES 3.4	**MCE**	**Total**								
RES 3.4		***Statewide***								

Gross First Year Savings (MTherms)

Report Name	PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
RES 3.1	PG&E	Home Energy Reports					
RES 3.1	**PG&E**	**Total**					
RES 3.1		***Statewide***					
RES 3.2	SCE	Home Energy Reports					
RES 3.2	**SCE**	**Total**					
RES 3.2		***Statewide***					
RES 3.3	SDG&E	Home Energy Reports					
RES 3.3	**SDG&E**	**Total**					
RES 3.3		***Statewide***					
RES 3.4	MCE	Home Utility Reports					
RES 3.4	**MCE**	**Total**					
RES 3.4		***Statewide***					

Net First Year Savings (MTherms)

Report Name	PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
RES 3.1	PG&E	Home Energy Reports		3,017						
RES 3.1	**PG&E**	**Total**		**3,017**						
RES 3.1		***Statewide***		***3,017***						
RES 3.2	SCE	Home Energy Reports								
RES 3.2	**SCE**	**Total**								
RES 3.2		***Statewide***								
RES 3.3	SDG&E	Home Energy Reports		124						
RES 3.3	**SDG&E**	**Total**		**124**						
RES 3.3		***Statewide***		***124***						
RES 3.4	MCE	Home Utility Reports								
RES 3.4	**MCE**	**Total**								
RES 3.4		***Statewide***								

Appendix AB. Standardized Per Unit Savings

Per Unit (Quantity) Gross Energy Savings (kWh)

Report Name	PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
RES 3.1	PG&E	Home Energy Reports	0		0.0%	1.0			
RES 3.2	SCE	Home Energy Reports	0		0.0%	1.0			
RES 3.3	SDG&E	Home Energy Reports	0		0.0%	1.0			
RES 3.4	MCE	Home Utility Reports	0		0.0%	1.0			

Per Unit (Quantity) Gross Energy Savings (Therms)

Report Name	PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
RES 3.1	PG&E	Home Energy Reports	0		0.0%	1.0			
RES 3.2	SCE	Home Energy Reports	0		0.0%	1.0			
RES 3.3	SDG&E	Home Energy Reports	0		0.0%	1.0			
RES 3.4	MCE	Home Utility Reports	0		0.0%	1.0			

Per Unit (Quantity) Net Energy Savings (kWh)

Report Name	PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
RES 3.1	PG&E	Home Energy Reports	0		0.0%	1.0	77.1	77.1	77.1
RES 3.2	SCE	Home Energy Reports	0		0.0%	1.0	48.0	48.0	48.0
RES 3.3	SDG&E	Home Energy Reports	0		0.0%	1.0	239.6	239.6	239.6
RES 3.4	MCE	Home Utility Reports	0		0.0%	1.0	0.0	0.0	0.0

Per Unit (Quantity) Net Energy Savings (Therms)

Report Name	PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
RES 3.1	PG&E	Home Energy Reports	0		0.0%	1.0	2.2	2.2	2.2
RES 3.2	SCE	Home Energy Reports	0		0.0%	1.0			
RES 3.3	SDG&E	Home Energy Reports	0		0.0%	1.0	8.2	8.2	8.2
RES 3.4	MCE	Home Utility Reports	0		0.0%	1.0			

Appendix AC. Recommendations

Study ID	Study Type	Study Title	Study Manager
Res 3	Impact Evaluation	Validation and Impact Evaluation of IOU's 2014 Home Energy Reports Program	CPUC

