REPORT

PG&E HER 2016 Energy and Demand Savings Early EM&V

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Prepared for
Pacific Gas & Electric

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1   Executive Summary

This report documents the energy and demand savings resulting from Pacific Gas and Electric Company's Home Energy Reports (HERs) Program for 2016. It includes estimated energy savings from a study of the persistence of the effect of the treatment over time and incremental savings from electronic delivery of HERs. The experimental waves that are included in this report are outlined in Table 1-1.

Table 1-1: Experimental Waves in field in 2016

Experimental Wave	Energy Usage Quartiles	Treatment	Control	First Report Generated
Beta	Top 1	60,000	60,000	7/19/2011
Gamma Standard Dual	All Quartiles	72,000	72,000	11/1/2011
Gamma Reduced Dual	All Quartiles	72,000	72,000	11/1/2011
Gamma All Electric	All Quartiles	45,000	45,000	11/1/2011
Gamma Gas Only	All Quartiles	15,000	15,000	11/1/2011
Wave 1	Top 3	360,000	90,000	2/27/2012
Wave 1 All Electric	Top 3	40,000	10,000	2/27/2012
Wave 2 Area 7	Top 3	80,000	50,000	1/28/2013
Wave 2 Not Area 7	Top 3	305,000	48,000	1/28/2013
Wave 3	Top 3	225,000	75,000	7/12/2013
Wave 4	Top 3	200,000	75,000	3/31/2014
Wave 5	Top 2	210,000	50,000	10/7/2014
Wave 6	Top 3	312,000	50,000	9/7/2015

The report is organized as follows. Section 2 summarizes the aggregate and monthly electric and gas savings from the HER program in 2016. Section 3 documents the methodology, calculations, and resulting estimates for peak megawatt load reduction resulting from the HER program for 2016. Section 4 contains the results from the three years of the Perstistence study including gas and electric savings. Section 5 provides the results from the eHER test also including gas and electric results.

2   Energy Savings

Nexant estimated energy savings resulting from Pacific Gas and Electric Company's Home Energy Reports (HERs) Program for 2016 as part of its contract to provide early measurement and verification (early M&V) of the HERs Program. Early M&V provides an independent estimate of savings to substantiate PG&E's energy savings claims made to the California Public Utilities Commission. A detailed report on early M&V of PG&E's HERs initiative was published by Freeman, Sullivan and Company (now Nexant) that documents evaluation design, participant and control group selection, energy savings estimation, and field research and analysis to avoid double-counting of savings (see CALMAC ID: ID PGE0329.01).

The methodology used to estimate energy savings resulting from HERs is the same as that used by Nexant for the 2015 early M&V. Program impacts on electricity consumption were estimated using a lagged dependent variable model in which monthly energy consumption for

treatment and control group customers was estimated using consumption data from the pretreatment period. The regression specification is below, followed by definitions for each term in Table 2-1.

$$kWh_{it} = a + b_t + c_t \cdot treatment_i + d \cdot pretreatment\_kwh_{it} + e_t \cdot pretreatment\_kwh_i + \varepsilon_{it}$$

Table 2-1: Lagged Dependent Variable Model Definitions

Variable	Definition
kWh_{it}	Customer i's usage in month t.
a	The estimated constant for energy consumption (average for all customers in all periods).
b_t	The estimated coefficient for the month and year indicator variable.
c_t	The estimated coefficient for the month and year indicator variable for treatment customers. This is the treatment effect for the particular month t.
$treatment_i$	The treatment indicator variable for customer i. Equal to 1 for treatment customers and 0 otherwise.
d	The estimated coefficient for pretreatment consumption.
$pretreatment\_kwh_{it}$	Pretreatment usage for customer i for month t. Pretreatment consumption for a particular month in the post treatment period refers to the same calendar month in the pretreatment period.
e_t	The estimated coefficient on pretreatment consumption for a particular month t.
ε_{it}	The error term.

This specification applies to all waves, with some indicator variables set to zero for some waves.[1] In other words, the particular months included in the model vary by experimental wave. In each case, the estimation included one year of pre-treatment billing data for each customer. Standard errors were estimated allowing for arbitrary correlation among errors within each customer's data.

The impacts for each experimental wave of the HER program were estimated separately (i.e., a unique regression equation was used for each wave), and within each of the waves, the savings for each fuel type were calculated independently. This estimation approach was used because there are certain inherent differences between dual-fuel and single-fuel customers that could add noise to an aggregate analysis, and the experiments were designed to test the respective impacts of receiving HERs on customers with different combinations of fuel types.

Month-specific savings have also been estimated in order to observe the trend in treatment effects over time. In order to maintain comparability between treatment and control groups, opt-outs (that is, customers assigned to treatment groups that requested to be removed from receiving the reports) are retained in the treatment groups throughout the course of the entire year. Two reasons underlie this decision. First, because the experiment uses an opt-out delivery design (in which households in the treatment receive the reports without requesting

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[1] This specification is a recommended specification for estimating treatment effects in this context. See equation 1.3, page 76 of "Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations," published by SEE Action, May 2012.

them), households that subsequently opt out of receiving the reports received at least one report before they dropped out. So, strictly speaking, they were treated. Second, it is impossible to remove parties in the control group who would have opted out, because their identity is unknown. Removing opt-outs only from the treatment group without doing so for the control group would compromise the internal validity of the savings estimates. HERs are assumed not to affect the rate at which customers close their accounts due to moving or other reasons; this appears to be true since the attrition rate between treatment and control groups are virtually identical. Treatment and control customers who move out during the year are retained in each sample until their accounts close. This means that the population of interest grows smaller for both the control and treatment groups as time progresses.

2.1 Aggregate and Adjusted Savings Claims

The aggregate electric and gas savings claims for the HER program are calculated using output from the above-described regression models. The aggregate savings estimates by wave are shown in Table 2-2. The table displays the estimated HER impact before and after removing electric savings that we believe may have been double counted.

Table 2-2: January 2016 through December 2016 HER Savings

Experimental Wave			Electric (in GWh)	Standard Error	Gas (in ,000 thms)	Standard Error
Beta			9.8	1.0	299	58
Gamma	Dual	Standard	4.9	0.9	101	41
		Reduced	3.8	0.9	117	37
	Electric-Only		3.3	0.6	–	–
	Gas-Only		–	–	5.3	–
Wave One	Dual		31.7	2.8	941	229
	Electric-Only		1.9	1.1	–	–
Wave Two	Not Area 7		27.6	2.9	716	148
	Area 7		6.2	0.9	299	48
Wave Three			16.8	2.0	537	93
Wave Four			8.7	1.7	413	77
Wave Five			19.3	2.7	452	121
Wave Six			12.4	0.8	516	128
Total			146.3	6.0	4,395	359
Reduction for Downstream			-0.8	–	-23	–
Adjusted Total			145.5	–	4,372	–

PG&E offers a variety of energy efficiency programs through which customers can receive rebates directly from PG&E for purchasing energy efficient equipment, such as installing a variable speed pool pump or purchasing an efficient refrigerator. PG&E receives credit for the savings achieved through those programs through a separate savings claim process. As documented in the FSC 2012 Final Report (see CALMAC ID: ID PGE0329.01), kWh savings for

all measures installed under downstream PG&E programs were identified for both treatment and control group members using data contained in PG&E's MDSS system. The double counted energy savings were obtained by subtracting the control group downstream savings from the treatment group downstream savings for each measure.

In the 2012 Final Report, a simplifying assumption was used: that all rebates for which it was determined that energy savings may have been reported by another program were assumed to have been installed during the first month of the analysis period. In the present report, kWh savings values were calculated for each customer who received a rebate by multiplying the number of days in 2016 since installation (as determined by PG&E rebate records) by the estimated kWh savings per day. The savings of each rebated measure vary by the time of day and time of year. For example, an efficient AC unit would not achieve great daily savings if it was installed in December. The kWh savings per day are estimated using DEER load profiles for each measure. Additionally, installed measures are only assumed to achieve daily savings during their EUL. The total savings for rebated measures is then summed for treatment and control customers producing the total double counted downstream savings.

In 2016 the total estimated double counted downstream savings was 0.8 GWh. This fairly low value indicates that savings from the HER program are largely attributable to the effects of the reports themselves and not due to a disproportional uptake of energy efficiency measures by households in the treatment groups for which downstream rebates were received. A similar methodology that did incorporated the DEER load shapes was used in 2015 and the adjustment was 2.4 GWh.

The same methodology was used to estimate Therm savings that resulted from PG&E's downstream measures. The total estimated double counted downstream gas savings was 23,000 Therms. This is a very small adjustment to the total gas savings estimate. The upstream lighting program joint-savings was not assessed in 2016.

Table 2-3 and Table 2-4 show how the aggregate savings values are calculated. It shows the number of treatment months, the estimated percentage impact,2 the average usage in the control group during 2016 and the average number of customers in each wave over the year. Multiplying these values together gives the estimated number of GWh or 1,000 Therms of savings from each segment of each wave – shown in the right-most column.

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[2] In the actual calculation, the regression produces a kWh value rather than a percentage value. The kWh value is used directly rather than using a percentage applied to a control load. The percentage and the average load are presented here for expositional purposes.

