Review and Validation of 2015 Pacific Gas and Electric Home Energy Reports Program Impacts (Final Report)

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Table of contents

List of tables

List of figures

1 EXECUTIVE SUMMARY

This report summarizes the results of DNV GL's review and evaluation of the Pacific Gas and Electric Company's (PG&E's) Home Energy Reports (HER) program impacts for 2015. The evaluation includes calculated energy and demand savings estimates that are used to validate an earlier HER 2015 impact evaluation from Nexant, Inc.

1.1 Background

PG&E began sending reports for their HER pilot program (Beta wave) in August 2011. The reports contain a mix of consumption information, comparison with similar neighbors and customized tips for saving energy. Since then, PG&E has sent reports to a new wave of households in each subsequent year. There are eight waves (Beta, Gamma, One, Two, Three, Four, Five, and Six) with some waves split further into smaller sub-waves (i.e., Wave Two Area 7 versus Wave Two Not Area 7). Table 1 shows the original number of households in the treatment and control groups across all HER experimental waves. PG&E started each wave at different times, drew them from different populations, and applied slightly different treatments. Approximately 1.5 million PG&E customers were enrolled in the treatment groups as of 2015.

Table 1. HER experimental waves and launch dates

Wave	Fuel type / Frequency of report / Area	Launch date	Treatment households	Control households
Beta	Dual fuel	July-11	60,000	60,000
Gamma*	Dual fuel – standard frequency	November-11	72,000	72,000
	Dual fuel – reduced frequency		72,000	72,000
	Electric only		45,000	45,000
Wave One	Dual fuel	February-12	360,000	90,000
	Electric only		40,000	10,000
Wave Two	Area 7	February-13	80,000	50,000
	Non - Area 7		305,000	48,000
Wave Three	Dual fuel	July-13	225,000	75,000
Wave Four	Dual fuel	March-14	200,000	75,000
Wave Five	Dual fuel	October-14	210,000	50,000
Wave Six	Dual fuel	September-15	312,000	50,000

* Customers in Gamma Wave – reduced frequency receive the comparative reports quarterly as opposed to receiving the reports every other month (standard frequency).

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.

1.2 Research questions and objectives

The primary objective of this evaluation is to provide independent verification of energy and demand savings attributable to the HER program. Specific research questions included the following:

- What are the energy savings for each HER wave?

- Are there downstream/upstream rebate program savings that could be jointly claimed by both the HER program and other PG&E rebate programs?
- What are the peak demand savings attributable to the program?
- Are the results produced by Nexant on behalf of PG&E consistent with the results produced by the independent evaluation?
- Do savings persist after customers stop receiving reports?
- Do customers who receive email reports generate more savings?

1.3 Study approach

To answer the research questions, DNV GL reviewed and validated Nexant's early impact evaluation for PG&E's 2015 HER program. DNV GL compared its independent estimates for the different components of HER program savings with Nexant's results. The different components are:

- *Overall unadjusted energy and demand savings*. These savings measure the impact of the HER program on average household energy consumption and demand. We estimated the unadjusted energy savings using a fixed effects regression model that compared the treatment group's pre- and post-program consumption difference to that of the control group. For the unadjusted demand savings, we estimated savings as the difference in peak load between the treatment group and control group during the hottest heatwave in pre- and post-periods. These energy and demand 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 PG&E rebate programs. This estimate is produced for two kinds of programs:
  - *Downstream* joint savings occur due to increased participation by the HER treatment group versus the control group in PG&E's tracked energy efficiency programs.
  - *Upstream* joint savings occur due to increased purchases of PG&E-supported upstream lighting program CFL and LED bulbs by the HER treatment group versus the control group.
- *Final adjusted energy and demand 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.

This ex-post validation did not only review the approach used by Nexant but also replicated the analysis. This approach allows DNV GL to provide the CPUC with recommendations from a more robust validation of the estimated savings that occurred within the program.

1.4 Key findings

Overall, the HER program continued to produce electric and gas savings that are statistically significant at the 90% confidence level. Table 2 provides the estimates of unadjusted and adjusted electric and gas savings at the household level in 2015. The electric savings range from 1% to 2% of electric consumption except for Wave Six while gas savings are approximately 1% of baseline gas consumption in 2015. Wave Six began in 2015 and does not represent savings for a full year.[1] The recommended electric and gas savings are based on Nexant's estimates for unadjusted electric and gas savings estimates along with DNV GL's joint savings estimates for downstream and upstream programs.

Table 2. Average kWh and therms savings per household as a percent of consumption for 2015

Wave	Per Household Savings (Unadjusted)	Per Household Savings (Adjusted)	% Savings	
			Unadjusted	Adjusted
Electric (kWh)				
Beta	224	208	2.3%	2.1%
Gamma Standard	110	100	1.6%	1.5%
Gamma Reduced	94	84	1.4%	1.2%
Gamma Electric Only	128	117	1.9%	1.7%
Wave One	121	111	1.8%	1.6%
Wave One - Electric Only	137	129	1.8%	1.7%
Wave Two – Area 7	97	94	1.7%	1.6%
Wave Two – Non Area 7	116	112	1.8%	1.7%
Wave Three	102	99	1.6%	1.5%
Wave Four	73	73	1.2%	1.2%
Wave Five	108	107	1.2%	1.2%
Wave Six	9	9	0.5%	0.5%
Gas (therms)				
Beta	7.4	7.2	1.1%	1.1%
Gamma Standard	2.4	2.6	0.6%	0.7%
Gamma Reduced	2.8	2.9	0.7%	0.8%
Wave One	3.6	3.7	0.9%	0.9%
Wave Two - Area 7	5.2	5.3	1.3%	1.3%
Wave Two – Non Area 7	4.0	4.1	1.0%	1.0%
Wave Three	3.4	3.4	0.9%	0.9%
Wave Four	3.3	3.3	0.9%	0.9%
Wave Five	2.7	2.7	0.6%	0.6%
Wave Six	0.7	0.7	0.5%	0.5%

In 2015 evaluation, Nexant switched from using the fixed effects to a post-only model with lagged dependent variables. Both models produce unbiased estimates of savings under valid experimental design. DNV GL assessed the savings estimates from the two models and found slight difference in savings. Despite differences in model specifications, the two sets of estimates almost always fall within each other's confidence bounds. DNV GL finds Nexant's results and methods acceptable for estimating savings for the HER program.

[1] Wave Six started in September 2015.

Table 3 shows DNV GL's recommended savings for the 2015 HER program. Since DNV GL's unadjusted electric and gas savings are sufficiently similar with Nexant's unadjusted estimates, we recommend using Nexant's estimates for unadjusted electric and gas savings. DNV GL reviewed Nexant's joint savings analysis and found differences for one wave's results. There is evidence that the difference may be the result of an error in the Nexant analysis data. As a result, we recommend using DNV GL's joint savings estimate for downstream programs.

Table 3. Unadjusted and adjusted total kWh and therms savings for 2015

Wave	Electric (kWh)		Gas (Therms)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Beta	9,973,947	9,237,310	327,070	318,927
Gamma - Dual Standard	5,689,245	5,150,415	125,369	131,566
Gamma - Dual Reduced	4,850,310	4,330,142	143,516	149,649
Gamma - Electric only	3,420,625	3,117,252	-	-
Wave One - Dual	32,316,557	29,558,684	942,579	971,883
Wave One - Electric only	3,499,619	3,308,183	-	-
Wave Two - Area 7	6,177,779	5,965,372	332,118	333,024
Wave Two - Non Area 7	28,396,036	27,332,444	977,469	984,801
Wave Three	17,665,036	17,050,923	591,006	575,204
Wave Four	11,480,559	11,397,398	516,658	517,822
Wave Five	19,673,112	19,409,732	496,166	493,096
Wave Six	2,741,718	2,729,856	215,974	215,525
Total	**145,884,543**	**138,587,709**	**4,667,926**	**4,691,497**

Note: For Wave Five, Nexant's calculation only considered savings from October 2015 to December 2015 when calculating total gas savings for 2015. DNV GL revised Nexant's calculation from 141,449 therms to 496,166 therms to represent a full year of savings in 2015.

Overall, the PG&E HER program achieved program savings of 139 GWh and 4.7 million therms in 2015. The 2015 HER adjusted electric and gas savings are approximately 29% and 59% higher than the 2014 adjusted savings. The increase in savings can be attributed to the persistence in savings in some of the older waves and additional savings from the newer waves.

The final savings are adjusted for potentially double counted savings from downstream rebates and upstream lighting programs. The adjusted savings calculation only considered average joint savings that are positive despite being non-statistically significant, as they provide some evidence of possible double counting. The double-counted savings account for a 5% decrease in electric savings while gas savings increased by less than 1% after deducting potentially double counted savings from rebate programs and accounting for heating and cooling interactive effects associated with installing energy saving lighting measures.

For peak demand reduction, DNV GL recommends DNV GL estimates. The California program administrators (PAs) agreed on a standardized approach for the 2015 evaluation that uses the difference-in-differences approach for calculating peak demand savings. DNV GL used a difference-in-differences method to produce its results.

DNV GL checked for statistical difference from zero in peak load during the pre-period and found that peak load during the pre-period is not balanced for some of the waves. Nexant continued to use a post-difference approach that did not take these pre-period differences into consideration. Table 4 provides the recommended estimates for demand savings for the HER program. The total adjusted peak demand savings

are based on DNV GL's demand savings and joint savings estimates. Overall, the HER program achieved a total adjusted peak reduction of 27 MW in 2015. The 2015 peak demand savings are significant at the 90% confidence level.

Table 4. Total peak demand (kW) savings

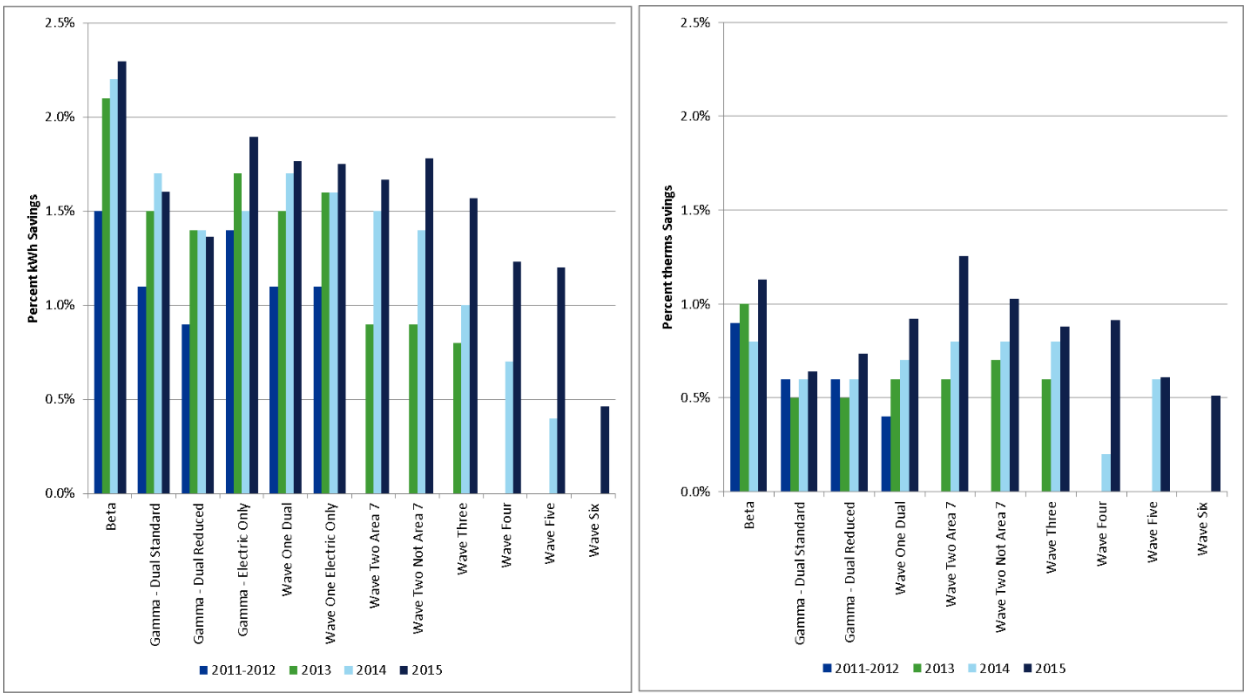
Wave	Unadjusted kW savings	Adjusted kW savings
Beta	3,054	2,890
Gamma - Dual Standard	807	659
Gamma - Dual Reduced	973	928
Gamma - Electric Only	472	391
One - Dual Standard	6,740	6,269
One - Electric Only	34	15
Two - Area 7	1,533	1,512
Two - Not Area 7	6,677	6,300
Three	2,226	1,710
Four	717	678
Five	6,144	5,929
Total	**29,377**	**27,282**

In 2014, PG&E stopped sending the reports to a randomly selected set of households (terminated group) in the treatment group to test the persistence in program savings after discontinuation of the reports in the Gamma waves. We observed a downward trend in electric and gas savings for the terminated group compared to households that continued to receive the reports. However, the difference in savings between terminated and continued groups are not statistically significantly different except for gas savings in Gamma-standard.

PG&E also started sending out electronic reports (eHERs) in addition to the paper reports to a randomly selected treatment household in Wave One and Wave Two in 2014. This experiment was designed to test if receiving electronic reports in addition to paper reports would provide additional benefits. Overall, we found small and not statistically significantly different savings between the eHERs and the treatment group receiving only paper reports. These findings suggest that sending additional electronic reports does not generate much more (if any) savings compared to sending out only paper reports.

Figure 1 shows historical electric and gas savings as a percent of baseline consumption for all PG&E experimental waves. The wave-level differences in percent savings are due to the different target populations, target areas and timing and frequency of the reports.

Figure 1. Percent kWh and therms savings from 2011-2015



Electric and gas savings continued to persist up through the fourth year of the program. For most of the waves, the electric savings increased at a decreasing rate with Beta producing the highest electric savings. From 2013 to 2014, electric savings appeared to flatten or diminish, but this apparent trend was not statistically significant. Compared to electric savings, gas savings remained relatively flatter to the point of not even showing a general increase in early waves. Gas savings are less than 1% for almost all experimental waves. We also observed a year to year variation in savings trends across the waves which may reflect natural variation in local weather. Overall, we observed the highest electric and gas saving in 2015 for almost all of the waves.

2 INTRODUCTION

The California Public Utilities Commission (CPUC) engaged DNV GL to review and validate Pacific Gas & Electric's (PG&E's) impact evaluation of the Home Energy Reports (HER) program for calendar year 2015. This report provides the findings of DNV GL's review and validation of PG&E HER program savings estimates produced by Nexant.

This is DNV GL's fourth year as the independent evaluator of the HER program. As such, DNV GL continues to have access to PG&E's billing, AMI and program tracking data that allows for a fully independent evaluation of savings estimates, including peak demand, for comparison with results produced by Nexant. This ex-post validation goes well beyond simply vetting the approach used by Nexant. By replicating the analysis, DNV GL provides a more robust validation of the estimated savings that are occurring within the program.

2.1 HER program description

PG&E started sending reports for the HER pilot program (wave Beta) in August 2011. The reports contain a mix of consumption information, comparison of energy usage with similar neighbors and customized tips for saving energy. Since then, PG&E has introduced eight waves: Beta Wave, Gamma Wave, Wave One, Wave Two, Wave Three, Wave Four, Wave Five and Wave Six. PG&E started each wave at different times, drew them from different populations, and applied slightly different treatments. Waves Three through Six represent replacements for the attrition the program experiences, which ranged from 10-20%, each year in 2013-15 program cycle. Table 5 provides the original count of treatment and control customers in each wave.