ommendat	Program or Database	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations	Recommendation Recipient	Affected Workpaper or DEER
1	HER	DNV GL and the IOUs are using different assumptions on the distribution of savings from measures installed under IOU rebate programs.	N/A	DNV GL is working with the IOUs and their consultants to standardize the approach used in joint savings analysis.	DNV GL, PG&E, SCE and SDG&E	N/A
2	HER	DNV GL and the IOUs are using different approaches in calculating joint savings at the peak.	N/A	DNV GL proposes leveraging CA statewide lighting report to estimate peak savings from efficient bulbs. DNV GL is working with the IOUs and their consultants to standardize the approach.	DNV GL, PG&E, SCE and SDG&E	N/A
3	HER	DNV GL's inability to replicate the climate zone heat waves identified in PG&E HER early impact study while seeming to leverage data from the same underlying sources and approaches, presents evidence that peak periods using the DEER definition is sensitive to small changes.	N/A	DNV GL proposes to employ a separate definition of peak period for comparison with the current peak definition. DNV GL is working with the IOUs and their consultants to standardize this process.	DNV GL, PG&E, SCE and SDG&E	N/A
4	HER	The IOUs are using slightly different approaches in peak demand savings that can produce substantially different results.	N/A	Estimate or continue to estimate demand savings at the wave-level instead of calculating demand savings at the climate zone-level. DNV GL is working with the IOUs and their consultants to standardize the approach used in calculating peak demand savings.	DNV GL, PG&E, SCE and SDG&E	N/A

5	HER	Discrepancies between DNV GL program saving estimates and saving estimates reported in the IOU's early impact evaluation reports are mostly due to differences in billing month assignments.	N/A	Standardize the billing month assignment. Use or continue to use the mid-point when assigning billing months to standardize the approach and minimize the sources of discrepancies in the results.	DNV GL, PG&E, SCE and SDG&E	N/A
6	HER	Rebate savings from program participation of inactive customers were counted in joint savings calculation for PG&E HER early impact study.	N/A	DNV GL recommends calculating joint savings based on rebate participation of customers that are still active in 2014.	PG&E	N/A
7	HER	Combining households from all Gamma waves (or Wave One) can produce results that are substantially different.	N/A	DNV GL recommends splitting out Gamma and Wave One sub-waves in the PG&E HER rebate analysis so that the treatment group is compared to the corresponding control group and for consistency with the approach used in energy savings calculation	PG&E	N/A
8	HER	Early impact evaluation of PG&E HER reported standard errors for the aggregated savings that were based on a regression model at the wave-level where an overall post-treatment indicator was specified	N/A	The standard errors of the annual savings should be calculated using the combined monthly parameter standard errors weighted by the monthly counts.	PG&E	N/A

Appendix BA. Public Comments on 2014 SDGE HER Evaluation

No.	From	Section	Comments	Response
1	SDGE	Table 1, page 2	Suggest adding number of customers to the table	Added as a footnote in the table
2	SDGE	Table 2, page 3	Suggest adding number of customers to the table	Added as a footnote in the table
3	SDGE	Table 3, page 4	Suggest adding number of customers to the table	Addressed in the table
4	SDGE	Table 9, page 19	Appears comma is in the wrong place on the high end of the Confidence Interval (should it be 194,904?); Also, suggest separating the 2 values with a "/" instead of a "," for readability	Addressed in the table
5	SDGE	Table 10, page 19	Suggest separating the 2 Confidence Interval values with a "/" instead of a "," for readability	Addressed in the table
6	SDGE	IESR Appendix AB-3	Why is this table, "Per Unit (Quanity) Net Energy Savings (kWh)," blank?	Addressed in the table
7	SDGE	IESR Appendix AB-4	Why is this table, "Per Unit (Quanity) Net Energy Savings (Therms)," blank?	Addressed in the table

Appendix BB. Public Comments from Opower

No.	From	Section	Comments	Response
1	Opower		Opower would like to comment on the recommended approach to use the bill period mid-point to assign usage to months. We do not have an objection to this approach to assigning usage to months, but we request that the evaluator(s) specify the method used to define the pre/post treatment border in the billing data. The motivation for this request is our observation that accurate measurement of savings requires that no post treatment usage be defined as pre-treatment in the data. Specifically, how did the evaluators ensure that no post-treatment usage data was defined in the data as pretreatment	For this evaluation, DNV GL used the end date of the billing cycle as the billing month. Billing months that fall onto the same month of the program start date will be the first month in the post period. This ensures that no post treatment periods are assigned in the pre-period. When using the mid-point, we agree that careful assignment of pre and post period should be ensured to accurately estimate savings. This approach will require identifying the billing cycle that includes the program start date as the start of the treatment period.