Table 2-3: Primary Inputs into the Electric Savings Estimates

Wave	# of Treatment Months	# of Treatment Months in 2016	% Impact	Average Monthly Control Load (kWh)	Average # of Treatment Customers	Aggregate GWh Impact
Beta	65	12	2.5%	782.6	41,124	9.8
Gamma Dual Standard	62	12	1.5%	548.6	47,714	4.9
Gamma Dual Reduced	62	12	1.2%	548.6	47,725	3.8
Gamma Electric-only	62	12	2.0%	552.7	23,967	3.3
Wave One Dual	59	12	1.9%	548.7	248,909	31.7
Wave One Electric-only	59	12	1.1%	617.8	23,324	1.9
Wave Two Non-Area 7	47	12	1.9%	526.7	225,739	27.6
Wave Two Area 7	47	12	1.8%	477.4	59,369	6.2
Wave Three	42	12	1.7%	526.2	157,124	16.8
Wave Four	34	12	1.1%	480.6	137,232	8.7
Wave Five	27	12	1.4%	718.9	159,829	19.3
Wave Six	16	12	0.8%	491.6	260,129	12.4
Total					1,432,184	146.3

Table 2-4: Primary Inputs into the Gas Savings Estimates

Wave	# of Treatment Months	# of Treatment Months in 2016	% Impact	Average Monthly Control Load (Therms)	Average # of Treatment Customers	Aggregate ,000 Therm Impact
Beta	65	12	1.1%	53.9	41,059	299
Gamma Dual Standard	62	12	0.5%	31.8	57,595	101
Gamma Dual Reduced	62	12	0.6%	31.5	47,687	117
Wave One Dual	59	12	1.0%	32.3	248,593	941
Wave Two Non-Area 7	47	12	0.8%	33.3	225,467	716
Wave Two Area 7	47	12	1.2%	36.4	59,327	299
Wave Three	42	12	0.9%	33.2	156,973	537
Wave Four	34	12	0.8%	30.5	137,086	413
Wave Five	27	12	0.6%	38.0	159,683	452
Wave Six	16	12	0.5%	30.5	259,987	516
Total					1,393,456	4,390

2.2 Electricity Savings Observed by Month

Table 2-5 presents the average percentage impact by month and the average monthly impact through the end of 2016 for every wave of the HER.

Table 2-5: Average Percentage Impact on Electricity Usage by Wave

| Month | Beta | Gamma | | | Wave One | | Wave Two | | Wave Three | Wave Four | Wave Five | Wave Six |
| | | Dual | | Electric-Only | Dual | Electric-Only | Not Area 7 | Area 7 | | | | |
		Standard	Reduced									
Jan-16	2.3%	1.9%	1.4%	2.0%	2.0%	1.9%	1.5%	1.9%	1.6%	1.1%	1.3%	0.5%
Feb-16	2.6%	2.2%	1.2%	2.4%	2.2%	1.4%	1.7%	1.6%	1.7%	0.7%	1.5%	0.5%
Mar-16	2.5%	1.9%	1.4%	1.9%	2.0%	2.2%	1.9%	1.8%	1.7%	1.1%	1.5%	0.5%
Apr-16	2.8%	1.8%	1.6%	2.2%	2.2%	1.7%	2.2%	1.8%	1.7%	1.2%	1.6%	0.8%
May-16	2.6%	1.4%	1.2%	2.1%	2.2%	1.1%	2.3%	1.9%	1.9%	1.3%	1.8%	1.1%
Jun-16	2.2%	1.4%	1.1%	1.9%	2.0%	0.8%	2.3%	1.7%	1.8%	1.2%	1.7%	0.8%
Jul-16	2.7%	1.2%	1.0%	1.7%	1.9%	0.3%	2.3%	2.0%	1.7%	1.1%	1.5%	0.9%
Aug-16	2.9%	1.5%	1.3%	2.0%	1.8%	0.0%	2.0%	1.9%	1.6%	1.2%	1.2%	0.9%
Sep-16	2.7%	1.4%	1.3%	2.2%	1.9%	0.8%	2.1%	2.0%	1.7%	1.2%	1.1%	1.0%
Oct-16	2.4%	1.6%	1.5%	2.3%	1.9%	1.3%	1.9%	1.8%	1.6%	1.1%	1.3%	0.8%
Nov-16	2.4%	1.4%	0.9%	2.2%	1.7%	2.1%	1.6%	1.8%	1.7%	1.1%	1.2%	0.8%
Dec-16	2.2%	1.3%	1.0%	2.0%	1.6%	1.2%	1.3%	1.5%	1.6%	0.9%	1.2%	0.9%
Avg.*	**2.5%**	**1.5%**	**1.2%**	**2.0%**	**1.9%**	**1.1%**	**1.9%**	**1.8%**	**1.7%**	**1.1%**	**1.4%**	**0.8%**

*Positive values indicates a real savings rate, negative values indicate a negative savings rate (greater usage by treatment customers than control customers).

The Beta wave has been in the field since August 2011 and targets customers in the highest quartile of energy usage in selected baseline territories. Beta HER recipients have the highest average monthly percentage energy savings at over 2.9% in August and smaller savings in the winter months. Other waves display seasonal fluctuations in savings as well. For example, the electric-only groups provide greater savings in the fall and winter than in spring and summer. This suggests that much of the savings are coming from changes in heating and cooling related behavior.

The Gamma wave of HERs is separated into dual-fuel "standard report frequency," dual-fuel "reduced report frequency," and electric-only customers. This stratification allows for the comparison of the impact of frequency of delivery of HERs on energy savings as well as the effect of HERs on customers with different fuel-types delivered by PG&E.[3] The difference in savings between customers who receive standard frequency reports (every other month) as compared to those who receive reduced frequency reports (every three months) is small with the standard frequency customers producing an average monthly savings of 1.5% and the reduced frequency customers producing an average monthly savings of 1.2%. This shows that the incremental gain in savings associated with delivering the reports every other month instead of quarterly is relatively small.

Wave One dual-fuel and electric-only customers have been receiving reports since March 2012. Dual-fuel customers saved 1.9%, on average, while electric-only customers saved 1.1%. The difference is explained in part by very small savings in August among electric-only customers. This is likely due to an extreme heat wave during the last week of the month.

Wave Two customers are divided into two groups, Area 7 and Non-Area 7. Customers in Area 7, located in north of the Bay Area (i.e., Humboldt, Mendocino, Lake, and Sonoma Counties primarily), were sampled separately because of concerns that they may respond differently to HERs than other customers. The program team anticipated that PG&E management may have excluded Area 7 from the Wave Two sample frame just prior to the launch of this wave. Both groups of Wave Two have been receiving reports since February 2013. The two groups had very similar electricity energy savings in 2016.

Wave Three customers have been receiving reports since July 2013. In 2016 they provided average monthly savings of 1.7%. The highest savings achieved by these customers was in May 2016 with a savings of 1.9%.

Wave Four customers began receiving reports in March 2014. In 2016 they provided monthly savings of 1.1%. Their highest savings of 1.3% was in May.

Wave Five customers have been receiving reports since October 2014. They provided an average monthly savings of 1.7%.

Wave Six customers have only been receiving reports since September 2015. Their average savings for the year was 0.8%.

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[3] Some electric-only customers have only electricity, while others have propane from a different supplier.

While percentage savings estimates provide context for understanding the magnitude of the impact of receiving HERs on individual customer electricity usage, the total monthly savings (kWh) show how actual savings by individual customers varies across the different waves. Table 2-6 displays the average monthly savings and average savings by month expressed in (kWh):[4]

Table 2-5 it is evident that Beta treatment customers save between 30% and 50% more energy than customers in other waves on a percentage basis. However, the average kWh saved by Beta customers is more than double that of customers in other waves. This result is expected, due to the relatively higher usage of Beta customers (all being in the highest quartile of energy consumption, as shown in Table 1-1) compared to the other recipients. In other words, because Beta customers use more electricity on average than the other wave customers, they have more opportunities to reduce their usage.

In real terms, Gamma standard frequency HER recipients save about 25% more on average than the Gamma reduced frequency HER recipients with 8.5 kWh in average monthly savings compared to 6.7 kWh. Gamma electric-only customers have an average monthly savings of 11.3 kWh.

Wave One electric-only customers provided greater kWh savings in the winter and fall. This is most likely due to increases in electric heating during the cooler months. Wave Six saw very small savings in the earlier months of 2016.

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[4] Because the energy usage profile of each wave varies, tables showing savings in percentage terms and in kWh terms will not show exactly the same patterns across months.

Table 2-6: Average per Customer Impact on Electricity Usage by Wave (kWh)

Month	Beta	Gamma			Wave One		Wave Two		Wave Three	Wave Four	Wave Five	Wave Six
		Dual		Electric-Only	Dual	Electric-Only	Not Area 7	Area 7				
		Standard	Reduced									
Jan-16	19.4	10.3	7.2	13.0	11.4	11.5	8.7	10.8	8.9	5.5	9.1	2.6
Feb-16	19.2	10.0	5.4	12.2	11.1	7.1	8.2	8.0	8.3	3.2	9.2	2.3
Mar-16	17.1	8.0	5.8	8.7	9.0	9.9	8.8	8.3	7.4	4.6	8.7	2.1
Apr-16	18.6	7.6	6.5	9.8	10.1	7.8	10.1	7.7	7.6	5.0	9.5	3.2
May-16	19.1	7.2	6.0	10.1	11.1	6.0	10.8	8.2	9.2	5.8	11.9	5.1
Jun-16	18.6	9.2	7.7	11.0	12.1	6.3	13.2	8.0	10.3	6.7	14.8	4.5
Jul-16	24.3	9.7	7.7	12.0	13.5	3.1	14.9	9.3	10.9	6.4	14.6	5.8
Aug-16	24.5	11.1	9.5	13.0	11.6	0.2	12.0	8.6	9.9	6.8	10.8	5.4
Sep-16	20.7	8.1	7.7	11.2	10.2	5.2	10.8	9.0	8.9	5.6	8.1	5.0
Oct-16	16.7	6.9	6.5	10.3	8.8	6.4	8.8	7.9	7.4	4.5	7.5	3.5
Nov-16	18.8	6.5	4.4	11.5	8.8	10.8	8.0	9.0	8.5	4.8	7.6	3.8
Dec-16	20.2	7.4	5.7	13.3	9.7	7.6	7.9	8.7	9.6	4.5	8.8	4.6
Avg.*	**19.7**	**8.5**	**6.7**	**11.3**	**10.6**	**6.9**	**10.2**	**8.6**	**8.9**	**5.3**	**10.0**	**4.0**

*Positive values indicates a real savings rate, negative values indicate a negative savings rate (greater usage by treatment customers than control customers).

2.3   Gas Savings Observed by Month

As with the electricity savings analysis, gas savings was assessed using both the average monthly impact by customer as well as the average raw energy consumption impact by customer by month. For every wave of the HER experiment that is currently out in the field, both real and percentage impacts increase over time with the first month's impacts yielding very low impacts compared to the average. Table 2-7 presents the average percentage impact by month and the average monthly impact through the end of 2016.