Table 5. HER experimental waves and launch dates

Wave	Fuel type / Frequency of report / Area	Launch date	Treatment households	Control households
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2.2 Evaluation objectives and approach

The primary objective of this evaluation is to provide independent verification of energy and demand savings attributable to the HER program. Specific research questions included the following:

- What are the energy savings for each HER wave?
- Are there downstream/upstream rebate program savings that could be jointly claimed by both the HER program and other PG&E rebate programs?
- What are the peak demand savings attributable to the program?
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- *Joint savings*. Joint savings represent HER-induced savings derived from the increased uptake of PG&E rebate programs. This estimate is produced for two kinds of programs:
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- *Final adjusted energy and demand 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.

3 METHODOLOGY

This section describes how DNV GL estimated impacts of the 2015 HER program.

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 effect
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 (SEE Action) Evaluation, Measurement, and

Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations.[2]

3.2 Demand savings

Reductions in demand at peak times that result from HER program participation can be measured through a variety of approaches. The preferred approach in California is to examine peak demand differences in pre- and post-program periods that occur during a given peak period. We used the peak period definition provided by the Database for Energy Efficiency Resources (DEER)[3]. This definition takes into account the average temperature, average afternoon temperature (12 p.m. – 6p.m.), and maximum temperature over the course of three-day heatwave candidates. Each candidate heatwave is a combination of three consecutive non-holiday weekdays occurring between June 1st and September 30th.

Using this definition, the optimal heatwave (HW) for each climate zone is ultimately selected by choosing the single candidate three-day-period with the highest peak score (Score_k) among all possible candidates.

The mathematical expression is given by:

$$HW = \max_{1 \le k \le K} (\text{Score}_k)$$

$$\text{Score}_k = \max_{1 \le d \le 3} (temp_{d,k}) + \frac{1}{d} \sum_{d=1}^{3} (daily\_mean_{d,k}) + \frac{1}{d} \sum_{d=1}^{3} (afternoon\_avg_{d,k})$$

Where

HW	=	Zone-specific set of three consecutive non-holiday weekdays that's has the highest value of Score_k for heat wave candidate k across all possible candidates K
Score_k	=	The summation of maximum temp, average daily, and afternoon average temperature
$daily\_max_{d,k}$	=	The maximum hourly temperature value across all hours on day d, for heat wave candidate k.
$daily\_mean_{d,k}$	=	The average hourly temperature across all hours on day d, for heat wave candidate k.
$afternoon\_avg_{d,k}$	=	The average hourly temperature between 12 and 6 PM on day d, for heat wave candidate k.

[2] 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] *http://www.cpuc.ca.gov/NR/rdonlyres/4F93F9C2-434E-4B06-8D80-B2CB7E0A4198/0/DEER2013UpdateDocumentation_792013.pdf*

DNV GL collected 15-minute and 60-minute interval data during the hours of 2 p.m.–5 p.m. of the most common heat wave in the pre- and post-periods for both treatment and control households. DNV GL then applied a difference-in-differences method to calculate demand savings due to the HER program.

The general equation for the difference-in-differences approach is given below:

$$\overline{kW}\ savings = \left(\overline{post\_kW_C}\ -\ \overline{post\_kW_T}\right) - \left(\overline{pre\_kW_C}\ -\ \overline{pre\_kW_T}\right)$$

where:

$\overline{kW}\ savings$ = Average demand reductions during the peak period

$\overline{pre\_kW_C}$ = Average hourly load of the control group during the peak period in the pre-period

$\overline{pre\_kW_T}$ = Average hourly load of the treatment group during the peak period in the pre-period

$\overline{post\_kW_C}$ = Average hourly load of the control group during the peak period in the post-period being evaluated or 2015

$\overline{post\_kW_T}$ = Average hourly load of the treatment group during the peak period in the post-period being evaluated or 2015

3.3 Downstream rebate joint savings

One possible effect of the HER program is to increase rebate activity in other PG&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 in conjunction 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 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 PG&E rebate program tracking databases and are claimed as part of those programs' savings unless further actions are taken to remove them. Savings from the HER program are adjusted using joint savings to avoid double counting of savings.

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

- Use accepted deemed savings values (those being used to claim the savings for the rebate program)
- Determine accumulated savings beginning from the installation date moving forward in time
- Assign daily savings on a load-shape-weighted basis (more savings when we expect the measure to be used more)

- Maintain 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 upon the installation of that measure. We determined the daily share of annual savings using hourly 2011 DEER load shapes[4] for PG&E. These load shapes indicate when a measure is used during the year and, by proxy, when efficiency savings would occur.[5]

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 and included 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. DNV GL's recommended method for estimating joint savings analysis is consistent with the approach recommended in the SEE Action report.

DNV GL used a similar approach to calculate potentially double counted savings in HER demand savings estimates. DNV GL used peak kW savings reported in the program tracking database from measures installed during the treatment period but before the start of the peak period. The average peak kW savings per household of the control group were subtracted from the average deemed kW savings per household of the treatment group to calculate joint savings between HER program and PG&E downstream rebate programs during the peak period.

3.4 Upstream joint savings

Upstream joint savings are similar to downstream joint savings, except that upstream savings are not tracked at the customer level. PG&E upstream savings still represent a source of savings that the HER program could potentially double count. Unlike tracked programs, it is not possible to directly compare all treatment and control group member activity. This makes it more challenging to determine if the HER program does increase savings in upstream programs.

In the past HER evaluations, the joint savings analysis for upstream programs used the efficient bulb uplift from the 2012 PG&E In-home Inventory. For this evaluation, DNV GL conducted an online survey to update the efficient bulb uplift due to HER and incorporated TRC's estimates for 2015 rebated sales fraction for CFL and LEDs. The online survey included treatment and control households in each of the waves and collected information on their purchase and installation of CFLs and LEDs for the past year. Appendix F presents the key inputs used in 2015 PG&E HER joint savings calculation for the upstream lighting program.

The estimates for the excess lamps due to HER are based on participants' recall of the number of bulbs purchased and installed in 2016. DNV GL calculated wave-level bulb uplift estimates and used these estimates as a proxy for the 2015 bulb uplift. We believe that the 2016 estimates from the online survey better represent the different HER waves than the results from the 2012 PG&E in-home inventory and studies from other jurisdiction.

DNV GL used TRC's estimate for PG&E rebated sales fraction in 2015 and TRC's savings per bulb based on 2013-2014 DEER program tracking data to calculate joint savings. We also used these savings per bulb estimates as a proxy savings per bulb in 2015. With regards to the timing of purchase of an efficient bulb,

[4] DEER load shapes are in an 8760-hourly format. DNV GL aggregated the hourly shares to daily shares in order to estimate daily savings. http://deeresources.com/DEER2011/download/DEER2011-UpdatedImpactProfiles-v2.zip

[5] 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.

the joint savings approach assumes that the excess efficient lamps purchased due to HER are purchased evenly throughout the year. 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 -0.019 therms per kWh based on DEER for 2013-14. The equation below is used to calculate the heating and cooling interactive effects associated with energy saving lighting measures:

$$\text{Therms savings due to interactive effects} = \text{Total kWh joint savings from ULP} \times (-0.019 \text{ therms per kWh})$$

The approach directly estimates gas effects 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 since the replacement of inefficient lighting measures with more efficient lamps can increase heating load consumption due to lower heat emissions from CFLs and LEDs.

For calculating upstream joint savings at the peak period, DNV GL followed the same method in calculating electric joint savings from upstream programs but instead of using the assumed CFL and LED kWh savings per bulb in Appendix E, DNV GL used peak watts impact to measure watt reductions per installed bulb at the time of peak. DNV GL also used Nexant's number of treatment households to calculate aggregate kW joint savings.

Table 6 provides DNV GL's calculation of peak watts impact for CFLs and LEDs. DNV GL calculated a peak watts impact of 2.7 watts for CFL and 2.0 watts for LEDs. These values were used to measure watts reductions at the peak from CFL and LED installation.

Table 6. PG&E CFL peak diversity factor

Factor	CFL	LED	Source
Installation Rate	97%	99%	2013-2014 ULP Evaluation (DNV GL, 2016)
Delta Watts	55.0	35.0	2013-2014 ULP Evaluation (DNV GL, 2016)
Peak CF	0.05	0.06	2013-2014 ULP Evaluation (DNV GL, 2016)
Peak Watts Impact	**2.67**	**2.08**	Calculated as installation rate × delta watts × Peak CF

Delta watts are a measure of instantaneous demand reductions in watts that results from replacing an inefficient incandescent bulb with a CFL, LED or other bulb type. DNV GL's lighting study reports that the peak coincidence factor (CF) for CFLs is approximately 0.05 indicating that only about 5% of these bulbs are actually turned on at time of peak. These two factors combined with an estimated installation rate of 97% provide a measure of watt reductions per installed bulb at time of peak.

To calculate for peak demand joint savings, the equations below are used:

CFL(or LED)kW joint savings per household = Excess CFLs(or LED)due to HER ×
Number of years CFLs(or LED)have been installed × CFL(or LED)rebated sales fraction × NTG ×
Peak watts impact CFL(or LED)/1000

Total kWh joint savings from ULP = Number of households in the treatment group ×(CFL kWh joint savings per household +
LED kWh joint savings per households)

4 RESULTS

DNV GL reviewed Nexant's methods as presented in its evaluation report[6] and in Stata program codes submitted by Nexant. DNV GL produced a set of comparison results for validating the reduction in consumption, joint savings, and peak demand analysis using DNV GL methods and data PG&E provided to the CPUC. This chapter presents DNV GL's assessment of the four main components that resulted in final program savings and demand savings estimates for the 2015 PG&E HER program.

4.1 Unadjusted kWh and therms savings estimates

DNV GL estimated electric and gas savings per household at the wave-level for the HER program with the objective to verify whether Nexant's results are consistent with independently produced results; not necessarily to produce identical results. DNV GL continued to use the fixed effects model as described in Chapter 3 for 2015 consistent with methods used by both DNV GL and Nexant for prior year evaluations.

For the 2015 evaluation, Nexant switched from using a fixed effects model specification to a post-only model using lagged dependent variables as control variables (Appendix B). These two models produce similar and unbiased results under valid RCT design and are consistent with the specification options offered in the State and Local Energy Efficiency Action Network's report (SEE Action, hereafter).[7]

Figure 2 and Figure 3 provide a comparison of DNV GL's and Nexant's monthly savings estimates for electric and gas, respectively. Overall, DNV GL and Nexant's savings estimates are similar and the two sets of estimates almost always fall within each other's confidence bounds. In most cases, the standard errors from Nexant's monthly estimates generally produced smaller standard errors suggesting higher precision.

[6] Nexant, Inc. *2015 Energy Efficiency Savings Estimates: Pacific Gas and Electric Home Energy Reports Program,* August 1, 2016. Nexant, Inc. *2015 Demand Savings Methodology and Estimate: Pacific Gas and Electric Home Energy Reports Program*, August 1, 2016.

[7] 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.

Figure 2. Comparison of unadjusted monthly kWh savings per household

Figure 3. Comparison of unadjusted monthly therms savings per household

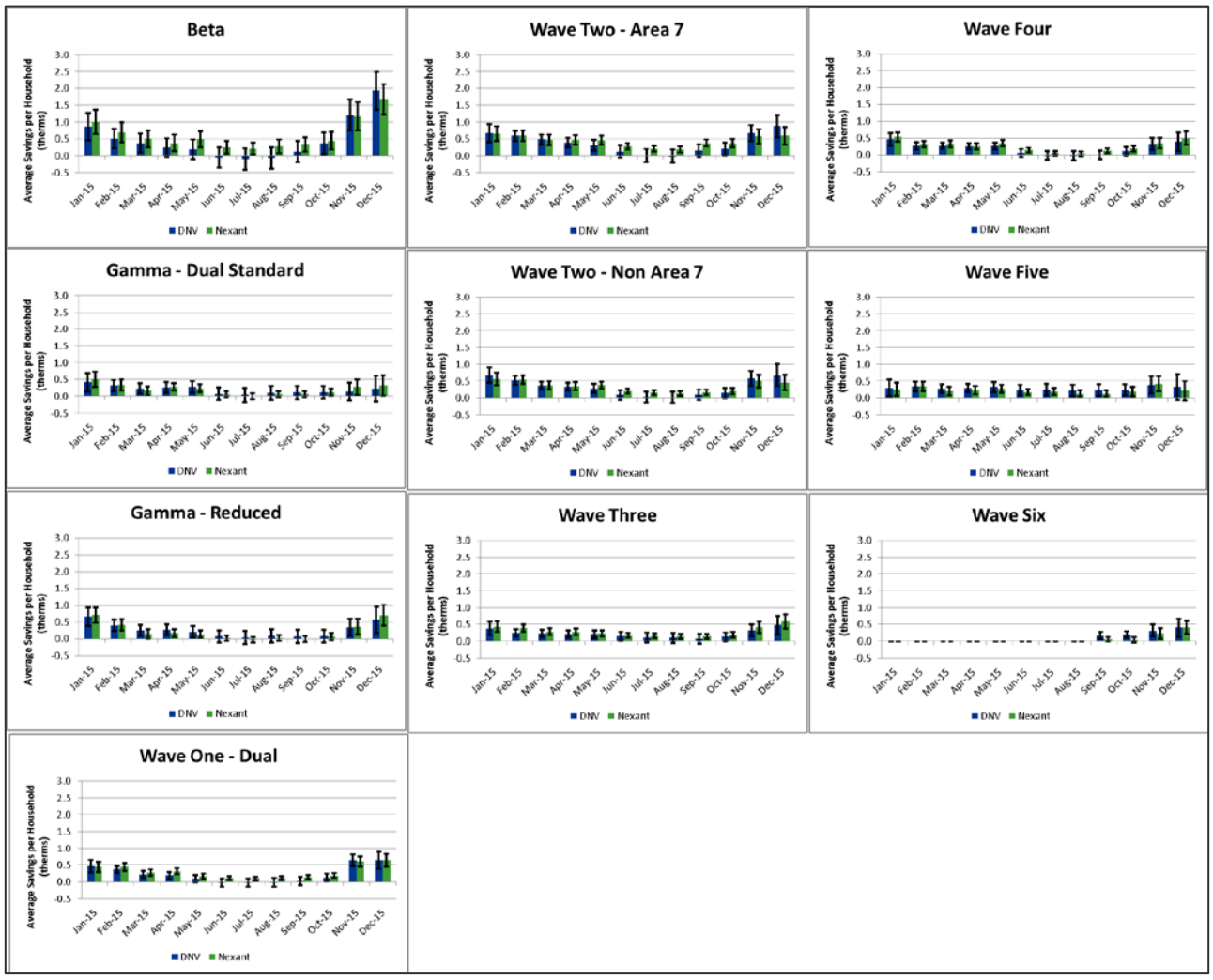


Table 7 presents a comparison of DNV GL's and Nexant's electric and gas savings per households in 2015. Overall, DNV GL estimates are comparable with Nexant's estimates for electricity and gas savings but the differences in savings varied among waves. On average, Nexant's estimates of savings are 8% higher for electric and 4% higher for gas.