			usage? For example, if a bill period included the treatment start date, but the bill period mid-point was prior to the start date, how was this bill defined in the data used for the savings regression?	
2	Opower	Joint Savings - Upstream	DNV-GL, AEG, Nexant and the utilities have been tasked with ensuring that savings identified from HER programs are not attributed to and claimed by other portfolio programs. While a straightforward process to identify and back out savings from the increased uptake of downstream measures of HER recipients has been made possible by the experimental design, it is difficult to ascertain the savings that could be attributable to upstream measures. Broadly, it is far more challenging to identify the specific actions being taken by customers that lead to savings. The composition of savings for individual households varies as much as each household's usage profile does. In most cases, the question of what comprises HER savings is academic, and insights based on data from various deployments can be inferred. However, in the case of measuring joint upstream savings, these questions lead to a direct impact on the assesment of the HER program, both in terms of absolute savings and on costeffectiveness. At a high level, the assumption underlying this analysis that customers receiving HERs adopt upstream efficient lighting technology at a higher rate than those in the control group deserves additional discussion and scrutiny. From a strictly theoretical standpoint, it makes sense that when customers are more aware of their energy usage, they take actions to reduce it and one of the least-cost actions a residential customer can take is	While we understand Opower's concern on the application of the same bulb uptake assumption across all program waves, the joint savings analysis from upstream programs were based on studies that were currently available at the time of the evaluation. DNV GL, the IOUs and the IOU consultants are working together to update the assumptions for future HER evaluations. Opower, the implementer of the program being evaluated, is welcome to provide any comments on the approach and assumptions used during public forums (i.e. EM&V quarterly meetings)

			purchasing efficient lighting. Proving this hypothesis is a challenging, costly, and imprecise exercise. In 2012, Freeman, Sullivan, & Company (FSC) conducted a socket-level survey on behalf of PG&E, involving more than 1,000 home visits to count the number of CFLs customers in both the treatment and control group had installed. The survey found that, on average, HER recipients installed approximately 0.95 more CFLs than households in the control group; however, FSC notes that this difference was not statistically significant. Despite the statistical uncertainty around this 0.95 figure, it was applied on a statewide level without addressing the high probability that any number of variables may impact customers' response to HERs with respect to their lighting purchases. Variations in usage patterns and the regional availability of different lighting technologies with varying levels of subsidies are all likely to have an impact on lighting purchases for HER recipients. In addition, the FSC survey focused on a subset of PG&E customers that was intentionally weighted toward relatively high users who have a higher relative propensity to take more significant savings actions in response to HERs. To assume that households with lower usage experiencing different variables will respond exactly the same is a logical leap that is unsupported by any data that Opower is aware of. To the contrary, the specific characteristics of the FSC survey group indicate that this segment was not representative of the broader PG&E customer base, let alone any other utility's	

			customer base. The new methodology included in the joint upstream savings methodology employed in the 2014 HER evaluations relies on phone and web surveys conducted by DNV-GL on behalf of Puget Sound Energy over the course of their long-running HER deployment. Similar to the socket-level survey conducted by FSC, the difference in reported adoption levels between treatment and control customers at Puget Sound Energy was not statistically significant. Opower goes to great lengths to ensure that any savings claimed by a utility from our programs are measured with statistical significance. In fact, it is highly unlikely that the CPUC would accept savings claims from behavioral programs that were not statistically significant. To use figures that do not meet this standard as underlying assumptions for removing savings from the HER program is inconsistent with the statistical rigor required of behavioral efficiency programs in California. Another concern regarding the new methodology is its extrapolation across lighting technologies. The methodology takes as its starting point an assumption that customers in the treatment group are purchasing 0.95, 0.4, 0.15, and 0.08 excess efficient bulbs compared with the control group in years 1-4 of an HER program. These numbers were arrived at through surveys conducted at a time when basic CFL bulbs comprised the vast majority of efficient lighting available. The new methodology assumes this number of excess efficient bulbs regardless of the changing lighting technologies in the	