Table 2-7: Average Percentage Impact on Gas Usage by Wave

| Month | Beta | Gamma | | Wave One | Wave Two | | Wave Three | Wave Four | Wave Five | Wave Six |
| | | Dual | | Dual | Not Area 7 | Area 7 | | | | |
		Standard	Reduced							
Jan-16	1.2%	0.4%	0.9%	0.7%	0.8%	1.0%	0.7%	0.8%	0.6%	0.6%
Feb-16	1.4%	0.7%	1.0%	1.0%	0.9%	0.9%	1.3%	0.7%	0.7%	0.5%
Mar-16	1.2%	0.6%	1.0%	0.9%	1.0%	1.3%	0.9%	0.7%	0.8%	0.5%
Apr-16	1.5%	0.6%	0.5%	1.3%	0.9%	1.3%	1.0%	0.7%	0.8%	0.9%
May-16	1.2%	0.5%	0.6%	1.3%	0.8%	1.7%	1.0%	0.9%	1.1%	0.9%
Jun-16	1.3%	0.7%	0.2%	1.1%	0.9%	1.0%	0.9%	0.5%	1.0%	0.6%
Jul-16	1.2%	0.5%	0.3%	0.9%	1.1%	1.3%	1.3%	0.6%	0.7%	0.3%
Aug-16	1.1%	0.3%	0.1%	0.9%	1.2%	1.4%	0.8%	0.7%	0.6%	0.2%
Sep-16	0.8%	0.7%	0.3%	1.0%	0.9%	1.9%	1.1%	1.2%	-0.1%	0.5%
Oct-16	0.9%	0.8%	0.9%	1.4%	1.1%	2.1%	1.0%	1.2%	0.8%	0.6%
Nov-16	0.8%	0.3%	0.3%	1.4%	0.7%	1.2%	0.6%	1.1%	0.6%	0.5%
Dec-16	0.9%	0.2%	0.6%	0.7%	0.4%	0.7%	0.5%	0.9%	0.3%	0.4%
Avg.*	1.1%	0.5%	0.6%	1.0%	0.8%	1.2%	0.9%	0.8%	0.6%	0.5%

*Positive values indicates a real savings rate, negative values indicate a negative savings rate (greater usage by treatment customers than control customers).

The percentage gas savings per customer are much lower than electric savings across nearly all of the waves. As expected, higher percentage savings are observed during the colder winter months. Table 2-8 shows these savings in real (Therms) terms.

Table 2-8: Average per Customer Impact on Gas Usage by Wave (in Therms)

Month	Beta	Gamma Dual		Wave One Dual	Wave Two		Wave Three	Wave Four	Wave Five	Wave Six
		Standard	Reduced		Not Area 7	Area 7				
Jan-16	1.31	0.31	0.59	0.44	0.50	0.72	0.48	0.46	0.44	0.35
Feb-16	1.05	0.30	0.44	0.46	0.41	0.45	0.58	0.27	0.39	0.19
Mar-16	0.74	0.19	0.32	0.33	0.37	0.56	0.33	0.22	0.32	0.16
Apr-16	0.66	0.15	0.13	0.32	0.23	0.37	0.25	0.16	0.23	0.23
May-16	0.40	0.10	0.12	0.25	0.17	0.39	0.21	0.17	0.25	0.18
Jun-16	0.32	0.10	0.03	0.18	0.15	0.17	0.16	0.09	0.18	0.10
Jul-16	0.27	0.07	0.04	0.13	0.19	0.21	0.22	0.10	0.11	0.05
Aug-16	0.25	0.05	0.02	0.14	0.20	0.23	0.14	0.12	0.10	0.03
Sep-16	0.21	0.10	0.05	0.17	0.16	0.34	0.21	0.20	-0.01	0.09
Oct-16	0.31	0.15	0.17	0.27	0.22	0.49	0.22	0.24	0.19	0.13
Nov-16	0.62	0.13	0.11	0.56	0.29	0.56	0.26	0.41	0.32	0.19
Dec-16	1.24	0.14	0.45	0.56	0.27	0.55	0.38	0.59	0.30	0.26
Avg.*	**0.61**	**0.15**	**0.20**	**0.31**	**0.26**	**0.42**	**0.28**	**0.25**	**0.24**	**0.17**

*Positive values indicates a real savings rate, negative values indicate a negative savings rate (greater usage by treatment customers than control customers).

The Beta wave customers have significantly higher Therms savings per month than all of the other waves at 0.61 average Therms per month saved. Gamma Standard customers provide the least savings at 0.15 Therms per month, but this is likely due to the persistence study described in Section 4.

3   Demand Savings

The deployment of Smart Meter technology has enabled PG&E to collect electric usage data at one-hour intervals (interval data) for residential customers throughout its service territory (in actuality the system captures usage data at more frequent intervals, but one-hour interval data is stored for the majority of PG&E residential customers). In this section we document the demand savings of PG&E's Home Energy Reports program using hourly interval data obtained from PG&E's Smart Meter system for 2016. In this section we:

- Define Peak Megawatt Load Reduction (PMLR) as provided for in the Database for Energy Efficiency Resources (DEER, see http://deeresources.com/) since it will be used as a basis for the demand savings claim for HER.
- Describe the methodology used to estimate PMLR for HER using interval data, and
- Apply the methodology to estimate PMLR for summer 2016 to include in the HER savings claims.

Peak Megawatt Load Reduction (PMLR): The PMLR is the difference between the electricity demand of HER treated households and their expected demand had they not been treated during specific peak weather conditions. In this analysis, the peak periods are identified using the DEER definition of weather conditions that are expected to produce a regional grid peak event. The peak consists of the hours between 2 PM and 5 PM during a "heat wave" defined by three consecutive weekdays of especially warm weather conditions. A single extreme heat wave is identified for the PG&E territory. This particular heat wave is the period that contains the three consecutive weekdays for which the average daily temperature plus the average temperature between 12 PM and 6 PM plus maximum daily temperature is greater than that of all other consecutive three day intervals. Demand savings are also reported for the CAISO and PG&E system peak hours.

Methodology for Calculating Peak Megawatt Load Reduction for Home Energy Reports:
For the application of Home Energy Reports (HERs), aggregate peak demand reductions are defined as the difference between an aggregate reference load (from the HER control group) and the aggregate treatment group's average demand during the hours of 2 to 5 PM on the 2016 heat wave minus the difference between an aggregate reference load (from the HER control group) and the aggregate treatment group's average demand during the hours of 2 to 5 PM on the heat wave from the year prior to the onset of treatment. This procedure is known as a "difference-in-differences" estimate. Demand savings are estimated separately for each experimental wave. There are multiple steps involved in calculating PMLR:

1. Collect 60-minute kWh interval data from all PG&E residential customer households in the treatment and control conditions of the HER experiments in the field:
    a. During the hours comprising the "heat wave" defined using DEER's definition of a three-day heat wave for the calendar year of interest so that PMLR can be calculated.
    b. During the CAISO and PG&E system peak hours[5].

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[5] See Appendix A for savings estimates during the CAISO and PG&E system peak hours

     c. For the summer prior to the onset of treatment and the summer immediately after treatment began so that pre-existing differences between treatment and control groups can be used.

2. Calculate average per-household hourly impacts as the difference between average control and average treatment demand across the peak periods in 2016 minus the the difference between average control and average treatment demand across the peak periods in the first year prior to treatment for all customers in each experimental wave.

3. Report the aggregate kW impact contained in the "heat wave" date range and CAISO and PG&E system peak hours.

Calculation of Peak Megawatt Load Reduction for 2016: Using DEER's definition of a three-day heat wave, peak periods in 2016 were estimated for PG&E's territory using weather data provided by PG&E. This weather data consists of hourly temperature values for each weather station within PG&E's territory. There are many weather stations within the territory, so a weighted average of weather station temperatures was used to estimate hourly temperatures at the territory level. The weights used in this calculation are the number of residential PG&E customers residing in each weather station's area.

According to DEER, three-day peak periods must be non-holiday weekdays falling between June 1 and September 30. The heat waves have the highest value for average temperature over three consecutive weekdays days plus the average temperature from noon to 6 PM over the three days plus the peak temperature over the three days. Further details of DEER's definition can be found here:
http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf . Using this process, a three-day heat wave was determined for the PG&E territory. While residential customers experience multiple heat waves throughout the summer, there can only be one maximum heat wave. The goal is to estimate the heat wave that had the largest impact on the system as a whole. Using the foregoing definition of the DEER heatwave, the period from Tuesday, July 26 through Thursday, July 28, 2016 was identified as the peak heat wave in 2016.

To calculate peak demand savings, 60-minute interval data were collected for each treatment and control customer within each of the twelve HER experimental waves in field in summer, 2016. Note that Wave Two consists of two separate experiments with unique control groups since customers in PG&E Service Territory Area 7 (known as North Coast and comprised of Humboldt, Mendocino, and Lake Counties, as well as most of Sonoma County, and portions of Marin County) were added to the Wave Two Experiment relatively late in the launch process. The Gamma Wave and Wave One have separate treatment and control groups that consist of all-electric customers. Wave 7 had not been launched at this time.

In order to account for pre-existing differences in peak load consumption, a difference-in-differences approach was used to calculate peak demand savings. Average electric demand from 2 to 5 PM was calculated separately for the treatment and control customers in each experimental wave. Average per household demand reduction was estimated as the difference between average control and treatment usage across these hours. Using the DEER definition

of the annual peak period and data from PG&E's weather stations, peak periods were chosen by Nexant for 2011 through 2016. The peak heat wave for the PG&E territory was chosen to be the peak period of interest. For each experimental wave, the difference between treatment and control peak demand was estimated for the summer immediately prior to the onset of treatment and the current year (2016). The pre- and post-treatment differences are presented in Table 3-1. The pre-treatment period difference between treatment and control average customer demand from 2 to 5 PM is less than 0.01 kW for each experimental wave.