Table 7. Comparison of kWh and therms savings per household and percent savings

HER Wave	Per Household Savings			Percent Savings		
	DNV GL	Nexant	% DNV GL / Nexant	DNV GL	Nexant	Difference = %DNV - %Nexant
Electric (kWh)						
Beta	219	224	98%	2.2%	2.3%	-0.1%
Gamma Standard	118	110	107%	1.7%	1.6%	0.1%
Gamma Reduced	97	94	103%	1.4%	1.4%	0.1%
Gamma Electric Only	117	128	91%	1.8%	1.9%	-0.1%
Wave One	112	121	93%	1.6%	1.8%	-0.1%
Wave One - Electric Only	143	137	105%	1.8%	1.8%	0.1%
Wave Two – Area 7	88	97	91%	1.5%	1.7%	-0.1%
Wave Two – Non Area 7	92	116	79%	1.4%	1.8%	-0.4%
Wave Three	90	102	88%	1.4%	1.6%	-0.2%
Wave Four	72	73	98%	1.2%	1.2%	0.0%
Wave Five	93	108	86%	1.0%	1.2%	-0.2%
Wave Six	6	9	60%	0.3%	0.5%	-0.2%
Gas (therms)						
Beta	5.6	7.4	75%	0.9%	1.1%	-0.2%
Gamma Standard	2.4	2.4	97%	0.6%	0.6%	0.0%
Gamma Reduced	3.1	2.8	112%	0.9%	0.7%	0.1%
Wave One	2.7	3.6	76%	0.7%	0.9%	-0.2%
Wave Two - Area 7	4.5	5.2	85%	1.1%	1.3%	-0.2%
Wave Two – Non Area 7	3.8	4.0	95%	1.0%	1.0%	0.0%
Wave Three	2.6	3.4	77%	0.7%	0.9%	-0.2%
Wave Four	2.5	3.3	75%	0.7%	0.9%	-0.2%
Wave Five	3.4	2.7	124%	0.8%	0.6%	0.2%
Wave Six	1.1	0.7	147%	0.8%	0.5%	0.2%

The discrepancies in savings estimates are due to differences in model specification and different methods used in data preparation. The differences are summarized below:

- Data preparation. Nexant included net metered customers in the analysis while DNV GL consistently removed all net metered customers because of the way that net metering is addressed in the billing data. Including solar households in the analysis requires household-level energy production data, otherwise, potential differences in solar energy production could be conflated with program-related savings, biasing the results up or down. However, the proportion of net metering is small and more or less balanced between the treatment and control groups. The inclusion or exclusion of net metering is not expected to have a substantial effect on the savings estimates.
- Model specification. Nexant and DNV GL used different model specifications in estimating 2015 HER savings. DNV GL used a fixed effects model specification while Nexant switched to using a post-only model with lagged dependent variables as control variables. These two models are acceptable model

specifications for evaluating behavioral based programs per SEE Action. The two models produce estimates that are similar and unbiased under valid experimental design.

Among the differences highlighted above, the difference in model specification explained most of the discrepancies between DNV GL and Nexant's savings estimates. However, DNV GL's and Nexant's savings estimates are sufficiently similar despite differences in model specification and data preparation methods. On average, DNV GL calculated less savings though the two estimates tend to fall within the confidence bounds of the other. The two estimates of savings are unbiased with Nexant's estimates showing slightly tighter confidence intervals at the monthly level. Thus, we recommend Nexant's total unadjusted electric and gas savings estimates (Table 8).

Table 8. Aggregate kWh and therms savings

Wave	Electric (kWh)	Gas (Therms)
Beta	9,973,947	327,070
Gamma - Dual Standard	5,689,245	125,369
Gamma - Dual Reduced	4,850,310	143,516
Gamma - Electric only	3,420,625	-
Wave One - Dual	32,316,557	942,579
Wave One - Electric only	3,499,619	-
Wave Two - Area 7	6,177,779	332,118
Wave Two - Non Area 7	28,396,036	977,469
Wave Three	17,665,036	591,006
Wave Four	11,480,559	516,658
Wave Five	19,673,112	496,166
Wave Six	2,741,718	215,974
Total Unadjusted Savings	**145,884,543**	**4,667,926**
Lower Bound at 90% CI	*136,941,895*	*3,791,422*
Upper Bound at 90% CI	*154,827,191*	*4,849,637*

For Wave Five, Nexant's calculation only considered savings from October 2015 to December 2015 when calculating aggregate gas savings. DNV GL revised Nexant's calculation of aggregate savings from 141,449 therms to 496,166 therms to represent a full year of savings in 2015.

The aggregate savings estimates are calculated using Nexant's unadjusted savings per households for each calendar month multiplied by the number of active accounts in each of the months. Appendix A provides a comparison of DNV GL's and Nexant's average treatment counts. Overall, DNV GL treatment counts are comparable with Nexant's.

Nexant's reported standard errors for the aggregated savings continue to be based on a separate regression model that calculates average savings for the program year rather than estimating savings for each of the month. This is consistent with Nexant's approach in prior years and is an unnecessary simplification that does not account for the different monthly counts in the aggregate estimates' standard errors. As previously recommended, the standard errors should be calculated using the combined monthly parameter standard errors weighted by the monthly counts if the annual savings estimates are calculated by combining monthly savings estimates and monthly treatment counts.[8]

[8] Estimates of combined parameter standard error estimates are standard output in any statistical computing package.

While we try to maintain consistent methods throughout our evaluations, we continuously look for ways to improve and refine energy savings calculation. As noted in the Research Plan for the 2015 HER program evaluation, we will examine the alternative model specification option for the HER program. DNV GL replicated Nexant's analysis and conducted additional analysis on the two model specifications by comparing results using identical datasets for some of the PG&E waves. Appendix B summarizes the results of this additional analysis.

Appendix D and Appendix E provide our analyses on the persistence of savings after discontinuation of treatment and the effect of sending electronic reports in addition to the paper reports.

4.2 Demand savings estimates

4.2.1 Heat waves

DNV GL identified the heat waves using the weather data provided by PG&E that used hourly temperatures from weather stations across the PG&E service territory from 2011-2015. Based on the results, the three-day heatwave in 2015 fell on September 8-10, the same heatwave Nexant identified. This three-day heat wave is elected to represent all waves in 2015. Table 9 shows the three-day heatwaves based on DEER definition for the pre- and post-period of the HER participants.

Table 9. Heat waves from during the pre-period and 2015

Program / Wave	DEER Heatwave	
	Pre-period	2015
Beta	6/20/2011 - 6/22/2011	9/8/2015 - 9/10/2015
Gamma: Dual Standard, Dual Reduced, Electric Only	6/20/2011 - 6/22/2011	9/8/2015 - 9/10/2015
One: Dual Standard, Electric Only	6/20/2011 - 6/22/2011	9/8/2015 - 9/10/2015
Two: Area 7, Not Area 7	8/27/2012 - 8/29/2012	9/8/2015 - 9/10/2015
Three	8/27/2012 - 8/29/2012	9/8/2015 - 9/10/2015
Four	6/26/2013 - 6/28'/2013	9/8/2015 - 9/10/2015
Five	7/23/2014 - 7/25/2014	9/8/2015 - 9/10/2015

4.2.2 Peak demand reductions

DNV GL and the California PAs agreed on a standardized approach for estimating peak demand reductions for the 2015 HER Impact Evaluation. The consensus was to use the difference-in-differences method for calculating peak demand analysis for the HER program. This approach involves identifying the peak period during the pre-period in addition to the peak period during the program year being evaluated. A difference-in-differences approach is a more appropriate method for controlling for pre-existing differences in demand between the treatment and the control group.

Nexant continued to use a post-difference approach in calculating peak demand savings while DNV GL calculated peak demand savings using a difference-in-differences approach.

Table 10 and Table 11 summarize DNV GL and Nexant's demand savings per household and at the aggregate level. Overall, DNV GL's estimate of aggregate peak savings is 19% less than Nexant's estimate.

Table 10. Comparison of kW savings per household

Wave	kW savings per household		% DNV GL / Nexant
	Nexant - Post difference	DNV GL - Difference-in-differences	
Beta	0.05	0.07	148%
Gamma - Dual Standard	0.02	0.02	97%
Gamma - Dual Reduced	0.01	0.02	165%
Gamma - Electric Only	0.02	0.02	118%
One - Dual Standard	0.04	0.03	71%
One - Electric Only	0.02	0.00	7%
Two - Area 7	0.03	0.03	92%
Two - Not Area 7	0.04	0.03	73%
Three	0.02	0.01	79%
Four	0.01	0.00	35%
Five	0.04	0.04	90%

Table 11. Comparison of total unadjusted kW savings

Heat Wave Start	Heat Wave End	Nexant Peak Reduction (kW)	DNV GL Peak Reduction (kW)	%DNV/Nexant
8-Sep-15	10-Sep-15	36,372	29,377	81%

DNV GL checked for statistical difference in peak load during the pre-period and found that, peak load during the pre-period is not balanced for some of the waves. Because of this, DNV GL recommends using DNV GL's peak demand savings estimates for the 2015 HER program. Table 12 shows the recommended aggregate demand savings estimates.

Table 12. Overall Peak kW savings comparison

Heat Wave Start	Heat Wave End	Nexant Peak Reduction (kW)
8-Sep-15	10-Sep-15	29,377

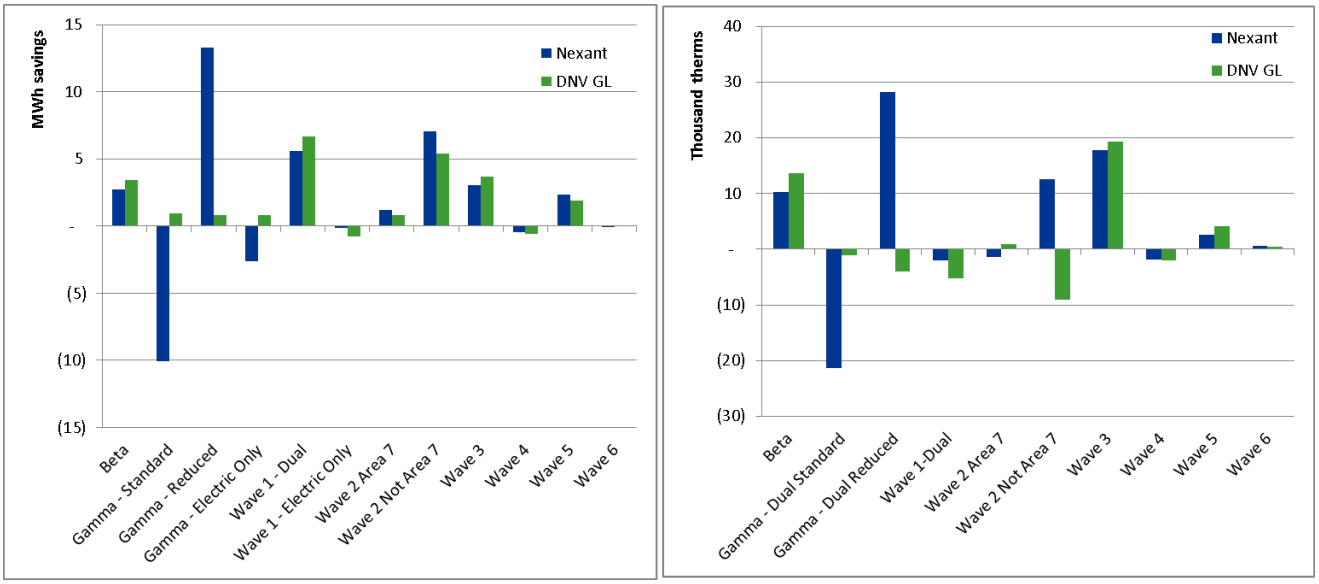
4.3 Joint savings: downstream programs

Joint savings estimate with downstream rebate programs can be calculated in multiple ways. DNV GL's approach involves collecting information on measures installed by active HER participants since program inception and assigning corresponding DEER load shapes to each of the measures. For the 2015 evaluation, Nexant also used this approach to calculate electric and gas joint savings for the HER program.

Figure 4 presents a comparison of DNV GL's and Nexant's joint electric and gas savings estimates from downstream rebate programs for each experimental wave. In general, DNV GL's kWh joint savings estimates

are comparable with Nexant's results except for Gamma waves. For gas joint savings estimates, results are similar except for the Gamma waves and Wave Two - Not Area 7.

Figure 4. Total joint savings from downstream rebate programs



The discrepancy in joint savings estimates for downstream programs are primarily due to the following:

- *Data cleaning*. DNV GL examined potential outliers in the program tracking data and excluded both positive and negative outliers in the analysis. We flagged records as negative outliers when the reported kWh, therms and kW savings are all negative. The positive outliers happen to be from lighting measures installed in common areas in multifamily homes under Gamma wave. We removed these records since Opower's selection criteria excluded multi-family accounts in the eligible HER population for Gamma as reported in Nexant's 2012 evaluation report.[9]
- *Data preparation*. The savings generated by the control groups for Gamma Standard and Reduced should be identical because they share the same customers. Upon inspection, DNV GL noticed that Nexant's values do not reflect this.

DNV GL recommends that Nexant revisit their joint savings calculation and apply the necessary adjustments and corrections for future HER program evaluation. DNV GL recommends using DNV GL's estimates for joint savings with downstream programs. The joint savings adjustments will only consider average joint savings that are positive despite being non-statistically significant, as they provide some evidence of possible double counting.

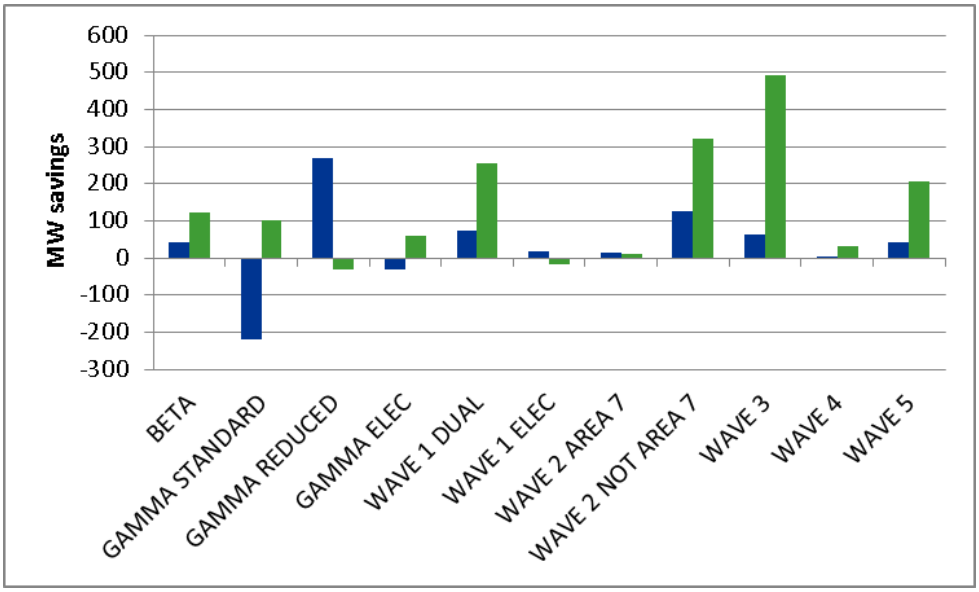
The issue of potential double counting also applies to demand impacts to the extent that HER programs successfully motivate increased uptake in other energy efficiency programs and those programs claim demand savings. DNV GL calculated joint savings that are attributed to downstream rebated measures by

[9] Freeman, Sullivan & Co. Evaluation of Pacific Gas and Electric Company's Home Energy Report Initiative for the 2010-2012 Program. April 25, 2013.

using deemed demand values contained in downstream rebate tracking data and only by using those measures installed prior to September 8, 2015, the first day of the most common heat wave in 2015.