			marketplace. It is unclear assumed that customers will adopt high-efficiency advanced CFLs and LEDs, which are significantly more expensive than basic CFLs were, at the same historical rates. As alluded to above, Opower is also concerned about the approach of applying one assumed number of excess bulbs to households in every wave, regardless of the clear differences amongst different deployments. In Opower's 400+ program years of experience implementing HER programs, we have found that every individual wave across different utilities in different geographies varies with regard to energy savings percentage and other key outcomes. It is therefore not appropriate to apply a single number (e.g. 1.58) of efficient bulbs to each individual wave without acknowledging substantive differences both in customer composition and geographies, climate zones and other variables. Aside from our concerns about the validity of the figures arrived at in these studies Opower is concerned that Energy Division and DNV-GL have landed on the belief that ⅓ or more of HER savings are due to lighting purchases (TRC Oct. 22 Memo; Page 3) despite the peer-reviewed evidence that a significant percentage of HER savings are very likely not associated with lighting. LBNL has analyzed a great deal of AMI data from HER recipients and published its findings in, "Insights from Smart Meters: Identifying specific actions, behaviors, and characteristics that drive savings in behavior-based programs." LBNL's analysis found that HER savings characteristics include a substantial increase during hotter days and higher	

			savings for households with high likelihood of having central A/C. This observed HER savings curve does not correlate with a standard indoor lighting profile. Therefore, not only is the evidence of substantial lighting uptake by HER recipients statistically suspect, but the more rigorous analysis of HER savings appears to directly conflict with the concept that such a significant percentage of savings is from lighting. Opower understands that DNV-GL and Energy Division are working against very tight timelines to finalize these 2014 evaluations, and the savings removed due to ULP joint savings is under 10% of total first year savings. However, we are concerned that if this methodology is continued into subsequent years, this percentage will rise substantially to levels that don't pass the smell test. Opower therefore urges Energy Division and DNV-GL to take a thoughtful, deliberative, and transparent approach to determining how to address the question of jointly attributable savings from upstream measures going forward. To date, the process for determining these policies has only involved the IOUs, Energy Division, and evaluators. This excludes implementers like Opower that have both a very significant interest in these discussions, but also a wealth of experience, data, and knowledge about the characteristics of HER programs in the real world. We urgently request that there be a more open and transparent process around this topic going forward, as this issue is anything but technical minutiae to Opower. What happens in California does not stay in California. Rather, other states and utilities oftentimes look to our state as the thought	

			leader on issues like this and will readily adopt the exact same policies without consideration of the local context or the level of debate that has occurred in California.	
3	Opower		The approach to accounting for jointly-attributable savings taken in the evaluations of PG&E, SCE, and SDG&E's HER programs raises broader policy questions regarding both downstream and upstream HER programs. While the current practice of savings attribution is a practical one given the ex ante vs. ex post approach to accounting for savings from deemed and behavioral programs respectively, it is at odds with the objectives placed on behavioral programs in California. HER programs have been deployed for more than seven years to produce verifiable savings via behavior change. Given their success, these programs could continue on with the narrow focus of behavioral change. But, behavioral programs are able to deliver various co-benefits beyond behavioral energy efficiency and there has been a significant push in California and peer states for HER programs to do more than just change behaviors in the short-term. Such outcomes include, but are not limited to, promoting participation in other demand side-management programs via targeted messaging to the right customer segment at the right time; maximizing the value of program marketing budgets; and increasing energy literacy. Based on evidence to date, HERs have been successful in delivering on these objectives, to the delight of regulators, clients, and the team at Opower. However, the current approach to accounting for jointly attributable	This is not within the scope of DNV GL's impact evaluation. The approach that DNV GL and the IOUs (and their consultants) use in measuring savings credited to the HER program is based on the decision/policy provided under D. 10-04-029 (http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/116710.htm) that states that savings credited to behavioral programs should not represent double counted savings.

			savings decreases the perceived cost-effectiveness of HER programs and provides a disincentive to achieve these objectives. While these co-benefits do not overshadow the primary output of the HER program, behavioral savings, we should be sure that policy is designed to promote the success of programs that have multiple co-benefits across categories, not penalize them for their efficiency. After years of study, we know for that those who receive HERs use less energy than those who do not. We have also observed that those who receive HERs are more likely to participate in rebated energy efficient programs. Because of the experimental design, we know that this increased participation occurs directly because of the HER program. Yet, the attribution for savings negatively impacts the very program that resulted in this increase. In order to accurately characterize the effect downstream and upstream lighting programs, while simultaneously allowing HERs to continue meeting the energy and policy objectives set for them, it may be time to reevaluate the attribution approach employed.	

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.