Table 3-1: Differences between Treatment and Control Peak Demand During Pre Treatment and Post Treatment Periods*

Experimental Wave	Treatment Period	Heatwave Start	Heatwave End	Avg. Control Demand 2-5 PM (kW)	Avg. Treatment Demand 2-5 PM (kW)	Difference (kW)	95% Confidence Interval	
Beta - Aug. 2011	Pre Treatment	20-Jun-11	22-Jun-11	2.81	2.81	0.00	-0.02	0.02
	Post Treatment	26-Jul-16	28-Jul-16	2.58	2.53	0.05	0.02	0.08
Gamma Standard - Nov. 2011	Pre Treatment	20-Jun-11	22-Jun-11	1.98	1.98	0.00	-0.02	0.01
	Post Treatment	26-Jul-16	28-Jul-16	2.00	1.99	0.01	-0.01	0.03
Gamma Electric - Nov. 2011	Pre Treatment	20-Jun-11	22-Jun-11	1.60	1.60	0.00	-0.02	0.02
	Post Treatment	26-Jul-16	28-Jul-16	1.76	1.74	0.02	-0.01	0.05
Gamma Reduced - Nov. 2011	Pre Treatment	20-Jun-11	22-Jun-11	1.98	1.97	0.01	-0.01	0.02
	Post Treatment	26-Jul-16	28-Jul-16	2.00	2.00	0.01	-0.02	0.03
Wave One - Feb. 2012	Pre Treatment	20-Jun-11	22-Jun-11	1.78	1.77	0.01	0.00	0.02
	Post Treatment	26-Jul-16	28-Jul-16	1.76	1.73	0.03	0.02	0.05
Wave One Electric - Feb. 2012	Pre Treatment	20-Jun-11	22-Jun-11	2.12	2.12	0.00	-0.03	0.03
	Post Treatment	26-Jul-16	28-Jul-16	2.24	2.25	-0.01	-0.07	0.04
Wave Two - Area 7 - Feb 2013	Pre Treatment	8-Aug-12	10-Aug-12	0.95	0.95	0.00	-0.01	0.01
	Post Treatment	26-Jul-16	28-Jul-16	0.93	0.90	0.03	0.01	0.04
Wave Two - Not Area 7 - Feb. 2013	Pre Treatment	8-Aug-12	10-Aug-12	1.48	1.48	0.00	-0.01	0.01
	Post Treatment	26-Jul-16	28-Jul-16	1.52	1.48	0.04	0.02	0.06
Wave Three - Jul. 2013	Pre Treatment	8-Aug-12	10-Aug-12	1.43	1.42	0.00	-0.01	0.01
	Post Treatment	26-Jul-16	28-Jul-16	1.48	1.45	0.02	0.01	0.04
Wave Four - Mar. 2014	Pre Treatment	1-Jul-13	3-Jul-13	1.63	1.63	0.00	-0.01	0.01
	Post Treatment	26-Jul-16	28-Jul-16	1.43	1.41	0.02	0.00	0.03
Wave Five - Oct. 2014	Pre Treatment	23-Jul-14	25-Jul-14	2.09	2.10	-0.01	-0.02	0.01
	Post Treatment	26-Jul-16	28-Jul-16	2.57	2.55	0.02	0.00	0.04
Wave Six - Sept. 2015	Pre Treatment	23-Jul-14	25-Jul-14	1.12	1.12	0.00	-0.01	0.01
	Post Treatment	26-Jul-16	28-Jul-16	1.47	1.44	0.02	0.01	0.04

* Rounding errors may make these small numbers misleading

Table 3-2 presents the values for peak heat wave period, July 26 through July 28 using the difference-in-difference estimation. Customers experienced temperatures of about 91 degrees Fahrenheit during the period. The peak reduction in 2016 was 34.4 MW. The peak reduction in 2015 was 36.4 MW, however Wave 6 customers did not contribute to the 2015 reduction. Additionally, the average tempereature during the peak period in 2015 was 96 degrees Fahrenheit, which is higher than 2016. This may partially explain why the aggregate reduction in 2016 is smaller than the aggregate reduction in 2015.

Customers in the Beta wave provided the greatest reductions: 0.05 kW per customer, on average. This is not surprising, as the Beta wave has been in the field for the longest period of time and includes larger energy users. Customers in the Beta, both Wave Two groups, and Wave 6 had percent impacts over 1.5%. The Gamma waves, and Wave One Electric customers did not produce statistically significant reductions. The Gamma waves include customers in the lowest quartile of energy usage, which could explain this result. These waves did not produce statistically significant reductions in 2015 as well.

Table 3-2: Peak Heat Wave Demand Reductions by Experimental Wave

Wave	Number of Control Residences	Number of Treated Residences	Control Load (kW)	Treatment Load (kW)	Impact (kW)	Percent Impact	95% Confidence Interval		Aggregate Impact (MW)	Temperature (F)
BETA	41,934	41,786	2.58	2.53	0.05	2.0%	0.03	0.08	2.2	92
GAMMA	48,423	48,401	2.00	1.99	0.01	0.6%	-0.01	0.03	0.6	96
GAMMA ELEC	23,998	24,103	1.76	1.74	0.02	1.2%	0.00	0.05	0.5	97
GAMMA REDUCED	48,423	48,203	2.00	2.00	0.00	0.0%	-0.02	0.02	0.0	96
WAVE 1	62,786	250,409	1.75	1.73	0.02	1.3%	0.01	0.03	5.7	91
WAVE 1 ELEC	5,835	23,297	2.24	2.25	-0.01	-0.6%	-0.06	0.03	-0.3	98
WAVE 2 AREA 7	37,050	59,314	0.93	0.90	0.03	2.9%	0.02	0.04	1.6	90
WAVE 2 NOT AREA 7	35,724	228,418	1.52	1.48	0.04	2.5%	0.02	0.05	8.7	87
WAVE 3	52,355	157,390	1.47	1.45	0.02	1.4%	0.01	0.03	3.3	88
WAVE 4	51,591	137,673	1.43	1.41	0.01	1.0%	0.00	0.03	1.9	89
WAVE 5	38,408	160,966	2.58	2.55	0.03	1.0%	0.01	0.04	4.1	97
WAVE 6	41,248	258,348	1.47	1.44	0.02	1.6%	0.01	0.04	6.0	89
Average/Total	487,775	1,438,308	1.71	1.69	0.02	1.4%	0.02	0.03	34.4	91

PG&E offers a variety of energy efficiency programs through which customers can receive rebates directly from PG&E for purchasing energy efficient equipment, such as installing a variable speed pool pump or purchasing a highly efficient refrigerator. Through a separate savings claim process, PG&E receives credit for the savings achieved through those programs. To estimate the overlap with these savings, kW savings for all measures installed under downstream PG&E programs were identified for both treatment and control group members using data contained in PG&E's MDSS system. The double counted demand savings were obtained by subtracting the control group downstream savings from the treatment group downstream savings for each measure. The adjustment to the aggregate demand reduction was estimated to be 0.1 MW. After this adjustment, the peak load reduction for the HER program is 33.4 MW. The aggregate demand impacts for the CAISO and PG&E system loak peaks can be found in Appendix A.

4 Persistence Study

PG&E's HER Persistence Study launched in May 2014. Customers in the Gamma Dual Standard experimental waves were randomly assigned to "Continued" and "Terminated" groups, the second of which did not receive any reports after the launch of the test. Among the two waves, 28,000 customers were assigned to the terminated group: 14,000 from Gamma Dual Standard and 14,000 from Gamma Dual Reduced. Gamma Standard customers receive reports every two months, while Gamma Reduced customers receive reports quarterly.

The methodology for estimating the persistence of HERs is similar to that used to measure energy savings for the program, but with one key difference. Rather than pre-treatment and post-treatment periods, the persistence model uses pre-termination and post-termination periods. The pre-termination period is defined to be the full year prior to the launch of the persistence study. Additionally, "treatment" in this case is defined to be the termination of receiving reports. The following model measures the difference in energy savings between the continued and terminated groups.

$$kWh_{it} = a + b_t + c_t \cdot termination_i + d \cdot pre\_termination\_kwh_{it} + e_t \cdot pre\_termination\_kwh_i + \varepsilon_{it}$$

Table 4-1: Lagged Dependent Variable Model Definitions

Variable	Definition
kWh_{it}	Customer i's usage in month t.
a	The constant on energy consumption.
b_t	The coefficient on the month and year indicator variable.
c_t	The coefficient on the month and year indicator variable for termination customers. This is the persistence effect for the particular month t.
$termination_i$	Termination indicator variable for customer i. Equal to 1 for terminated customers and 0 otherwise.
d	The coefficient on pre-termination consumption.
$pre\_termination\_kwh_{it}$	Pre-termination usage for customer i for month t. Pre-termination consumption for a particular month in the post termination period refers to the same calendar month in the pre-termination period.
e_t	The coefficient on pre-termination consumption for a particular month t.
ε_{it}	The error term.

The six tables and their associated figures below present electric energy savings estimates for terminated and continued customers for each year of the persistence study. The values presented in the "Energy Savings Impact for Terminated Group" column were measured using the model described above. The savings estimates for continued customers were measured using the model described in Section 2, with one small difference. The persistence test was limited to customers who were active at the time of random assignment to the terminated and continued groups. This filter has been applied to the continued group. As a result, the energy savings presented here differ slightly from those presented in the earlier sections.

4.1 Persistence of Electricity Savings

Table 4-2 through Table 4-4 summarize the persistence of electricity savings for the Gamma Standard Treatment group for each year of the experiment. In the first year of the study, the difference between the Continued and Terminated groups was about 22%. In other words, the savings from customers who had received HERs for approximately three years dropped by approximately 22% during the 12 months after which the treatment was withdrawn – however this difference was not statistically significant. Because of the seasonality of the trend in savings in electricity it is impossible to describe an orderly trend in the rate of decay in savings. Suffice it so say that the rate of decay was about 22% in the first year and increased to about 33% in the second year, followed by 67% in the third (which was statistically significant). So, the effect of treatment appears to persist for at least two years, and it is reasonable to assume it is decaying at the rate of about 20% per year for the first two years.