Figure 5 provides DNV GL's and Nexant's joint savings estimates for downstream programs at the peak. The kW joint savings are different for the majority of waves and Nexant's estimates are substantially smaller. Upon inspection of Nexant's codes and data, it appears that Nexant calculated demand savings from measures by applying the hourly 2011 DEER load shapes from 2-5pm to the electric measure savings while DNV GL used the peak kW savings as reported in PG&E tracking data. In addition, DNV GL found the same issue identified above for the Gamma wave. Because of this, DNV GL recommends using DNV GL's estimates for peak demand joint savings from downstream programs.

Figure 5. kW joint savings from downstream rebate programs by wave



4.4 Joint savings: upstream programs

DNV GL's calculation used input assumption from the 2014 HER evaluation and results from the online survey to update assumptions used for the excess bulbs installed due to the HER program. The survey produced estimates of 2015 bulb uplift that are specific to each of the experimental waves. Table 13 provides DNV GL's kWh and kW joint savings with the upstream lighting program and associated gas penalty due to increased heating load from installing lower heat emission CFL and LED bulbs.

Table 13. DNV GL's kWh and kW joint savings estimates from upstream programs

PG&E Treatment Wave	Number of Households	Annual kWh joint savings per household		Total kWh joint savings per household	Gas savings (therms, 000)	kW joint savings per household
		CFL	LED			
Beta	44,447	8.8	0.2	8.9	(0.13)	0.00093
Gamma Dual Standard	51,583	7.9	0.6	8.6	(0.12)	0.00090
Gamma Dual Reduced	51,525	8.0	0.5	8.5	(0.12)	0.00090
Gamma Electric only	26,667	7.9	0.4	8.3	(0.12)	0.00087
Wave One Dual	267,302	6.8	1.0	7.8	(0.11)	0.00083
Wave One Electric Only	25,587	7.1	0.4	7.5	(0.10)	0.00080
Wave Two Area 7	63,721	1.1	1.0	2.1	(0.03)	0.00015
Wave Two Non Area 7	243,564	1.1	1.0	2.2	(0.03)	0.00023
Wave Three	172,766	0.8	0.6	1.4	(0.02)	0.00015
Wave Four	157,208	0.2	0.4	0.5	(0.01)	0.00005
Wave Five	182,548	0.1	0.3	0.4	(0.01)	0.00004
Wave Six	296,688	0.0	0.0	0.0	(0.00)	-

The joint savings per household are small and ranged from 0 to 9 kWh per household. The replacement of inefficient lighting measures with efficient lamps is associated with an increase in heating load due to lower heat emissions from CFLs and LEDs. These interactive effects translate to a gas penalty that would have been double counted by HER and the ULP. This negative number is subtracted from the unadjusted gas savings to remove the gas penalty associated with the removal of electric joint savings from upstream programs.

DNV GL reviewed Nexant's upstream joint savings estimates. Because updated information was not available when they finished their evaluation, their calculations are different and based on less appropriate inputs. As a result, we recommend using DNV GL's estimates of upstream joint savings. Table 14 presents the total program joint savings from upstream programs.

Table 14. DNV GL's aggregate kWh and kW joint savings from upstream programs

PG&E Treatment Wave	Total kWh joint savings	Total kW joint savings	Total gas savings
Beta	397,695	40.3	(5.6)
Gamma Dual Standard	442,642	45.6	(6.2)
Gamma Dual Reduced	438,058	45.1	(6.1)
Gamma Electric only	221,056	22.1	(3.1)
Wave One Dual	2,093,102	216.8	(29.3)
Wave One Electric Only	191,437	19.0	(2.7)
Wave Two Area 7	134,499	9.1	(1.9)
Wave Two Non Area 7	523,711	55.9	(7.3)
Wave Three	245,703	25.0	(3.4)
Wave Four	83,161	6.8	(1.2)
Wave Five	71,374	6.8	(1.0)
Wave Six	10,889	-	(0.1)
Total	4,853,329	493	(68)

4.5 Per-household savings and total program savings

Table 15 summarizes the recommended electric and gas savings per household for each experimental wave. Baseline consumption and unadjusted per household savings are based on Nexant's estimates while joint savings adjustments are based on DNV GL's downstream rebate analysis and joint savings calculation for upstream programs. Overall, the HER program continued to produce electric and gas savings up to 2.3% and 1.3%, respectively.

Table 15. 2015 Recommended per household kWh and therms savings for the 2015 HER program

HER Wave	Baseline Consumption	Per Household Savings (Unadjusted)	Per Household Savings (Adjusted)	% Savings	
				Unadjusted	Adjusted
Electric (kWh)					
Beta	9,766	224	208	2.3%	2.1%
Gamma Standard	6,884	110	100	1.6%	1.5%
Gamma Reduced	6,884	94	84	1.4%	1.2%
Gamma Electric Only	6,772	128	117	1.9%	1.7%
Wave One	6,843	121	111	1.8%	1.6%
Wave One - Electric Only	7,801	137	129	1.8%	1.7%
Wave Two – Area 7	5,816	97	94	1.7%	1.6%
Wave Two – Non Area 7	6,536	116	112	1.8%	1.7%
Wave Three	6,519	102	99	1.6%	1.5%
Wave Four	5,935	73	73	1.2%	1.2%
Wave Five	9,019	108	107	1.2%	1.2%
Wave Six	2,014	9	9	0.5%	0.5%
Gas (therms)					
Beta	657	7.4	7.2	1.1%	1.1%
Gamma Standard	381	2.4	2.6	0.6%	0.7%
Gamma Reduced	381	2.8	2.9	0.7%	0.8%
Wave One	387	3.6	3.7	0.9%	0.9%
Wave Two - Area 7	417	5.2	5.3	1.3%	1.3%
Wave Two – Non Area 7	393	4.0	4.1	1.0%	1.0%
Wave Three	391	3.4	3.4	0.9%	0.9%
Wave Four	360	3.3	3.3	0.9%	0.9%
Wave Five	450	2.7	2.7	0.6%	0.6%
Wave Six	145	0.7	0.7	0.5%	0.5%

Wave Six was launched in September 2015. Baseline consumption (control usage in 2015) and savings only represent partial months of 2015. Gas savings estimates (adjusted) take into account gas interactive effects from increased participation in ULP.

The adjusted savings calculation only considered average joint savings that are positive despite being non-statistically significant, as they provide some evidence of possible double counting. Figure 6 through Figure 11 show the recommended kWh, kW and therms savings at the program level. The recommendations are based on Nexant's unadjusted electric and gas savings and DNV GL's demand savings and joint savings estimates.

Figure 6. Recommended total kWh savings for Beta, Gamma and Wave One

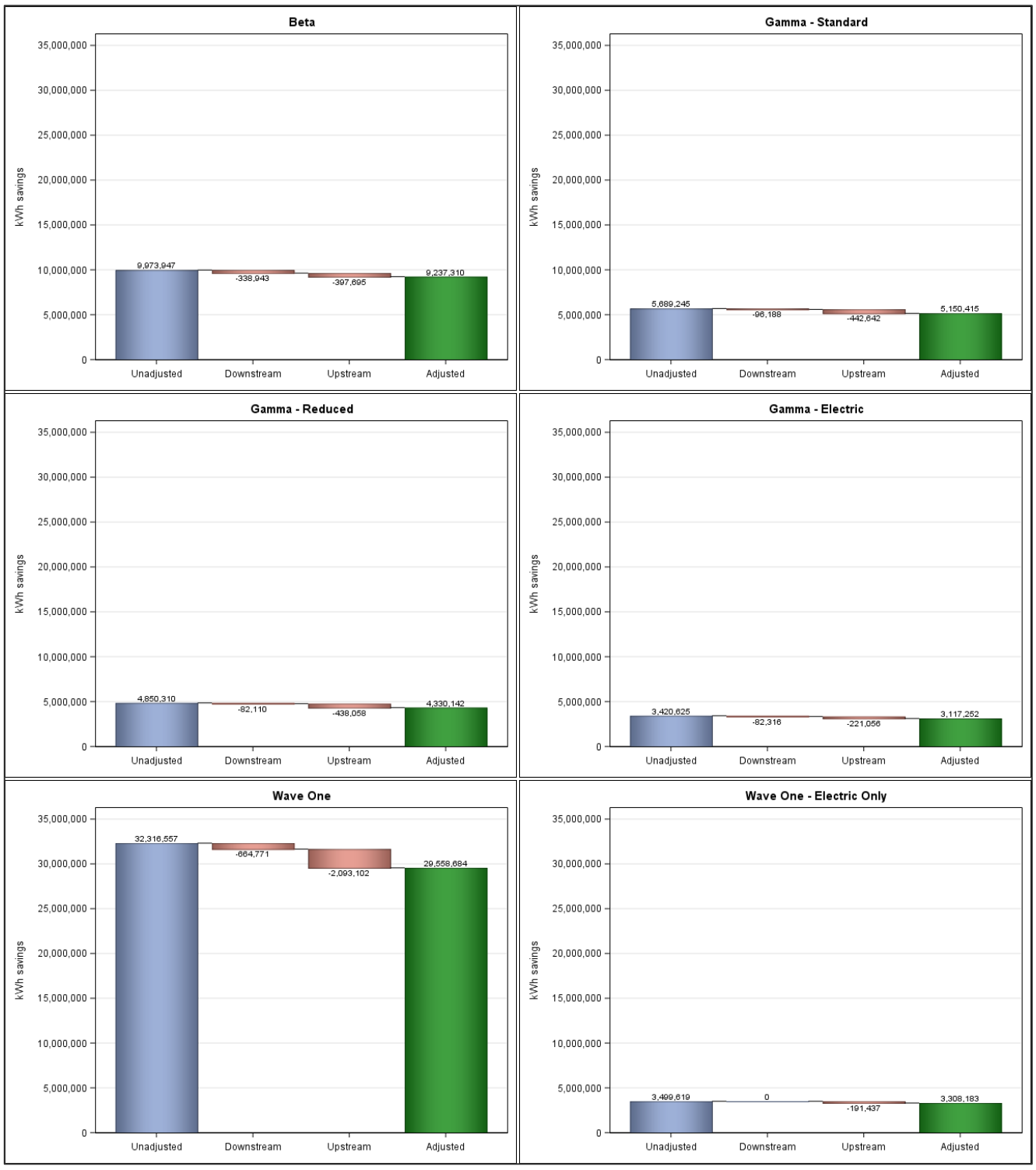


Figure 7. Recommended total kWh savings for Wave Two through Wave Six

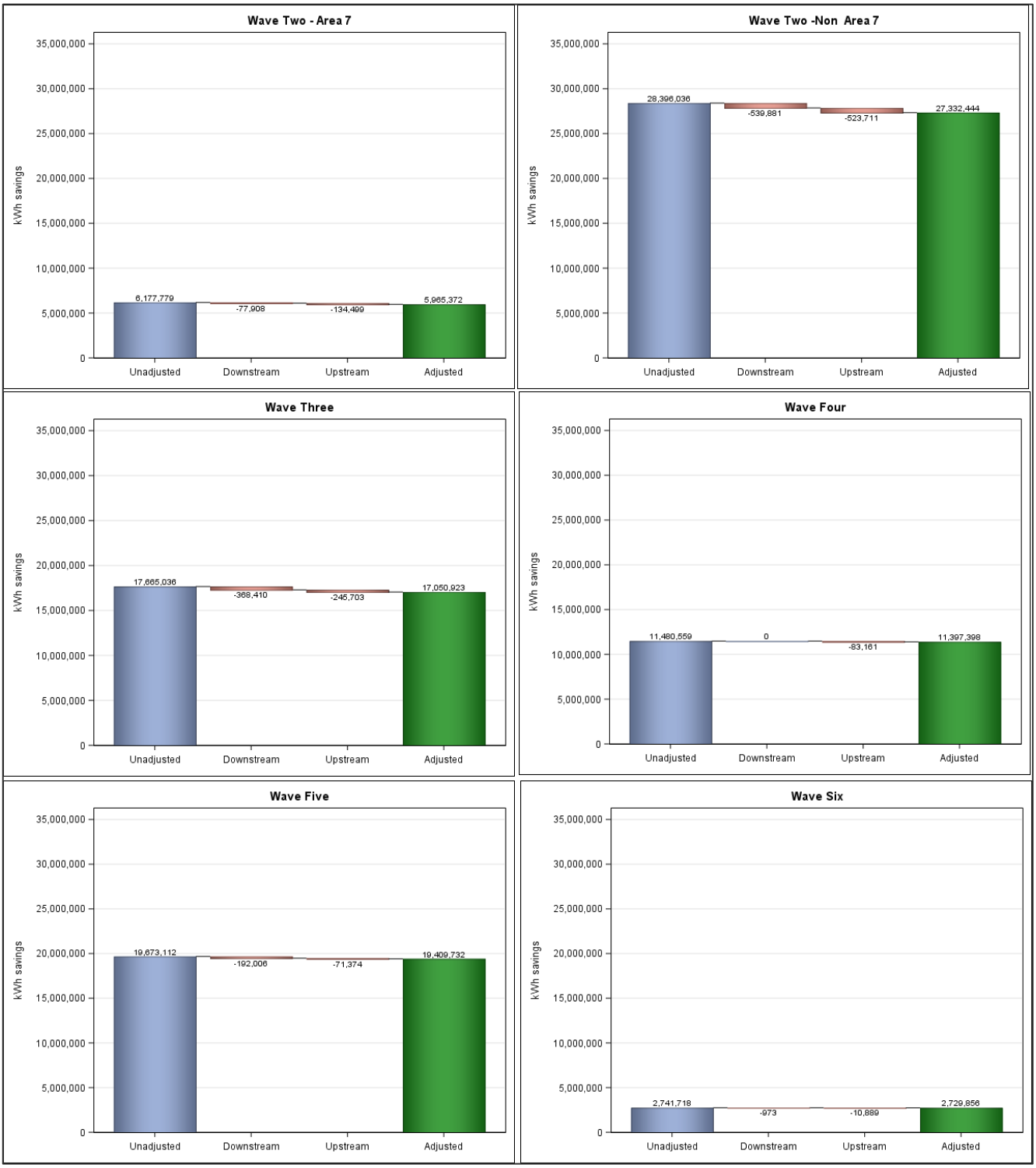


Figure 8. Recommended total therms savings for Beta, Gamma and Wave One

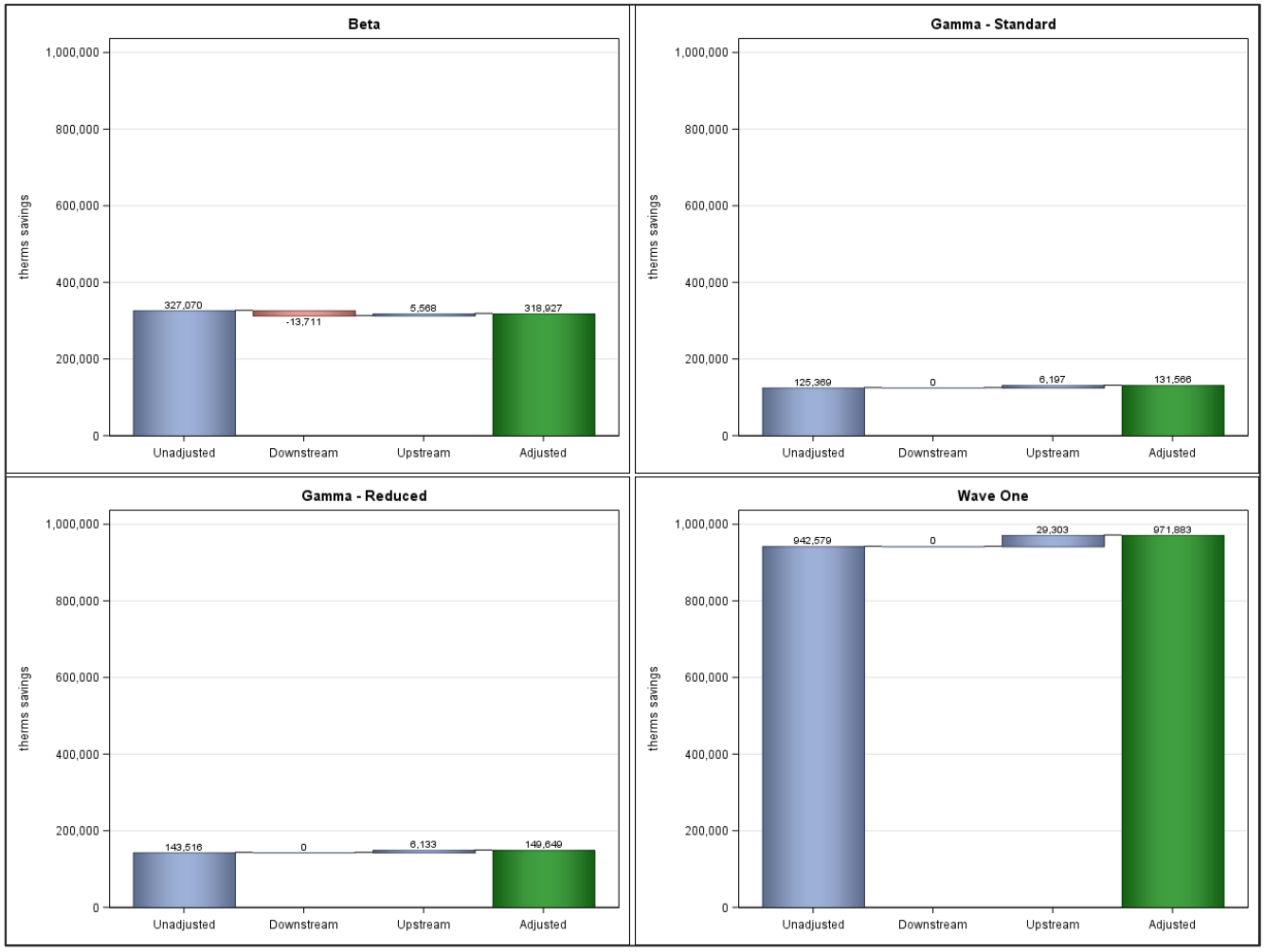


Figure 9. Recommended total therms savings for Wave Two through Wave Six

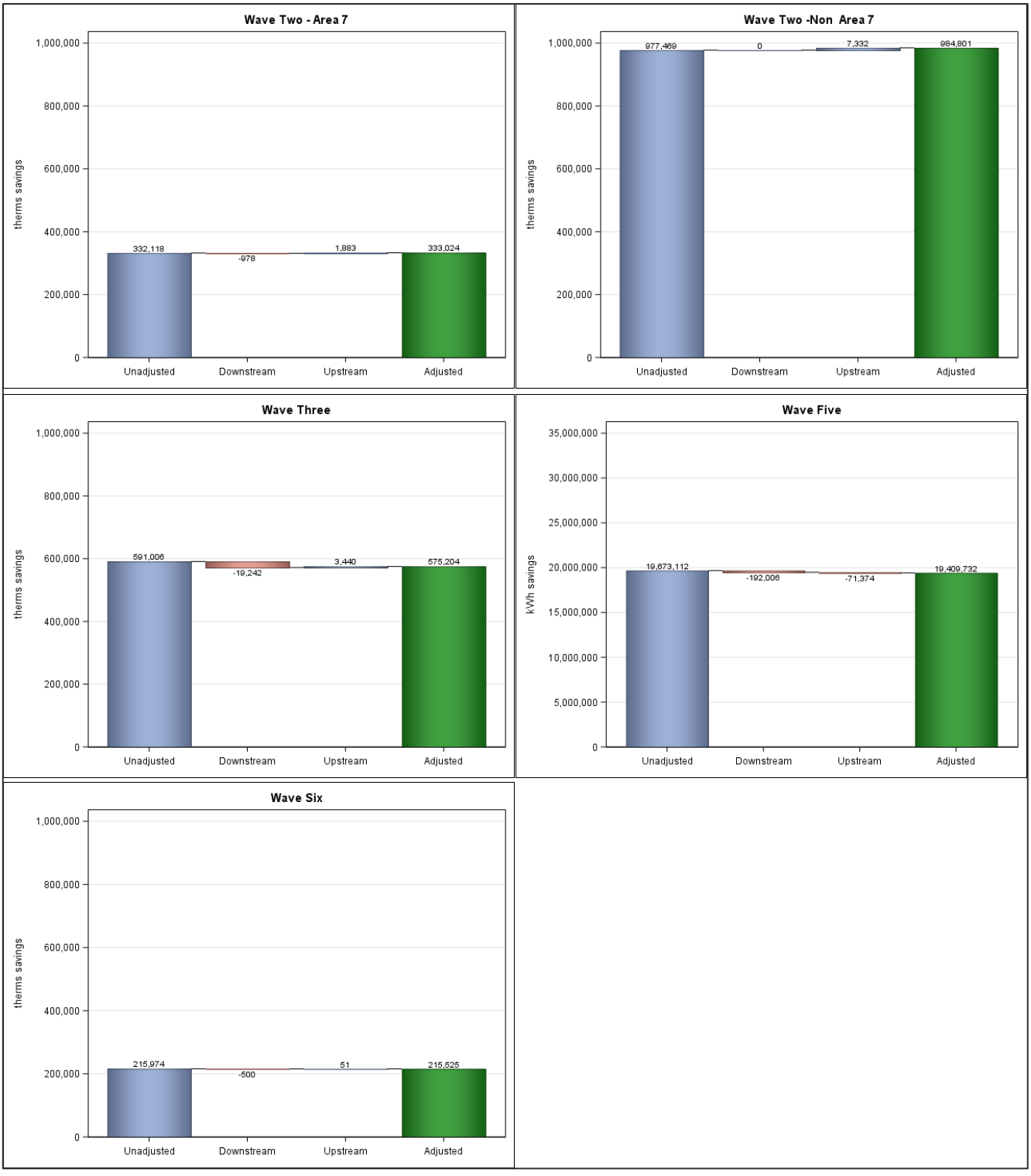


Figure 10. Recommended total kW savings for Beta, Gamma and Wave One

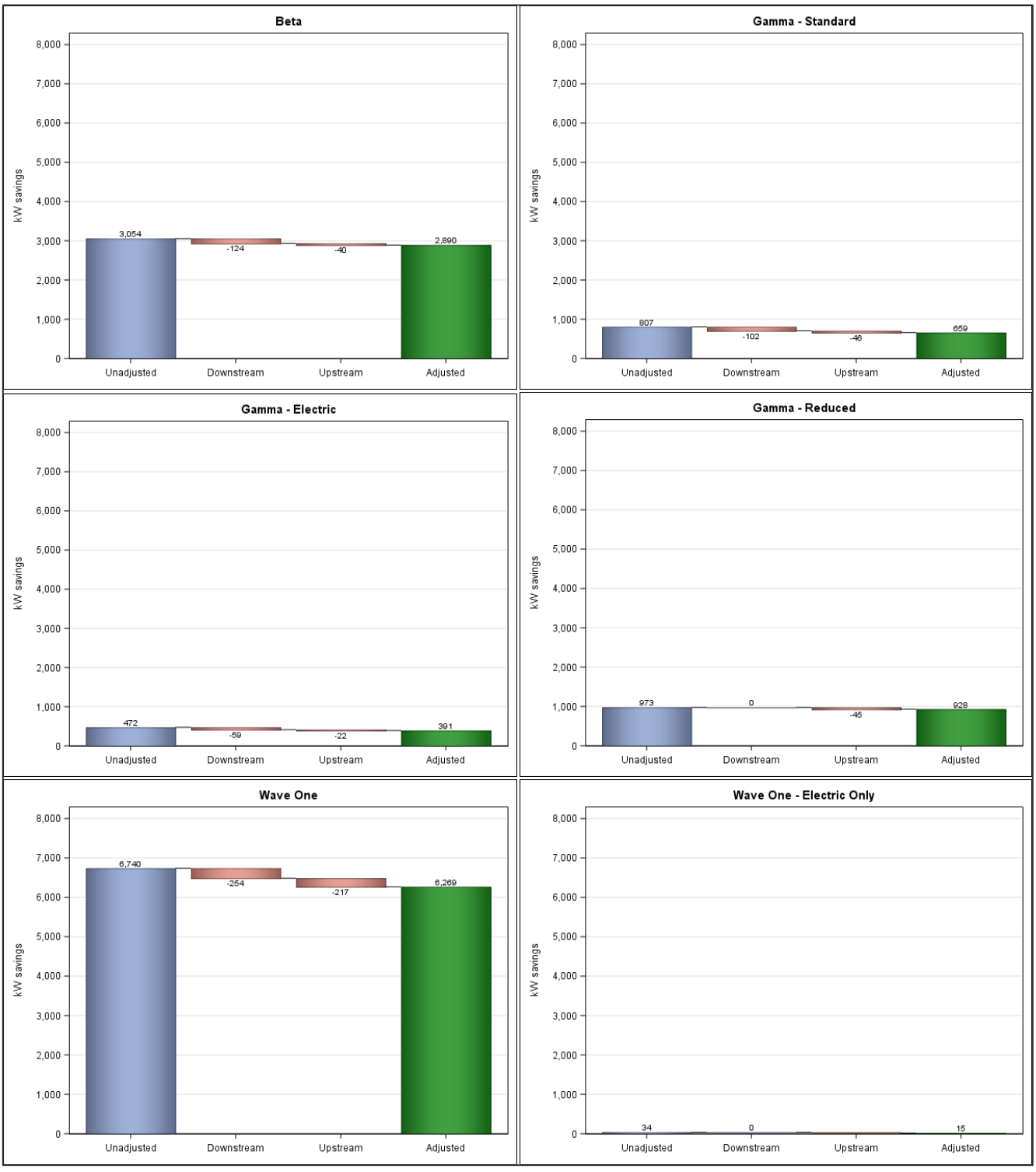
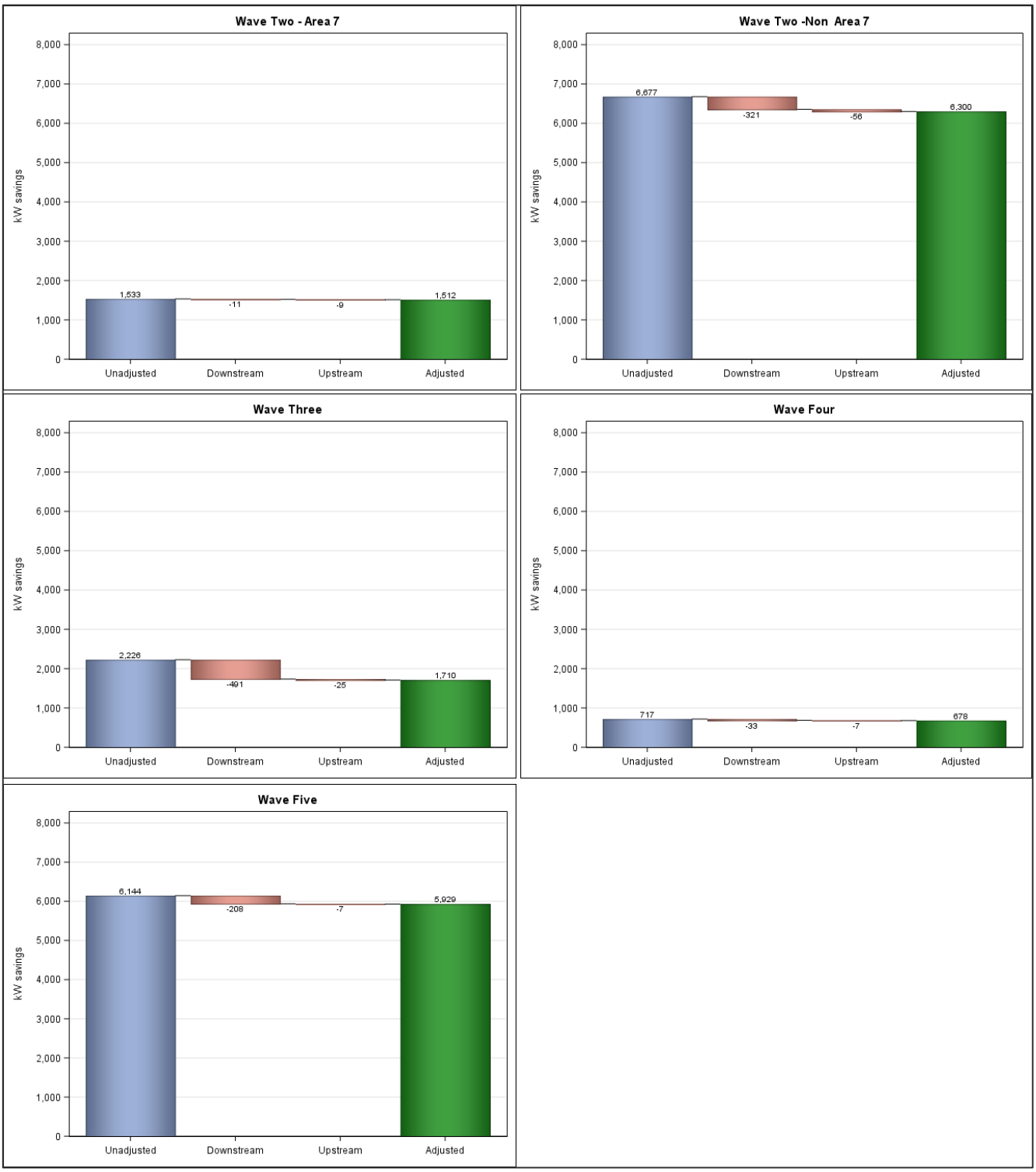


Figure 11. Recommended total kW savings for Wave Two through Wave Five



Appendix C presents the tabular form of Figure 6 through Figure 11 and Appendix F presents the historical electric and gas saving per household for the HER program across program administrators.

5 CONCLUSIONS

Overall, DNV GL found no major concerns with the methodology Nexant used for estimating unadjusted kWh and therms savings. DNV GL and Nexant's savings estimates are sufficiently similar despite differences in the model specifications used in calculating program savings. DNV GL recommends using Nexant's unadjusted electric and gas savings (with corrections applied on gas savings for Wave Five).