It is important to keep in mind that while the difference in savings between the Continued and Terminated groups appears to be material and is certainly substantively significant, the magnitude of the change in savings cannot be precisely estimated. This stems from the lack of statistical power in the test that was conducted. The annual savings impact of the Gamma Standard treatment is approximately 1.5% (see Table 2-5). This is a relatively subtle change in usage that requires a relatively large sample size (i.e., in excess of 10,000) to reliably detect. Removing treatment from 14,000 customers for 36 months reduces the treatment effect by about 67% in the third year. However, this relatively large change in the impact of the treatment is small compared to the variation in energy consumption across customers in the continued and terminated groups – on the order of 0.5%. The effect is statistically significant overall, but the confidence interval of the estimate is quite wide. Based on the width of the 90% confidence interval, we can say with reasonable confidence that the range of decay is between 13% and about 120% for the three year period.

Looking at the month to month trends in the difference in energy savings it is evident that the savings difference is not random. The savings from the terminated group are almost always smaller than they are for the continued group, so it is clear that the differences between the continued and terminated group are not random.

Significant differences in energy savings between the continued and terminated groups are indicated with an asterisk. On a monthly basis, only a few of the differences in savings are statistically significant and the difference in savings over the third year is statistically significant for Gamma Standard customers. However, the sample sizes are small and the confidence intervals are quite wide. In other words, it appears that a significant amount of the effect of HERs on electricity usage persists for at least 24 months after customers receive their last reports, but tapers off in the third year.

Figure 4-1: Gamma Standard – Persistence of Electric Savings

Table 4-2: Gamma Standard – Persistence Of Electric Savings – Year 1

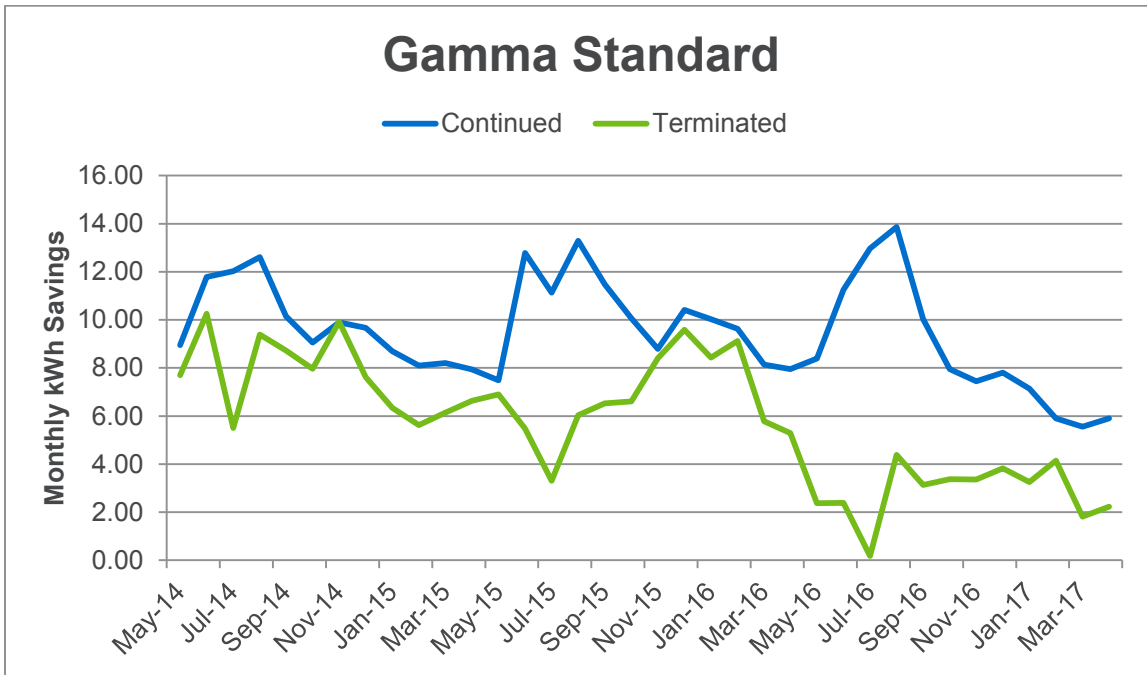| Month	Monthly kWh Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	**Terminated**					
May-14	8.94	7.70	1.24	-2.07	4.56	13.9%	
Jun-14	11.79	10.26	1.53	-2.50	5.56	13.0%	
Jul-14	12.03	5.50	6.53	2.07	11.00	54.3%	*
Aug-14	12.61	9.39	3.23	-1.07	7.53	25.6%	
Sep-14	10.15	8.72	1.43	-2.42	5.28	14.1%	
Oct-14	9.06	7.96	1.09	-1.98	4.17	12.1%	
Nov-14	9.90	9.92	-0.02	-3.00	2.97	-0.2%	
Dec-14	9.66	7.62	2.04	-0.98	5.06	21.1%	
Jan-15	8.69	6.33	2.36	-0.58	5.30	27.1%	
Feb-15	8.10	5.62	2.49	-0.86	5.83	30.7%	
Mar-15	8.21	6.14	2.07	-0.90	5.04	25.2%	
Apr-15	7.93	6.63	1.30	-2.22	4.83	16.4%	
Year 1	**9.78**	**7.67**	**2.12**	**-0.62**	**4.85**	**21.6%**	

Table 4-3: Gamma Standard – Persistence Of Electric Savings – Year 2

Month	Monthly kWh Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	Terminated					
May-15	7.48	6.90	0.58	-3.70	4.85	7.7%	
Jun-15	12.78	5.48	7.30	2.24	12.36	57.1%	*
Jul-15	11.14	3.30	7.84	2.68	13.00	70.4%	*
Aug-15	13.29	6.03	7.26	2.10	12.43	54.6%	*
Sep-15	11.48	6.53	4.95	0.36	9.54	43.1%	*
Oct-15	10.06	6.61	3.45	-0.39	7.29	34.3%	
Nov-15	8.79	8.41	0.38	-3.48	4.25	4.3%	
Dec-15	10.41	9.59	0.82	-3.06	4.70	7.9%	
Jan-16	10.03	8.42	1.60	-2.06	5.27	16.0%	
Feb-16	9.63	9.12	0.52	-3.45	4.48	5.4%	
Mar-16	8.13	5.78	2.35	-1.30	6.01	28.9%	
Apr-16	7.95	5.29	2.67	-1.70	7.04	33.5%	
Year 2	**10.14**	**6.75**	**3.38**	**-0.69**	**7.46**	**33.4%**	

Table 4-4: Gamma Standard – Persistence Of Electric Savings – Year 3

Month	Monthly kWh Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	Terminated					
May-16	8.38	2.38	6.01	0.78	11.23	71.6%	*
Jun-16	11.26	2.39	8.87	2.87	14.87	78.8%	*
Jul-16	12.97	0.17	12.80	6.33	19.26	98.7%	*
Aug-16	13.86	4.38	9.49	3.55	15.42	68.4%	*
Sep-16	10.03	3.13	6.89	2.24	11.55	68.7%	*
Oct-16	7.95	3.37	4.59	0.79	8.38	57.7%	*
Nov-16	7.45	3.36	4.09	0.11	8.07	54.9%	*
Dec-16	7.81	3.82	3.99	-0.39	8.37	51.1%	
Jan-17	7.14	3.25	3.89	-0.37	8.15	54.5%	
Feb-17	5.90	4.14	1.76	-2.81	6.33	29.8%	
Mar-17	5.56	1.82	3.74	-0.39	7.87	67.3%	
Apr-17	5.90	2.22	3.68	-1.07	8.43	62.4%	
Year 3	**8.77**	**2.87**	**5.90**	**1.16**	**10.64**	**67.3%**	*

Table 4-5 through Table 4-7 present the difference in electric savings for Gamma Reduced customers for each of the three years of the experiement. This group yielded an unexpected result in that terminated customers had greater savings than customers who continued to receive reports. This occurs during the warmer summer months, especially during the first two years of the study. It is important to note that this effect is only statistically significant for two months out of the entire three year period. It is also interesting that energy savings appear to decline for both groups, especially in the third year.

In the first year of the persistence study, customers in the terminated group had savings about 22% larger than those who continued to receive reports. This increase declined in the second year to 18% in the second year and 12% in the third.

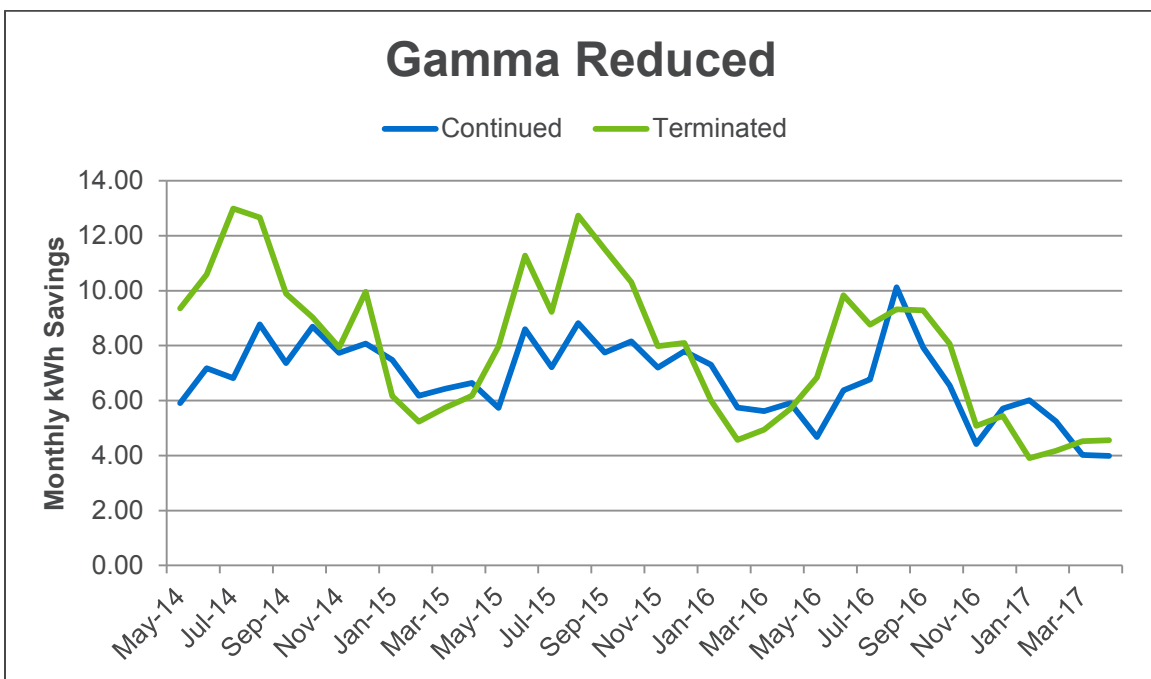**Figure 4-2: Gamma Reduced – Persitence of Electric Savings**