For peak demand reduction, DNV GL recommends using DNV GL's unadjusted demand savings estimates. The peak demand during the pre-period is not balanced between the treatment and control groups for some of the waves. DNV GL used a difference-in-differences method to account for this pre-period differences while Nexant continued to use a post-difference approach that did not take these pre-period differences into consideration.

For downstream and upstream joint savings, DNV GL recommends using DNV GL's joint savings estimates to adjust Nexant's unadjusted electric and gas savings estimates and DNV GL's unadjusted demand savings for the 2015 HER program.

Overall, the PGE HER program continued to produce electric, demand and gas savings that are statistically significant at the 90% confidence level. Table 16 summarizes the recommendations for the final adjusted energy and demand savings for 2015 PG&E HER program. PG&E may use these results to support savings claims for program year 2015.

Table 16. Recommended kWh, therms, and kW savings for 2015 HER program

Type of Savings	Total program savings
Electric (kWh)	
Unadjusted	145,884,543
Joint Savings Downstream	2,443,505
Joint Savings Upstream	4,853,329
Adjusted	138,587,709
Gas (therms)	
Unadjusted	4,667,926
Joint Savings Downstream	38,499
Joint Savings Upstream	(62,070)
Adjusted	4,691,497
Peak Demand Savings (kW)	
Unadjusted	29,377
Joint Savings Downstream	1,603
Joint Savings Upstream	493
Adjusted	27,282

APPENDIX A. OPOWER POPULATION COUNTS

Population counts are used to expand estimated per-household savings to the program level. The population counts are a key component of the final savings estimates because of the size of the program, but the process is complicated by ongoing attrition in both the treatment and control groups.

DNV GL population counts approximately recreate the counts reported by Nexant. Exact counts depend on details such as how a move-out date is assigned and data quality criteria to be included in the regression. As a result, evaluators did not attempt to recreate the exact average population Nexant used to produce the savings estimates. In addition, DNV GL used PG&E billing data to establish a move-out date. Overall, DNV GL treatment counts are comparable with Nexant's. Table 1 presents the comparison of the number of customers in the treatment group. These numbers are based on electric customers only.

Table 1. Number of customers in the HER treatment groups

Wave	Treatment		%DNV/Nexant
	Nexant	DNV GL	
Beta	44,447	42,084	95%
Gamma	129,775	125,292	97%
Wave One	292,889	286,528	98%
Wave Two - Area 7	63,721	63,142	99%
Wave Two - Non Area 7	243,564	239,275	98%
Wave Three	172,766	170,870	99%
Wave Four	157,208	156,854	100%
Wave Five	182,548	181,316	99%
Wave Six	296,688	296,116	100%

APPENDIX B. MODEL COMPARISON

DNV GL assessed the model specification used by Nexant in evaluating the HER program and compared it with the fixed effects model that is commonly used for evaluating the HER program. Nexant switched from using a fixed effect model to using a post only model specification that makes use of lagged dependent variables (i.e consumption during the pre-period) to calculate savings. We provide the fixed effect and post only model specification below:

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

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 effect
ε_{it} = Regression residual

Post only: $E_{it} = \alpha_0 + \lambda_t + \beta_{1t} T_{it} + \beta_{2it} Elag_{it} + \beta_{3it} Elag_{it} * \lambda_t$

where:

E_{it} = Average daily energy consumption for account i during month t in the post period
T = Binary variable: one for households in the treatment group in the month t, zero otherwise
$Elag$ = Average daily energy consumption for account i during month t in the pre-period
λ_t = Monthly effects
α_0 = Overall intercept
ε_{it} = Regression residual

Under valid RCTs, both fixed effects and post only model specification produce unbiased estimates of savings and the post only model is claimed to produce smaller standard errors, on average. We assessed the savings estimates produced by the two models. Figure 1 provides a comparison of DNV GL savings estimated from the fixed effects model (DNV GL – FE), Nexant's reported savings from the post only model (Nexant – LDV) and DNV GL's savings estimates from the fixed effects model using Nexant's analysis datasets. This allows us to compare the savings estimates from two different model specifications as well as compare the savings from the fixed effects model using DNV GL's and Nexant's analysis data.

Figure 1. Comparison of kWh and therms savings from the fixed effects and post-only models

Overall, we found the two sets of savings estimates from the fixed effects model to be very similar. This implies that differences in data cleaning/screening resulted did not affect the results substantially. The savings estimates from the fixed effect model and post only model specification are slightly different for each of the month but each estimate is within the confidence bounds of the other. This suggests that these models produce consistent results. Based on the results from both waves, the post only model appears to produce slightly smaller standard errors which suggests better precision than the fixed effects model.

DNV GL also calculated savings using the post-only model specification using DNV GL's analysis datasets to compare with Nexant's results. Overall, we found that the savings estimates from the post-only model specification using DNV GL's and Nexant's datasets are consistent.

Despite differences in model specification, DNV GL finds Nexant's results and methods acceptable for estimating the program effects for the HER program. The fixed effects and post-only model produce results that are consistent for the PG&E HER program. Going forward, we recommend reporting the savings estimates from the two models for comparison when switching from a fixed effect model to another specification as we continue to vet this approach. Although we try to maintain consistent methods throughout our evaluations, we are open to future improvements and refinements in our methods. We recommend to review and assess the approach for strengths and weakness versus the current approach. DNV GL will continue to review the post-only approach and other viable options for evaluating the HER program.

APPENDIX C. RECOMMENDED TOTAL KWH, THERMS, AND KW SAVINGS BY WAVE

Table 1. Recommended total kWh savings for the 2015 HER program

Wave	Electric (kWh)			
	Unadjusted	Joint Savings - Downstream	Joint Savings - Upstream	Adjusted
Beta	9,973,947	338,943	397,695	9,237,310
Gamma - Dual Standard	5,689,245	96,188	442,642	5,150,415
Gamma - Dual Reduced	4,850,310	82,110	438,058	4,330,142
Gamma - Electric only	3,420,625	82,316	221,056	3,117,252
Wave One - Dual	32,316,557	664,771	2,093,102	29,558,684
Wave One - Electric only	3,499,619	-	191,437	3,308,183
Wave Two - Area 7	6,177,779	77,908	134,499	5,965,372
Wave Two - Non Area 7	28,396,036	539,881	523,711	27,332,444
Wave Three	17,665,036	368,410	245,703	17,050,923
Wave Four	11,480,559	-	83,161	11,397,398
Wave Five	19,673,112	192,006	71,374	19,409,732
Wave Six	2,741,718	973	10,889	2,729,856
Total	**145,884,543**	**2,443,505**	**4,853,329**	**138,587,709**

Table 2. Recommended total therms savings for the 2015 HER program

Wave	Gas (Therms)			
	Unadjusted	Joint Savings - Downstream	Joint Savings - Upstream	Adjusted
Beta	327,070	13,711	(5,568)	318,927
Gamma - Dual Standard	125,369	-	(6,197)	131,566
Gamma - Dual Reduced	143,516	-	(6,133)	149,649
Gamma - Electric only	-	-	-	-
Wave One - Dual	942,579	-	(29,303)	971,883
Wave One - Electric only	-	-	-	-
Wave Two - Area 7	332,118	978	(1,883)	333,024
Wave Two - Non Area 7	977,469	-	(7,332)	984,801
Wave Three	591,006	19,242	(3,440)	575,204
Wave Four	516,658	-	(1,164)	517,822
Wave Five	496,166	4,069	(999)	493,096
Wave Six	215,974	500	(51)	215,525
Total	**4,667,926**	**38,499**	**-62,070**	**4,691,497**

Table 3. Recommended demand (kW) savings for 2015 HER program

Wave	Electric (kW)			
	Unadjusted	Joint Savings Downstream	Joint Savings Upstream	Adjusted
Peak Demand Savings	29,377	1,603	493	27,282

APPENDIX D. GAMMA PERSISTENCE STUDY

In May 2014, PG&E stopped sending the reports to a randomly selected set of households in the treatment group to test the persistence in program savings after discontinuation of the reports in the Gamma waves. The treatment group in the Gamma – Standard wave receives the reports bi-monthly while the treatment group in the Gamma-Reduced receive the reports quarterly. A total of 28,000 households from the treatment group in Gamma-Standard and Gamma-Reduced waves were randomly selected to stop receiving the reports (terminated group) while the remaining households in the treatment group continued to receive the report (continued group).

DNV GL reviewed and replicated Nexant's analysis on the persistence studies. Figure 1 shows estimates on savings from the continued and terminated treatment groups for the Gamma- Standard wave. Consistent with Nexant's findings, DNV GL observed a reduction in electric savings for terminated households. Despite the fact that the two sets of results are not statistically significantly different, there is a clear downward trend in terminated savings. The effect of the discontinuation of reports is more pronounced in summer for electric and winter for gas. During summer months, the magnitude of electric savings from the terminated group is lower and in most cases. For gas, we observed the reverse seasonal trend where gas savings are substantially lower and even negative during the winter months.

Figure 1. kWh and therms savings for continued and terminated treatment groups, Gamma Standard

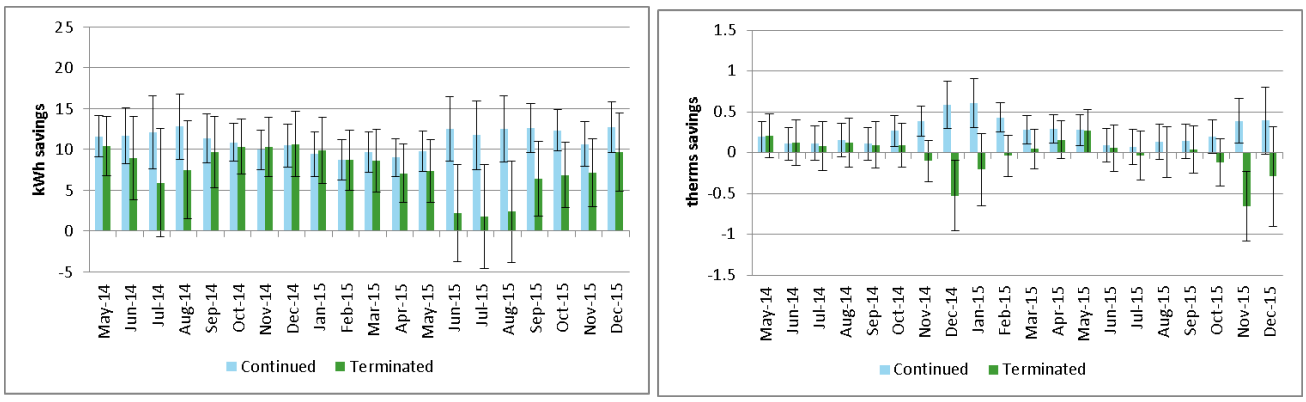
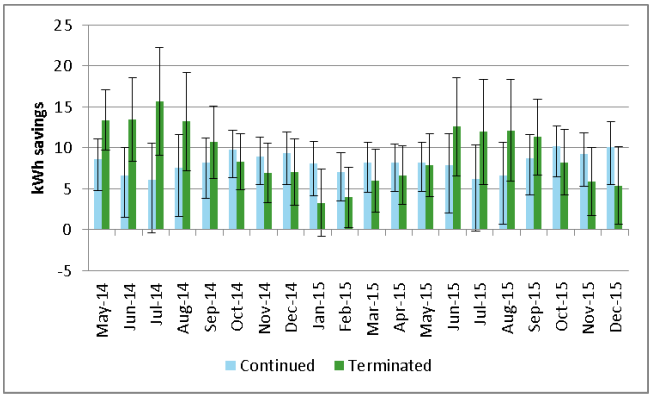


Figure 2 shows estimates on savings from the continued and terminated treatment groups for the Gamma-Reduced wave. For Gamma-Reduced wave, the impact of discontinuation of the reports is surprising. The terminated group appears to produce more electric savings during the summer and more gas savings during most of the months in winter. Again, there is not statistically significant difference between the continued and terminated group savings except gas in Gamma-standard.

Figure 2. kWh and therms savings for continued and terminated treatment groups, Gamma Reduced



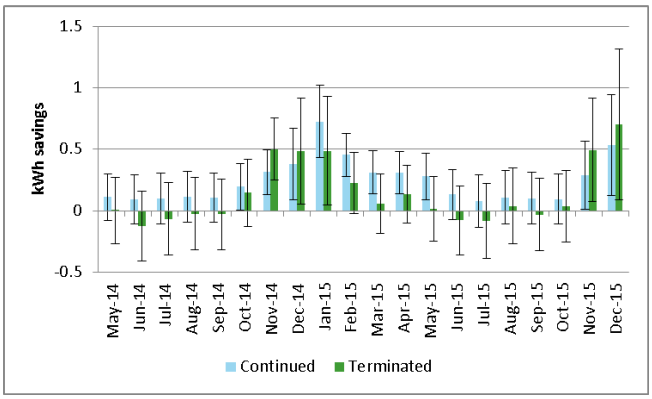


Table 1 shows electric and gas savings of the terminated and continued treatment groups in 2015. On average, the decrease in savings in the terminated group in Gamma-Reduced is less pronounced than the decrease in savings for terminated group in Gamma – Standard. The terminated group in the Gamma-Reduced produced 3% less electric savings and 42% less gas savings compared to the continued group savings in 2015. For Gamma-Standard, the decrease in savings of the terminated group is approximately 40% for electric and 120% for gas. The Gamma-Standard terminated group did not produce any gas savings in 2015.

Table 1. kWh and therms savings for continued and terminated treatment groups, 2015.

Wave	Fuel	Continued	Terminated	Difference (Terminated-Continued)	% Difference
January 2015 to December 2015					
Gamma - Standard	kWh	131	78	-54	-41%
	therms	3	-1	-4	-123%
Gamma - Reduced	kWh	99	95	-3	-3%
	therms	3	2	-1	-42%

APPENDIX E. INTRODUCTION OF EHERS

In April 2014, PG&E started sending out electronic reports (eHERs) in addition to the paper reports to a randomly selected treatment household in Wave One and Wave Two – Not Area 7. This experiment was designed to test if receiving electronic reports during the months households do not receive the report would provide additional benefits. In each of the waves, PG&E randomly selected households from treatment group to either paper only and the eHERs groups (electronic and paper reports). The paper only and eHERs treatment groups are composed of households eligible to receive emails from PG&E. PG&E also created a sample of the control group who are eligible to receive emails from PG&E.

Figure 1 and Figure 2Figure present a comparison of savings between the paper only and eHERs treatment groups for Wave One and Wave Two. In 2015, the additional email reports result in a 1% and 15% increase in electric savings for Wave One and Wave Two Not Area 7, respectively. For gas, we found that the additional email reports did not result into additional savings for either of the waves. Overall, these results are small and not statistically significant. This suggest that sending additional electronic reports does not generate much more (if any) savings compared to sending out only paper reports.

Figure 1. kWh and therms savings for paper only and eHERs recipients, Wave One

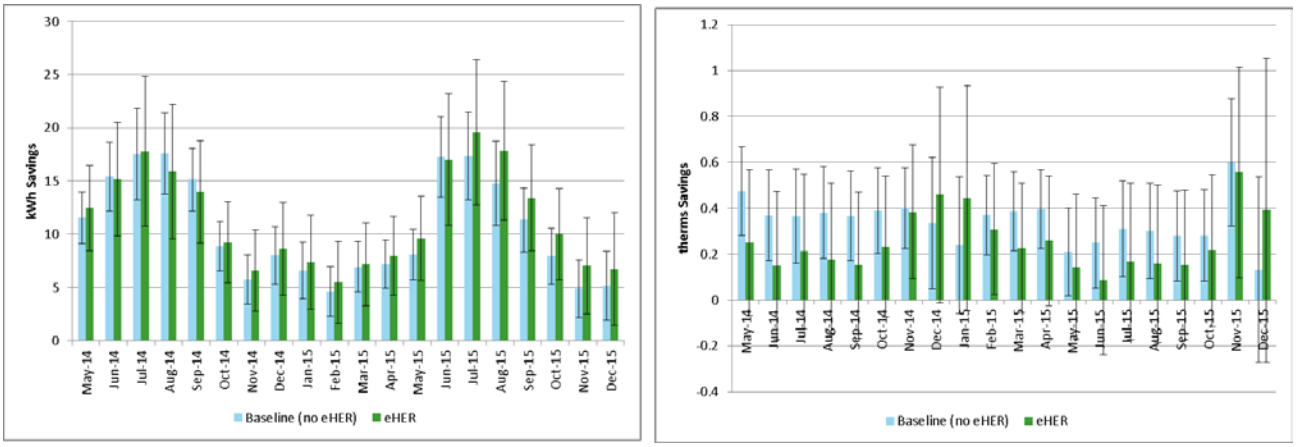
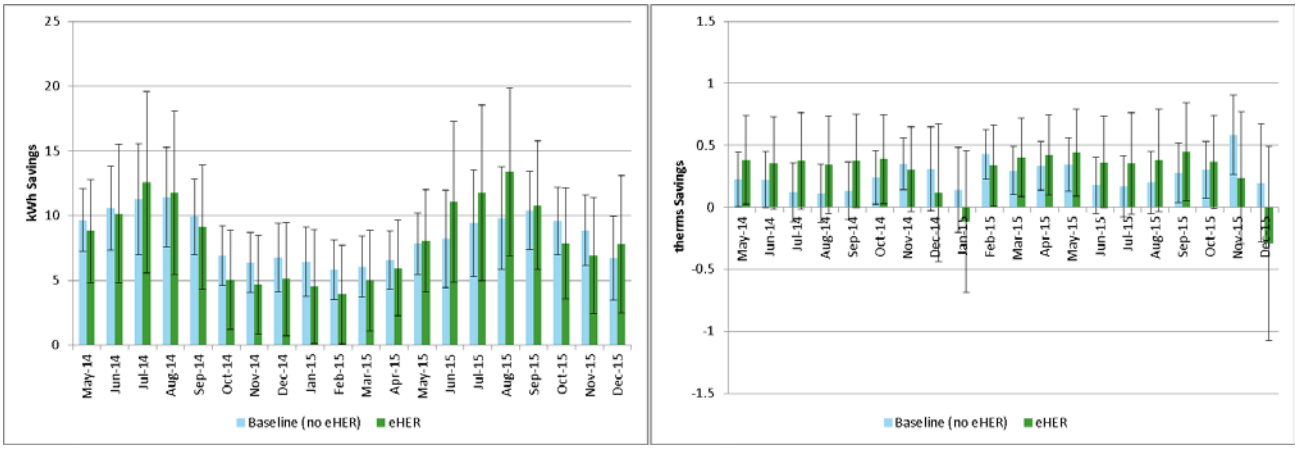


Figure 2. kWh and therms savings for paper only and eHERs recipients, Wave Two Not Area 7



APPENDIX F. KEY INPUTS FOR UPSTREAM JOINT SAVINGS CALCULATIONS

Table 1. Inputs for upstream joint savings calculation.

Assumptions	CFL Inputs	LED Inputs	Source
Excess lamps due to HER			
Year 1	0.95		2012 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)
2015 Beta	-0.17	0.09	2015 IOU Residential Behavioral Programs: Online Survey Results (DNV GL, 2017)
2015 Gamma Standard	0.17	0.33	
2015 Gamma Reduced	0.01	0.44	
2015 Gamma Electric Only	-0.07	0.23	
2015 Wave One Dual	0.02	0.71	
2015 Wave One Electric Only	0.61	0.24	
2015 Wave Two Area 7	0.02	0.51	
2015 Wave Two Not Area 7	0.01	0.55	
2015 Wave Three	0.09	0.09	
2015 Wave Four	-0.16	-0.09	
2015 Wave Five	0.00	0.11	
2015 Wave Six	0.03	0.29	
Rebated sales fraction			
2011	50%		TRC estimate
2012	45%		TRC estimate
2013	16%		TRC estimate
2014	7%	21%	TRC estimate
2015	9%	20%	TRC estimate
Annual savings per bulb			
2011	26.8		2010-12 ULP Evaluation (DNV GL, 2014)
2012	26.2		2010-12 ULP Evaluation (DNV GL, 2014)
2013	23.5		Program tracking data (DEER 2013-14)
2014	23.5	24.8	Program tracking data (DEER 2013-14)
Fraction of CFL lamps in 2014	0.66	0.34	TRC estimate of total CFL and LED sold in territory
2010-2012 Net-to-gross	0.63		2010-12 ULP Evaluation (DNV GL, 2014)
2013-2014 Net-to-gross	0.31	0.45	2013-14 ULP Evaluation (DNV GL, 2014)
Installation rate	97%	99%	2013-14 ULP Evaluation (DNV GL, 2014)
Assumed gas savings	-0.02	-0.02	Program tracking data (DEER 2013-14)

APPENDIX G. HER SAVINGS BY PROGRAM ADMINISTRATOR (PA) FROM 2011 TO 2014

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

Year/PA	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%	NA	NA
	Wave One Dual	11	77	1.1%	1	0.4%
	Wave One Electric only	11	85	1.1%	NA	NA
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%	NA	NA
	Wave One Dual	12	112	1.5%	3	0.6%
	Wave One Electric only	12	128	1.6%	NA	NA
	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	123	1.2%	NA	NA
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%	NA	NA
	Wave One Dual	12	117	1.7%	3	0.7%
	Wave One Electric only	12	129	1.6%	NA	NA
	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%	NA	NA
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_2015_PGE_HER	PGE	Home Energy Reports	116,439[a]	138,588	1.19	0.0%	1.19
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**116,439**	**138,588**	**1.19**	**0.0%**	**1.19**
RES_3_1_2015_PGE_HER		***Statewide***	***116,439***	***138,588***	***1.19***	***0.0%***	***1.19***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	4,565	4,796	1.05	0.0%	1.05
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**4,565**	**4,796**	**1.05**	**0.0%**	**1.05**
RES_3_2_2015_SCE_HER		***Statewide***	***4,565***	***4,796***	***1.05***	***0.0%***	***1.05***
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0	5,658			
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0	5,531			
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0**	**11,189**			
RES_3_3_2015_SDGE_HER		***Statewide***	***0***	***11,189***			
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0	0			
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0**	**0**			
RES_3_4_2015_MCE_HUR		***Statewide***	***0***	***0***			

[a] The ExAnte savings represent savings claimed by PG&E.

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_2015_PGE_HER	PGE	Home Energy Reports	116,439[a]	138,588	1.19	0.0%	1.00	1.00	1.00	1.00
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**116,439**	**138,588**	**1.19**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_1_2015_PGE_HER		***Statewide***	***116,439***	***138,588***	***1.19***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	4,565	4,796	1.05	0.0%	1.00	1.00	1.00	1.00
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**4,565**	**4,796**	**1.05**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_2_2015_SCE_HER		***Statewide***	***4,565***	***4,796***	***1.05***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0	5,658				1.00		1.00
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0	5,531				1.00		1.00
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0**	**11,189**				**1.00**		**1.00**
RES_3_3_2015_SDGE_HER		***Statewide***	***0***	***11,189***				***1.00***		***1.00***
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0	0						
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0**	**0**						
RES_3_4_2015_MCE_HUR		***Statewide***	***0***	***0***						

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	20.0[a]	27.3	1.36	0.0%	1.36
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**20.0**	**27.3**	**1.36**	**0.0%**	**1.36**
RES_3_1_2015_PGE_HER		***Statewide***	***20.0***	***27.3***	***1.36***	***0.0%***	***1.36***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	0.7	0.7	1.02	0.0%	1.02
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**0.7**	**0.7**	**1.02**	**0.0%**	**1.02**
RES_3_2_2015_SCE_HER		***Statewide***	***0.7***	***0.7***	***1.02***	***0.0%***	***1.02***
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0.0	1.4			
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0.0	0.0			
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0.0**	**1.4**			
RES_3_3_2015_SDGE_HER		***Statewide***	***0.0***	***1.4***			
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0.0	0.0			
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0.0**	**0.0**			
RES_3_4_2015_MCE_HUR		***Statewide***	***0.0***	***0.0***			

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	20.0[a]	27.3	1.36	0.0%	1.00	1.00	1.00	1.00
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**20.0**	**27.3**	**1.36**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_1_2015_PGE_HER		***Statewide***	***20.0***	***27.3***	***1.36***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	0.7	0.7	1.02	0.0%	1.00	1.00	1.00	1.00
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**0.7**	**0.7**	**1.02**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_2_2015_SCE_HER		***Statewide***	***0.7***	***0.7***	***1.02***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0.0	1.4				1.00		1.00
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0.0	0.0						
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0.0**	**1.4**				**1.00**		**1.00**
RES_3_3_2015_SDGE_HER		***Statewide***	***0.0***	***1.4***				***1.00***		***1.00***
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0.0	0.0						
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0.0**	**0.0**						
RES_3_4_2015_MCE_HUR		***Statewide***	***0.0***	***0.0***						

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	4,148[a]	4,691	1.13	0.0%	1.13
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**4,148**	**4,691**	**1.13**	**0.0%**	**1.13**
RES_3_1_2015_PGE_HER		***Statewide***	***4,148***	***4,691***	***1.13***	***0.0%***	***1.13***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	0	0			
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**0**	**0**			
RES_3_2_2015_SCE_HER		***Statewide***	***0***	***0***			
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0	130			
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0	271			
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0**	**401**			
RES_3_3_2015_SDGE_HER		***Statewide***	***0***	***401***			
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0	0			
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0**	**0**			
RES_3_4_2015_MCE_HUR		***Statewide***	***0***	***0***			

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	4,148[a]	4,691	1.13	0.0%	1.00	1.00	1.00	1.00
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**4,148**	**4,691**	**1.13**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_1_2015_PGE_HER		***Statewide***	***4,148***	***4,691***	***1.13***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	0	0						
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**0**	**0**						
RES_3_2_2015_SCE_HER		***Statewide***	***0***	***0***						
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0	130				1.00		1.00
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0	271				1.00		1.00
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0**	**401**				**1.00**		**1.00**
RES_3_3_2015_SDGE_HER		***Statewide***	***0***	***401***				***1.00***		***1.00***
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0	0						
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0**	**0**						
RES_3_4_2015_MCE_HUR		***Statewide***	***0***	***0***						

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	116,439[a]	138,588	1.19	0.0%	1.19
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**116,439**	**138,588**	**1.19**	**0.0%**	**1.19**
RES_3_1_2015_PGE_HER		***Statewide***	***116,439***	***138,588***	***1.19***	***0.0%***	***1.19***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	4,565	4,796	1.05	0.0%	1.05
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**4,565**	**4,796**	**1.05**	**0.0%**	**1.05**
RES_3_2_2015_SCE_HER		***Statewide***	***4,565***	***4,796***	***1.05***	***0.0%***	***1.05***
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0	5,658			
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0	5,531			
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0**	**11,189**			
RES_3_3_2015_SDGE_HER		***Statewide***	***0***	***11,189***			
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0	0			
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0**	**0**			
RES_3_4_2015_MCE_HUR		***Statewide***	***0***	***0***			

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	116,439[a]	138,588	1.19	0.0%	1.00	1.00	1.00	1.00
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**116,439**	**138,588**	**1.19**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_1_2015_PGE_HER		***Statewide***	***116,439***	***138,588***	***1.19***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	4,565	4,796	1.05	0.0%	1.00	1.00	1.00	1.00
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**4,565**	**4,796**	**1.05**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_2_2015_SCE_HER		***Statewide***	***4,565***	***4,796***	***1.05***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0	5,658				1.00		1.00
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0	5,531				1.00		1.00
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0**	**11,189**				**1.00**		**1.00**
RES_3_3_2015_SDGE_HER		***Statewide***	***0***	***11,189***				***1.00***		***1.00***
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0	0						
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0**	**0**						
RES_3_4_2015_MCE_HUR		***Statewide***	***0***	***0***						

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	20.0[a]	27.3	1.36	0.0%	1.36
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**20.0**	**27.3**	**1.36**	**0.0%**	**1.36**
RES_3_1_2015_PGE_HER		***Statewide***	***20.0***	***27.3***	***1.36***	***0.0%***	***1.36***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	0.7	0.7	1.02	0.0%	1.02
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**0.7**	**0.7**	**1.02**	**0.0%**	**1.02**
RES_3_2_2015_SCE_HER		***Statewide***	***0.7***	***0.7***	***1.02***	***0.0%***	***1.02***
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0.0	1.4			
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0.0	0.0			
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0.0**	**1.4**			
RES_3_3_2015_SDGE_HER		***Statewide***	***0.0***	***1.4***			
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0.0	0.0			
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0.0**	**0.0**			
RES_3_4_2015_MCE_HUR		***Statewide***	***0.0***	***0.0***			

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	20.0[a]	27.3	1.36	0.0%	1.00	1.00	1.00	1.00
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**20.0**	**27.3**	**1.36**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_1_2015_PGE_HER		***Statewide***	***20.0***	***27.3***	***1.36***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	0.7	0.7	1.02	0.0%	1.00	1.00	1.00	1.00
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**0.7**	**0.7**	**1.02**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_2_2015_SCE_HER		***Statewide***	***0.7***	***0.7***	***1.02***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0.0	1.4				1.00		1.00
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0.0	0.0						
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0.0**	**1.4**				**1.00**		**1.00**
RES_3_3_2015_SDGE_HER		***Statewide***	***0.0***	***1.4***				***1.00***		***1.00***
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0.0	0.0						
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0.0**	**0.0**						
RES_3_4_2015_MCE_HUR		***Statewide***	***0.0***	***0.0***						

[a]*The ExAnte savings represent savings claimed by PG&E.*

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_2015_PGE_HER	PGE	Home Energy Reports	4,148[a]	4,691	1.13	0.0%	1.13
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**4,148**	**4,691**	**1.13**	**0.0%**	**1.13**
RES_3_1_2015_PGE_HER		***Statewide***	***4,148***	***4,691***	***1.13***	***0.0%***	***1.13***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	0	0			
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**0**	**0**			
RES_3_2_2015_SCE_HER		***Statewide***	***0***	***0***			
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0	130			
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0	271			
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0**	**401**			
RES_3_3_2015_SDGE_HER		***Statewide***	***0***	***401***			
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0	0			
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0**	**0**			
RES_3_4_2015_MCE_HUR		***Statewide***	***0***	***0***			

[a]The ExAnte savings represent savings claimed by PG&E.