Table 4-5: Gamma Reduced – Persistence Of Electric Savings – Year 1

Month	Monthly kWh Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	Terminated					
May-14	5.91	9.35	-3.45	-6.82	-0.07	-58.4%	*
Jun-14	7.18	10.59	-3.41	-7.49	0.68	-47.4%	
Jul-14	6.82	12.99	-6.17	-10.44	-1.90	-90.4%	*
Aug-14	8.77	12.66	-3.89	-7.87	0.09	-44.3%	
Sep-14	7.36	9.90	-2.54	-6.11	1.03	-34.5%	
Oct-14	8.70	9.03	-0.34	-3.07	2.40	-3.9%	
Nov-14	7.73	7.93	-0.20	-2.62	2.22	-2.6%	
Dec-14	8.07	9.97	-1.89	-4.69	0.90	-23.5%	
Jan-15	7.48	6.16	1.32	-1.34	3.98	17.7%	
Feb-15	6.18	5.23	0.95	-1.67	3.57	15.4%	
Mar-15	6.43	5.75	0.69	-1.89	3.26	10.7%	
Apr-15	6.65	6.17	0.48	-2.52	3.48	7.2%	
Year 1	**7.29**	**8.88**	**-1.59**	**-4.00**	**0.82**	**-21.8%**	

Table 4-6: Gamma Reduced – Persistence Of Electric Savings – Year 2

Month	Monthly kWh Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact
	Continued	Terminated				
May-15	5.73	7.98	-2.25	-6.20	1.70	-39.2%
Jun-15	8.60	11.28	-2.68	-7.53	2.17	-31.1%
Jul-15	7.21	9.23	-2.02	-7.00	2.96	-28.0%
Aug-15	8.82	12.73	-3.92	-8.72	0.88	-44.4%
Sep-15	7.75	11.51	-3.76	-8.00	0.49	-48.5%
Oct-15	8.16	10.32	-2.16	-5.69	1.38	-26.4%
Nov-15	7.20	7.98	-0.78	-4.28	2.71	-10.9%
Dec-15	7.79	8.09	-0.30	-3.94	3.34	-3.9%
Jan-16	7.31	6.01	1.30	-2.10	4.71	17.8%
Feb-16	5.75	4.57	1.17	-2.46	4.81	20.4%
Mar-16	5.62	4.94	0.68	-2.74	4.10	12.1%
Apr-16	5.91	5.70	0.20	-3.59	3.99	3.4%
Year 2	**7.19**	**8.46**	**-1.27**	**-4.81**	**2.27**	**-17.7%**

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Table 4-7: Gamma Reduced – Persistence Of Electric Savings – Year 3

Month	Monthly kWh Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact
	Continued	Terminated				
May-16	4.67	6.85	-2.18	-6.89	2.54	-46.7%
Jun-16	6.37	9.84	-3.46	-9.01	2.08	-54.3%
Jul-16	6.77	8.76	-2.00	-8.10	4.11	-29.5%
Aug-16	10.13	9.32	0.81	-4.71	6.33	8.0%
Sep-16	7.94	9.28	-1.35	-5.65	2.95	-17.0%
Oct-16	6.55	8.06	-1.52	-4.89	1.85	-23.2%
Nov-16	4.42	5.08	-0.67	-4.16	2.83	-15.1%
Dec-16	5.71	5.44	0.27	-3.59	4.13	4.7%
Jan-17	6.02	3.90	2.11	-1.67	5.90	35.1%
Feb-17	5.24	4.17	1.07	-2.83	4.98	20.5%
Mar-17	4.02	4.52	-0.51	-4.07	3.05	-12.6%
Apr-17	3.99	4.55	-0.56	-4.49	3.36	-14.1%
Year 3	**6.02**	**6.53**	**-0.71**	**-4.77**	**3.36**	**-11.7%**

4.2 Persistence of Gas Savings

The following tables and figures present the impacts of the persistence test on gas consumption. Once again, significant impacts are highlighted with an asterisk. Table 4-8 indicates that savings declined by about 54% for Gamma Standard customers who no longer receive HERs during the firt year of this experiment. This grows to 85% in the second year, then back down to 78% in the third. The impacts in the first and second year are statistically significant, but the impact in the third year is not. The declines in gas savings are much higher in winter months than they are during other times of the year. It is reasonable to conclude from this result that removal of treatment from gas customers who are receiving the standard treatment (i.e., six reports per year) results in significant deterioration in the effect. The impact of removing treatment is statistically significant in many of the cooler months. However, it is important to bear in mind that the impact of the standard treatment on gas consumption is very small and as a consequence the range of statistical error around the estimate of the decline in impact is very large. The confidence interval for the overall decline in the effect ranges from about negative 8% to 164% in the third year. So, while it is safe to conclude that the effect does not persist, it is really impossible to precisely state how quickly it is dissipating from the results of this experiment.

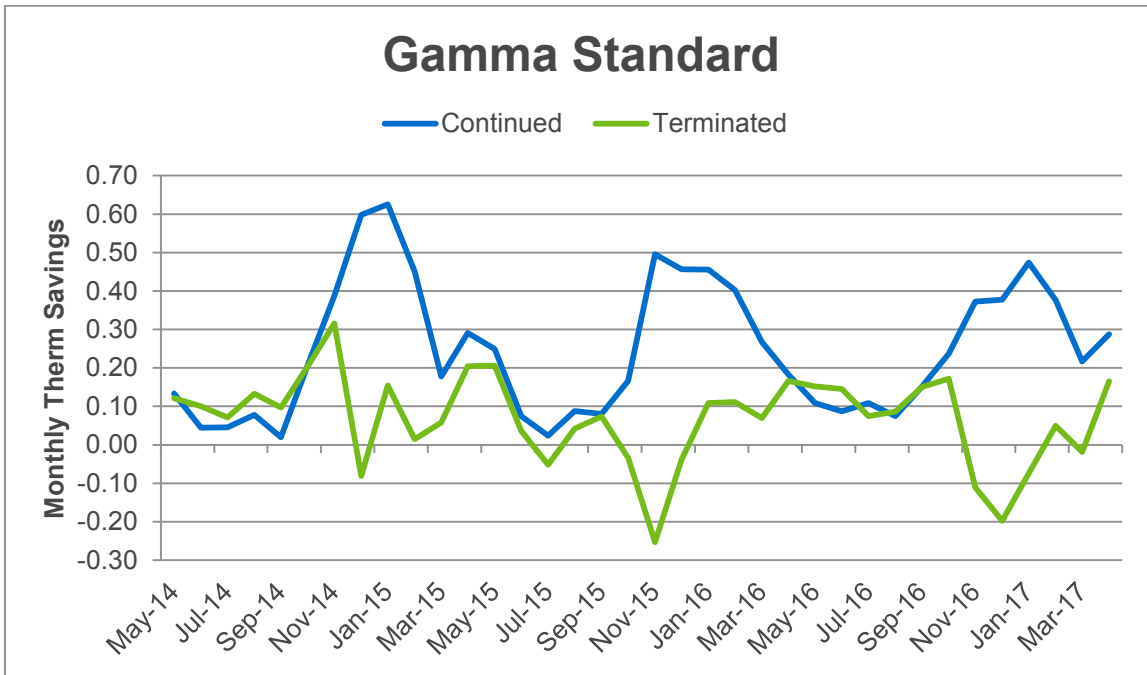**Figure 4-3: Gamma Standard – Persistence of Gas Savings**

Table 4-8: Gamma Standard – Persistence Of Gas Savings – Year 1

Month	Monthly Therm Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	Terminated					
May-14	0.13	0.12	0.01	-0.10	0.13	9.4%	
Jun-14	0.04	0.10	-0.06	-0.17	0.06	-124.6%	
Jul-14	0.05	0.07	-0.03	-0.13	0.08	-56.4%	
Aug-14	0.08	0.13	-0.05	-0.15	0.05	-70.3%	
Sep-14	0.02	0.10	-0.08	-0.20	0.04	-393.9%	
Oct-14	0.21	0.20	0.00	-0.13	0.14	1.8%	
Nov-14	0.39	0.32	0.07	-0.18	0.32	18.5%	
Dec-14	0.60	-0.08	0.68	0.34	1.02	113.5%	*
Jan-15	0.63	0.15	0.47	0.16	0.79	75.4%	*
Feb-15	0.45	0.01	0.44	0.20	0.67	96.8%	*
Mar-15	0.18	0.06	0.12	-0.05	0.29	67.6%	
Apr-15	0.29	0.20	0.09	-0.07	0.24	29.7%	
Year 1	**0.25**	**0.12**	**0.13**	**0.02**	**0.25**	**53.8%**	*

Table 4-9: Gamma Standard – Persistence Of Gas Savings – Year 2

Month	Monthly Therm Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	Terminated					
May-15	0.25	0.21	0.04	-0.13	0.22	17.4%	
Jun-15	0.07	0.04	0.04	-0.08	0.16	51.2%	
Jul-15	0.02	-0.05	0.08	-0.03	0.18	318.6%	
Aug-15	0.09	0.04	0.05	-0.07	0.16	51.7%	
Sep-15	0.08	0.07	0.01	-0.11	0.13	8.2%	
Oct-15	0.17	-0.03	0.20	0.04	0.36	120.4%	*
Nov-15	0.50	-0.25	0.75	0.39	1.11	151.1%	*
Dec-15	0.46	-0.04	0.49	0.06	0.93	108.4%	*
Jan-16	0.46	0.11	0.35	-0.05	0.75	76.2%	
Feb-16	0.40	0.11	0.29	0.00	0.58	72.4%	
Mar-16	0.27	0.07	0.20	-0.02	0.41	73.9%	
Apr-16	0.18	0.17	0.02	-0.15	0.18	8.8%	
Year 2	**0.24**	**0.04**	**0.20**	**0.04**	**0.37**	**84.9%**	*

Table 4-10: Gamma Standard – Persistence Of Gas Savings – Year 3

Month	Monthly Therm Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	Terminated					
May-16	0.11	0.15	-0.04	-0.20	0.11	-39.0%	
Jun-16	0.09	0.15	-0.06	-0.19	0.07	-67.3%	
Jul-16	0.11	0.07	0.03	-0.10	0.17	31.4%	
Aug-16	0.07	0.09	-0.01	-0.15	0.13	-16.3%	
Sep-16	0.15	0.15	0.00	-0.14	0.14	0.4%	
Oct-16	0.24	0.17	0.06	-0.10	0.23	27.4%	
Nov-16	0.37	-0.11	0.48	0.18	0.79	129.7%	*
Dec-16	0.38	-0.20	0.57	0.10	1.04	152.3%	*
Jan-17	0.47	-0.07	0.55	0.04	1.05	115.7%	*
Feb-17	0.38	0.05	0.33	-0.07	0.73	86.9%	
Mar-17	0.22	-0.02	0.24	-0.05	0.52	108.5%	
Apr-17	0.29	0.17	0.12	-0.10	0.34	42.5%	
Year 3	**0.23**	**0.05**	**0.18**	**-0.02**	**0.38**	**78.3%**	

Table 4-11 through Table 4-13 display the difference in gas savings for Gamma Reduced customers who continued and were terminated from treatment. Gas savings reduced by about

25% during the first year of the experiment, 28% during the second year, and 47% during the third. However, this reduction is not statistically significant in any year, again because of the relatively small magnitude of gas savings per customer (i.e., < 0.2 therms per month). Moreover, unlike the dissipation observed for the Gamma Standard group, there is no apparent seasonality in the change in savings. That is, reductions in savings are not occurring at higher levels in winter months.

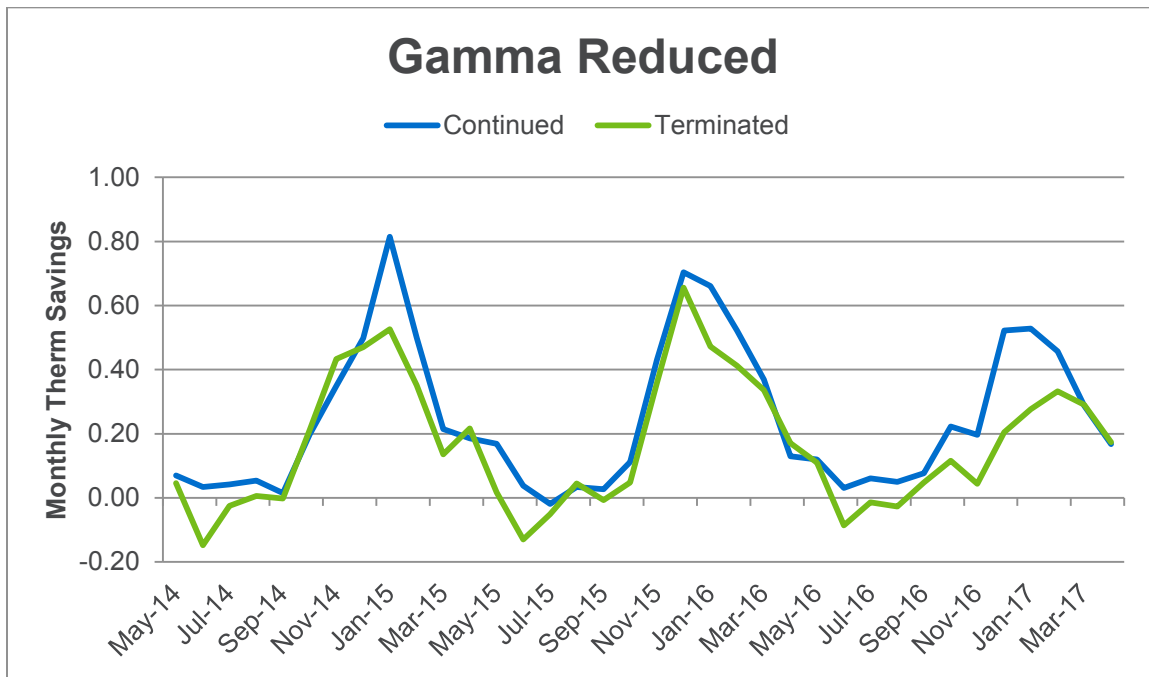**Figure 4-4: Gamma Reduced – Persistence of Gas Savings**

Table 4-11: Gamma Reduced – Persistence Of Gas Savings – Year 1

Month	Monthly Therm Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	Terminated					
May-14	0.07	0.05	0.02	-0.11	0.16	33.8%	
Jun-14	0.03	-0.15	0.18	0.05	0.32	535.9%	*
Jul-14	0.04	-0.02	0.07	-0.05	0.18	159.8%	
Aug-14	0.05	0.01	0.05	-0.08	0.17	88.4%	
Sep-14	0.01	0.00	0.02	-0.11	0.15	113.5%	
Oct-14	0.20	0.21	-0.01	-0.15	0.12	-6.9%	
Nov-14	0.35	0.43	-0.08	-0.33	0.16	-23.9%	
Dec-14	0.50	0.47	0.03	-0.32	0.37	5.6%	
Jan-15	0.81	0.53	0.29	-0.04	0.61	35.4%	
Feb-15	0.50	0.35	0.15	-0.10	0.39	29.6%	
Mar-15	0.21	0.14	0.08	-0.10	0.26	36.9%	
Apr-15	0.19	0.22	-0.03	-0.21	0.14	-16.9%	
Year 1	**0.24**	**0.18**	**0.06**	**-0.06**	**0.19**	**25.4%**	

Table 4-12: Gamma Reduced – Persistence Of Gas Savings – Year 2

Month	Monthly Therm Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact	
	Continued	Terminated					
May-15	0.17	0.02	0.15	-0.04	0.35	90.0%	
Jun-15	0.04	-0.13	0.17	0.04	0.30	444.3%	*
Jul-15	-0.02	-0.05	0.03	-0.09	0.15	-163.5%	
Aug-15	0.03	0.04	-0.01	-0.13	0.11	-31.1%	
Sep-15	0.03	-0.01	0.03	-0.10	0.17	126.4%	
Oct-15	0.11	0.05	0.06	-0.10	0.23	57.0%	
Nov-15	0.43	0.36	0.07	-0.29	0.43	16.7%	
Dec-15	0.70	0.66	0.05	-0.39	0.49	6.8%	
Jan-16	0.66	0.47	0.19	-0.21	0.59	28.6%	
Feb-16	0.52	0.41	0.11	-0.18	0.40	21.1%	
Mar-16	0.37	0.34	0.03	-0.19	0.26	9.0%	
Apr-16	0.13	0.17	-0.04	-0.22	0.14	-31.6%	
Year 2	**0.26**	**0.19**	**0.07**	**-0.10**	**0.24**	**27.6%**	

Table 4-13: Gamma Reduced – Persistence Of Gas Savings – Year 3

Month	Monthly Therm Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact
	Continued	Terminated				
May-16	0.12	0.11	0.01	-0.16	0.18	8.3%
Jun-16	0.03	-0.09	0.12	-0.04	0.27	380.2%
Jul-16	0.06	-0.01	0.07	-0.08	0.23	122.4%
Aug-16	0.05	-0.03	0.08	-0.08	0.23	153.2%
Sep-16	0.08	0.05	0.03	-0.14	0.20	37.4%
Oct-16	0.22	0.12	0.11	-0.07	0.28	48.0%
Nov-16	0.20	0.04	0.15	-0.16	0.46	77.4%
Dec-16	0.52	0.20	0.32	-0.15	0.79	60.9%
Jan-17	0.53	0.28	0.25	-0.24	0.74	47.7%
Feb-17	0.46	0.33	0.12	-0.28	0.52	27.2%
Mar-17	0.29	0.29	0.00	-0.30	0.29	-0.9%
Apr-17	0.17	0.17	-0.01	-0.24	0.23	-3.2%
Year 3	**0.22**	**0.12**	**0.10**	**-0.10**	**0.31**	**46.7%**

5   Electronic HERs

In April 2014, approximately 220,000 HER recipients in Wave One, Wave Two, and Wave Three began receiving electronic HERs (eHERs) in addition to paper HERs (the treatment group). These households receive eHERs on the months that they do not receive paper reports (i.e., every other month), so that customers receiving eHERs are receiving 12 reports per year in effect. eHERs were withheld from a sample of 81,000 HER recipients in the same experimental waves (the baseline group), thereby allowing for the measurement of the incremental effect of eHERs (as compared to the effect of HERs alone). Additionally, a sample of 72,000 non-recipient households served as a control group (for purposes of measuring energy savings). All three samples consist of PG&E customers who are eligible to receive e-mails from PG&E. These customers have slightly higher electricity consumption than customers for whom PG&E does not have email addresses so the results reported in this section are not directly comparable to those reported in Section 2. Table 5-1 presents the number of customers in the baseline, treatment and control groups by experimental wave.

Table 5-1: eHER Households by Experimental Wave

Experimental Wave	Baseline	Treatment	Control
Wave One	21,367	93,500	28,348
Wave Two	20,850	82,500	16,111
Wave Three	39,041	44,000	27,697

The methodology for estimating the incremental savings of eHERs is identical to that used to measure energy impacts of the persistence test. The pre-treatment period is defined to be the full year prior to the launch of eHERs. This methodology requires at least one year of HER treatment data prior to the introduction of eHERs. The latest wave - Wave Three - was launched in July 2013 so there is not a full year of HER treatment data prior to the introduction of eHERs to estimate the incremental savings.

Table 5-2 and Table 5-3 display the electric energy savings estimates for the baseline and eHER treatment groups for waves One and Two respectively. The overall incremental impacts for receiving eHERs in addition to paper reports are not statistically signicant for either group. In other words, the addition of eHERs for the months where customers would have not received any report does not add any additional savings to their overall savings. However, it is important to note that there is considerable month to month variation in the impacts observed in both tables with no clear seasonal trend. In the end, again because of the small magnitude of the initial energy savings and (i.e., ~1.9%) and the significant variation in energy savings between customers the difference in savings for those who received eHERs and those who did not is not statistically significant overall.