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_2015_PGE_HER	PGE	Home Energy Reports	4,148[a]	4,691	1.13	0.0%	1.00	1.00	1.00	1.00
RES_3_1_2015_PGE_HER	**PGE**	**Total**	**4,148**	**4,691**	**1.13**	**0.0%**	**1.00**	**1.00**	**1.00**	**1.00**
RES_3_1_2015_PGE_HER		***Statewide***	***4,148***	***4,691***	***1.13***	***0.0%***	***1.00***	***1.00***	***1.00***	***1.00***
RES_3_2_2015_SCE_HER	SCE	Home Energy Reports	0	0						
RES_3_2_2015_SCE_HER	**SCE**	**Total**	**0**	**0**						
RES_3_2_2015_SCE_HER		***Statewide***	***0***	***0***						
RES_3_3_2015_SDGE_HER	SDGE	Home Energy Reports	0	130				1.00		1.00
RES_3_3_2015_SDGE_HER	SDGE	Manage Act Save	0	271				1.00		1.00
RES_3_3_2015_SDGE_HER	**SDGE**	**Total**	**0**	**401**				**1.00**		**1.00**
RES_3_3_2015_SDGE_HER		***Statewide***	***0***	***401***				***1.00***		***1.00***
RES_3_4_2015_MCE_HUR	MCE	Home Utility Reports	0	0						
RES_3_4_2015_MCE_HUR	**MCE**	**Total**	**0**	**0**						
RES_3_4_2015_MCE_HUR		***Statewide***	***0***	***0***						

[a]*The ExAnte savings represent savings claimed by PG&E.*

Appendix AB. Standardized Per Unit Savings

Not reported.

Appendix AC. Recommendations

Appendix AC: Recommendations

Study ID	Study Type	Study Title	Study Manager			
Res 3.1	Impact Evaluation	Review and Validation of 2015 Pacific Gas and Electric Home Energy Reports Program Impacts	CPUC			
Recommendation	**Program or Database**	**Summary of Findings**	**Additional Supporting Information**	**Best Practice / Recommendations**	**Recommendation Recipient**	**Affected Workpaper or DEER**
1	HER	For Wave Five, PG&E early evaluation only considered savings from October 2015 to December 2015 when calculating total gas savings for 2015.	N/A	Calculate total savings for all 12 months in 2015	PG&E	N/A
2	HER	The post-difference method used in PG&E early evaluation does not correct for the pre-existing differences in peak load consumption found in some of the waves.	N/A	Use the difference-in-differences approach for calculating peak demand savings. The California IOUs agreed on a standardized approach that uses the difference-in-differences approach for calculating peak demand savings.	PG&E	N/A
3	HER	DNV GL and PG&E are using different approaches in calculating joint savings at the peak.	N/A	DNV GL will work with PG&E to standardize the approach in calculating joint savings at the peak.	PG&E	N/A
4	HER	The assumptions used for upstream joint savings calculation are based on earlier studies on upstream lighting program.	N/A	We recommend updating the key assumptions with the most recent available upstream lighting studies and using efficient bulb uplift estimates for each of the wave based on DNV GL's recent online survey.	PG&E	N/A
5	HER	Gamma Standard and Gamma Reduced share the same control group. The reported rebate savings of the control group for Gamma Standard and Reduced should be identical.	N/A	We recommend revisiting the joint savings calculation and apply the necessary corrections for future evaluations.	PG&E	N/A

6	HER	PG&E switched from using a fixed effect model to using a post only model specification that makes use of lagged dependent variables.	N/A	We recommend reporting the savings estimates from the two models for comparison when switching from a fixed effect model to another specification.	PG&E	N/A
7	HER	PG&E early evaluation continued to report standard errors for the aggregated savings that were based on a separate regression model .	N/A	The standard errors of the total program savings should be calculated using the combined monthly parameter standard errors weighted by the number of treatment counts.	PG&E	N/A

Appendix BA. Public Comments on 2015 PG&E HER Evaluation

No.	From	Area	Comments	DNV GL Response
1	PG&E/ Nexant	Key Findings: "Since DNV GL's unadjusted electric and gas savings are sufficiently similar with Nexant's unadjusted estimates, we recommend using Nexant's estimates for unadjusted electric and gas savings."	It is gratifying that the unadjusted electric and gas savings estimates derived from two different firms using different statistics applications and models result in very similar results. This is particularly relevant as the models used were different: post-only model with lagged dependent variables for Nexant and fixed-effects model for DNV GL.	No response required.
2	PG&E/ Nexant	Key Findings: "DNV GL reviewed Nexant's joint savings analysis and found differences for one wave's results. There is evidence that the difference may be the result of an error in the Nexant analysis data. As a result, we recommend using DNV GL's joint savings estimate for downstream programs."	A typographical error in Nexant's analysis caused this problem - it has been corrected. A new estimate produced by Nexant confirms DNV GL's estimate.	No response required.
3	PG&E/ Nexant	Unadjusted kWh and Therms Savings Estimates: "For the 2015 evaluation, Nexant switched from using a fixed effects model specification to a post-only model using lagged dependent variables as control variables (Appendix B). These two models produce similar and unbiased results under valid RCT design and are consistent with the specification options offered in the State and Local Energy Efficiency Action Network's report (SEE Action, hereafter)."	PG&E and Nexant concur. The motivation for Nexant to adopt the post-only model on behalf of PG&E was to maintain consistency with estimates produced by vendor Opower, which adopted this change.	For this evaluation, results from the two models came out close as expected under valid experimental design. While we understand the motivation for Nexant to adopt the methodology used by the program implementer, DNV GL will continue to use the fixed effects model specification in evaluating HER impacts. Our approach is consistent with the methods we have used in the past HER evaluations in CA and allows comparison of results using consistent methodology across program years and across the IOUs.
4	PG&E/ Nexant	Unadjusted kWh and Therms Savings Estimates: "Nexant included net metered customers in the analysis while DNV GL consistently removed all net metered customers because of the way that net metering is addressed in the billing data. Including solar households in the analysis requires household-level energy production data, otherwise, potential differences in solar energy production could be conflated with program-related savings, biasing the	When assigning PG&E customers to HER treatment, net metered customers are removed from treatment and control groups. Net metered customers who remain in the treatment and control groups therefore became net metered at some time after assignment to the program. We believe that the savings achieved by these customers should be included in the analysis since solar adoption occurred after random selection and was made in roughly equal	No response required.

		results up or down."	proportions by customers assigned to treatment and control. However, PG&E respects this decision made by DNV GL since net metered customers were removed for both treatment and control customers.	
5	PG&E/ Nexant	Unadjusted kWh and Therms Savings Estimates: "Model specification. Nexant and DNV GL used different model specifications in estimating 2015 HER savings. DNV GL used a fixed effects model specification while Nexant switched to using a post-only model with lagged dependent variables as control variables. These two models are acceptable model specifications for evaluating behavioral based programs per SEE Action. The two models produce estimates that are similar and unbiased under valid experimental design."	PG&E and Nexant concur.	See response #3.
6	PG&E/ Nexant	Unadjusted kWh and Therms Savings Estimates: "For Wave Five, Nexant's calculation only considered savings from October 2015 to December 2015 when calculating aggregate gas savings."	A typographical error in Nexant's analysis caused this problem - it has been corrected. The new estimate confirms DNV GL's estimate.	No response required.
7	PG&E/ Nexant	Unadjusted kWh and Therms Savings Estimates: "Nexant's reported standard errors for the aggregated savings continue to be based on a separate regression model that calculates average savings for the program year rather than estimating savings for each month. This is consistent with Nexant's approach in prior years and is a simplification that does not account for the different monthly counts in the aggregate estimates' standard errors."	PG&E and Nexant believe both approaches are valid. Nexant used one regression model to measure annual savings (and separate models to measure monthly savings).	We believe that when calculating total program savings, it is more accurate and best practice to calculate the standard errors from the same model specification. In this case, if the annual savings estimates are calculated by multiplying monthly savings estimates with the number of treatment in each month, then standard errors should be calculated in a consistent manner. Estimates of combined parameter standard error are standard output in any statistical computing package. In fact, PG&E/Nexant agreed to update their methodology to follow DNV GL's approach for estimating the standard errors in response to the same recommendation DNV GL provided in the 2014 evaluation.
8	PG&E/ Nexant	Demand Savings Estimates: "DNV GL identified the heat waves using the	PG&E and Nexant concur.	No response required.

		weather data provided by PG&E that used hourly temperatures from weather stations across the PG&E service territory from 2011-2015. Based on the results, the three-day heatwave in 2015 fell on September 8-10, the same heatwave Nexant identified."		
9	PG&E/ Nexant	Demand Savings Estimates: "Nexant continued to use a post-difference approach in calculating peak demand savings while DNV GL calculated peak demand savings using a difference-in-differences approach."	PG&E and Nexant believe both methods are valid in an RCT.	We agree that the two methods are valid under RCT to the extent that peak load during the pre-period is balanced between the treatment and control groups. However, there is a chance of imbalance if peak load is not included in the stratification used for the HER program. Our analysis showed that the difference in peak load during the pre-period is unbalanced between the treatment and control for some of the waves which provides a greater justification for using the difference-in-differences approach. Moreover, on March 3, 2016 the California program administrators (PAs) agreed on a standardized approach for the 2015 evaluation that uses the difference-in-differences approach for calculating peak demand savings.
10	PG&E/ Nexant	Joint Savings Downstream Programs: "Data cleaning. DNV GL examined potential outliers in the program tracking data. Some lighting measures in Gamma wave had very high savings values. DNV GL reviewed these records and excluded these observations since these savings appear to be from measures installed in common areas in multifamily homes."	PG&E and Nexant believe this decision to remove positive outliers but retain negative outliers is inconsistent. Moreover the decision to remove these cases assumes that HERs cannot influence customers to change common area lighting billed to multifamily accounts. Nexant's approach to retain all customers is more conservative. However PG&E respects this decision made by DNV GL.	We addressed this issue in the report (Section 4.3 page 24). DNV GL removed both positive and negative outliers in the data. We flag observations as negative outliers when a rebated measure kWh, therm, and kW savings are all negative. The positive outliers happen to be from measures installed in common areas in multifamily homes under Gamma wave. We removed these measures since Opower's selection criteria for the eligible HER population removed customers who live in multifamily dwellings and mastered-meter accounts as reported in Nexant's (formerly FSC) 2012 evaluation report. This indicates that the program removed multifamily accounts and measures installed in common areas in multifamily homes should not be included in the joint

				savings analysis.
11	PG&E/ Nexant	Joint Savings Downstream Programs: "Data preparation. The savings generated by the control groups for Gamma Standard and Reduced should be identical because they share the same set of customers. Upon inspection, DNV GL noticed that Nexant's values do not reflect this."	An error in Nexant's analysis code caused this problem and has been corrected.	No response required.
12	PG&E/ Nexant	Joint Savings Downstream Programs: "The joint savings adjustments will only consider average joint savings that are positive despite being non-statistically significant, as they provide some evidence of possible double counting."	PG&E respects this decision made by DNV GL, but PG&E and Nexant believe that the joint savings adjustments should also include average joint savings that are negative, and not just those that are positive. When estimating energy savings of HERs, Nexant and DNV-GL do not exclude customers with negative savings. The same should be true when measuring joint savings. Excluding measures with negative savings will inflate the joint savings estimate.	Joint savings occur when the HER program increases the uptake of PG&E's rebate programs. The objective of the joint savings analysis is to estimate the increase in uptake of rebate programs due to the reports and estimate the portion of the HER savings that are potentially shared with the rebate programs. A positive joint savings means that joint savings exists and the reports caused the treatment group to increase their rebate program participation. To avoid the potential of double counting savings, we deduct the joint savings estimate from the unadjusted HER savings. On the other hand, a zero or negative joint savings means that the program does not increase the uptake of rebate programs. In other words, there is no joint savings or potential for double counting savings between the HER and rebate programs. Nexant and DNV GL's approach calculates average savings at the wave-level and not at the customer-level. This approach is consistent to how DNV GL calculates joint savings. To the extent that there are joint savings (positive), then we deduct those joint savings from the HER savings estimate. Otherwise, no adjustments are made since deducting a negative joint savings will increase HER savings as a result of random imbalance between the

				treatment and control groups with respect to participation in other rebate programs. Many of the small joint savings estimates, both positive and negative, are not statistically significant. To strictly avoid the potential of double counting, we overlook this in positive joint savings, but not in negative joint savings.
13	PG&E/ Nexant	Joint Savings Downstream Programs: "...it appears that Nexant calculated demand savings from measures by applying the DEER load shapes from 2-5pm to the electric measure savings while DNV GL used the peak kW savings as reported in PG&E tracking data."	PG&E and Nexant believe DNV-GL's method is probably very similar if the following is true: - In the program tracking data, the variable total adjusted gross kw represents peak demand savings from a measure - If so, is the "peak" represented here the same assumed to be the DEER-defined annual peak (from 2 to 5 PM)? "Peak" in this context could refer to an average daily peak, which would make DNV-GL's assumption incorrect.	The kW savings in the historical program tracking data we received from the IOUs through CPUC correspond to the summer/on peak kW savings and not the average daily peak. The on peak kW is calculated based on CPUC mandated DEER peak demand definition except for those measures that do not have a DEER load shape. The hourly 2011 DEER load shapes that Nexant used in calculating kW savings from the kWh savings likely represent a normal year and not 2015. This means that distributing the savings using the hourly DEER load shapes and calculating kW savings from kWh savings may not represent the 2015 peak period. If 2015 was hotter than normal weather then it is likely that peak savings for weather sensitive measures are underestimated. DNV GL will work with PG&E to standardize the approach and agree on assumptions used in rebate analysis for peak going forward.
14	PG&E/ Nexant	Joint Savings Downstream Programs: "DNV GL reviewed Nexant's upstream joint savings estimates. Because updated information was not available when they finished their evaluation, their calculations are different and based on less appropriate inputs. As a result, we recommend using DNV GL's estimates of upstream joint savings."	PG&E and Nexant Concur.	No response required.
15	PG&E/ Nexant	Persistence: "For Gamma-Reduced wave, the impact of discontinuation of the reports is unexpected. The	PG&E and Nexant are aware of this 'unexpected' result and have not identified any root cause that might explain this	No response required.

		terminated group appears to produce more electric savings during the summer and more gas savings during most of the months in winter. Again, there is not statistically significant difference between the continued and terminated group savings."	anomalous finding. Consequently, we agree with DNV GL's interpretation that energy savings continues unabated for two years after mailing of the reports stops in the reduced-frequency condition.	
		Key Findings: "Approximately 2 million PG&E customers were enrolled in the treatment groups as of 2015."	As of 2015, approximately 1.5 million customers were enrolled in the treatment groups and 0.5 million customers were enrolled in the control groups.	Addressed in the text under Section 1.1 page 3.
		Key Findings: "Table 3Error! Reference source not found."	This cross-reference link should be corrected.	Addressed in the text under Section 1.4 page 6.
		Persistence: "After 8 months of the receiving the reports, the terminated group in the Gamma-Reduced produced 3% less electric savings and 40% less gas savings compared to households receiving the reports quarterly. For Gamma-Standard, the rate of decline is around 40% in electric and the magnitude of gas savings among terminated treatment group are very small and negative."	PG&E and Nexant recommend that this section be rewritten as it contains inaccuracies and is vague. Specifically, the first sentence should specify "bi-monthly" rather than "quarterly" as the last work. In the second sentence, it is unclear what the timeframe is for the rate of decline specified.	Addressed in the text under Appendix D page D-6.

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.