PG&E has not tested the impact of sending only eHERs to customers, but this idea has been tested elsewhere. The savings achieved by eHERs alone is smaller than those achieved by paper HERs, but this varies by geographic location.

Table 5-2: Wave One Electric Energy Savings – eHER Recipient vs. Baseline

Month	Monthly kWh Energy Savings		Energy Savings Increase for eHER group	90% Conf. Interval		Percent Savings Increase
	No eHER (Baseline)	eHER Recipient				
May-14	4.7	5.3	0.6	-1.8	2.9	12%
Jun-14	2.1	1.6	-0.5	-3.3	2.4	-23%
Jul-14	1.9	4.6	2.7	-0.4	5.9	142%
Aug-14	2.2	2.8	0.5	-2.3	3.4	24%
Sep-14	5.6	5.3	-0.3	-2.9	2.3	-5%
Oct-14	3.0	3.4	0.4	-1.7	2.5	14%
Nov-14	4.5	4.6	0.1	-1.9	2.0	1%
Dec-14	7.3	7.1	-0.2	-2.4	2.0	-3%
Jan-15	5.4	6.1	0.7	-1.4	2.9	14%
Feb-15	3.9	5.4	1.5	-0.7	3.6	38%
Mar-15	2.0	2.2	0.2	-1.8	2.3	11%
Apr-15	0.5	2.0	1.5	-1.3	4.2	266%
May-15	1.8	3.4	1.6	-1.4	4.6	89%
Jun-15	4.9	4.7	-0.2	-3.7	3.3	-4%
Jul-15	3.8	7.3	3.5	0.0	7.1	94%
Aug-15	1.8	6.3	4.4	0.9	8.0	241%
Sep-15	3.8	5.8	2.0	-1.2	5.2	53%
Oct-15	4.1	4.4	0.3	-2.4	3.0	8%
Nov-15	4.6	5.5	0.9	-1.8	3.5	18%
Dec-15	7.0	6.3	-0.7	-3.5	2.0	-10%
Jan-16	7.6	8.9	1.3	-1.4	3.9	17%
Feb-16	5.6	6.5	0.9	-1.8	3.7	17%
Mar-16	3.1	3.9	0.8	-1.8	3.4	27%
Apr-16	4.4	3.7	-0.7	-3.9	2.6	-15%
May-16	6.6	6.4	-0.2	-3.8	3.4	-4%
Jun-16	6.7	5.5	-1.3	-5.5	3.0	-19%
Jul-16	8.8	8.2	-0.7	-5.2	3.9	-8%
Aug-16	7.9	5.8	-2.1	-6.2	2.1	-26%
Sep-16	4.5	5.7	1.2	-2.2	4.5	26%
Oct-16	3.8	3.9	0.1	-2.5	2.8	3%
Nov-16	6.1	6.8	0.7	-2.1	3.5	12%
Dec-16	6.8	7.1	0.3	-2.8	3.4	4%
Average	**4.7**	**5.3**	**0.6**	**-1.3**	**2.5**	**13%**

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Table 5-3: Wave Two Electric Energy Savings – eHER Recipient vs. Baseline

Month	Monthly kWh Energy Savings		Energy Savings Increase for eHER group	90% Conf. Interval		Percent Savings Increase
	No eHER (Baseline)	eHER Recipient				
May-14	5.7	3.6	-2.1	-4.7	0.4	-38%
Jun-14	6.6	4.6	-2.0	-4.9	0.9	-30%
Jul-14	5.8	6.1	0.3	-2.7	3.4	5%
Aug-14	6.5	7.2	0.6	-2.2	3.5	10%
Sep-14	4.9	5.3	0.4	-2.3	3.0	8%
Oct-14	3.9	3.4	-0.5	-2.8	1.7	-14%
Nov-14	5.8	4.6	-1.3	-3.4	0.9	-22%
Dec-14	8.3	6.4	-1.9	-4.3	0.4	-23%
Jan-15	6.7	5.8	-0.8	-3.2	1.5	-13%
Feb-15	6.1	6.3	0.2	-2.0	2.4	3%
Mar-15	3.4	3.8	0.4	-1.7	2.5	11%
Apr-15	3.6	4.1	0.5	-2.4	3.5	15%
May-15	3.5	4.5	1.0	-2.0	4.0	29%
Jun-15	6.1	8.3	2.2	-1.3	5.8	37%
Jul-15	6.5	7.8	1.3	-2.3	4.9	20%
Aug-15	8.5	11.4	2.9	-0.7	6.5	34%
Sep-15	7.3	8.6	1.3	-1.8	4.4	17%
Oct-15	7.9	8.3	0.4	-2.3	3.1	5%
Nov-15	8.1	7.2	-1.0	-3.7	1.7	-12%
Dec-15	7.8	8.6	0.8	-2.0	3.7	11%
Jan-16	8.2	8.8	0.5	-2.2	3.3	7%
Feb-16	6.0	6.8	0.8	-2.1	3.6	13%
Mar-16	5.7	6.7	1.0	-1.6	3.6	17%
Apr-16	7.1	7.7	0.6	-2.7	3.8	8%
May-16	7.9	9.2	1.3	-2.3	4.8	16%
Jun-16	11.1	12.6	1.6	-2.6	5.7	14%
Jul-16	10.4	13.6	3.3	-1.1	7.6	32%
Aug-16	9.9	11.7	1.8	-2.2	5.9	19%
Sep-16	9.7	10.5	0.8	-2.5	4.1	8%
Oct-16	8.5	10.7	2.2	-0.6	4.9	26%
Nov-16	9.5	10.1	0.6	-2.3	3.5	6%
Dec-16	8.9	11.2	2.3	-0.9	5.5	26%
Average	**5.4**	**5.9**	**0.5**	**-1.4**	**2.4**	**8%**

The following tables present the estimated incremental gas savings for Wave One and Wave Two. eHERs sent to customers in Wave One resulted in significant incremental gas savings when looking at the entire 32 month period. On average, Wave One customers receiving eHERs saved an additional 0.12 therms each month compared to Wave One customers not receiving eHERs. While Table 5-5 shows negative percent savings this result is statistically insignificant as well as almost all of the monthly results for Wave Two gas eHER incremental savings. The outrageously high percent savings values in both Table 5-4 and Table 5-5 are due to statistically insigicant estimates in either the baseline or eHER recipient results.

Table 5-4: Wave One Gas Energy Savings – eHER Recipient vs. Baseline

Month	Monthly Therm Energy Savings		Energy Savings Increase for eHER group	90% Conf. Interval		Percent Savings Increase
	No eHER (Baseline)	eHER Recipient				
May-14	0.35	0.29	-0.06	-0.16	0.04	-16%
Jun-14	0.27	0.27	-0.01	-0.10	0.09	-2%
Jul-14	0.25	0.28	0.03	-0.07	0.12	12%
Aug-14	0.22	0.25	0.03	-0.05	0.11	12%
Sep-14	0.23	0.23	0.01	-0.08	0.10	4%
Oct-14	0.22	0.25	0.03	-0.07	0.12	12%
Nov-14	0.43	0.57	0.15	-0.03	0.33	35%
Dec-14	0.32	0.57	0.25	0.00	0.50	77%
Jan-15	0.22	0.62	0.40	0.17	0.64	185%
Feb-15	0.57	0.72	0.15	-0.02	0.31	25%
Mar-15	0.46	0.44	-0.02	-0.15	0.11	-3%
Apr-15	0.41	0.47	0.05	-0.08	0.19	13%
May-15	0.12	0.25	0.13	-0.01	0.27	106%
Jun-15	0.15	0.19	0.05	-0.05	0.14	32%
Jul-15	0.18	0.22	0.05	-0.04	0.13	26%
Aug-15	0.17	0.26	0.09	0.00	0.18	53%
Sep-15	0.17	0.27	0.10	0.01	0.19	59%
Oct-15	0.15	0.21	0.06	-0.06	0.18	39%
Nov-15	0.75	0.94	0.19	-0.06	0.44	26%
Dec-15	0.33	0.57	0.24	-0.07	0.55	72%
Jan-16	0.24	0.57	0.33	0.04	0.61	136%
Feb-16	0.54	0.74	0.20	0.00	0.40	38%
Mar-16	0.37	0.49	0.11	-0.05	0.28	31%
Apr-16	0.35	0.50	0.15	0.00	0.29	41%
May-16	0.27	0.40	0.13	0.00	0.25	48%
Jun-16	0.23	0.38	0.15	0.04	0.27	67%
Jul-16	0.18	0.29	0.11	-0.01	0.22	58%
Aug-16	0.15	0.28	0.13	0.03	0.24	87%
Sep-16	0.12	0.29	0.17	0.06	0.28	139%
Oct-16	0.02	0.25	0.24	0.11	0.37	1505%
Nov-16	0.40	0.63	0.22	0.00	0.44	55%
Dec-16	-0.02	0.32	0.34	0.00	0.68	-1860%
Average	**0.32**	**0.44**	**0.12**	**0.05**	**0.20**	**39%**

Table 5-5: Wave Two Gas Energy Savings – eHER Recipient vs. Baseline

Month	Monthly Therm Energy Savings		Energy Savings Increase for eHER group	90% Conf. Interval		Percent Savings Increase
	No eHER (Baseline)	eHER Recipient				
May-14	0.15	0.09	-0.06	-0.17	0.05	-38%
Jun-14	0.16	0.07	-0.09	-0.19	0.01	-56%
Jul-14	0.14	0.13	-0.01	-0.10	0.08	-5%
Aug-14	0.08	0.04	-0.04	-0.13	0.05	-46%
Sep-14	0.05	0.07	0.02	-0.08	0.12	49%
Oct-14	0.13	0.10	-0.02	-0.13	0.08	-18%
Nov-14	0.37	0.28	-0.10	-0.28	0.09	-26%
Dec-14	0.17	0.09	-0.07	-0.33	0.19	-44%
Jan-15	0.31	0.04	-0.28	-0.51	-0.04	-89%
Feb-15	0.53	0.50	-0.03	-0.21	0.14	-7%
Mar-15	0.32	0.39	0.06	-0.07	0.19	19%
Apr-15	0.34	0.28	-0.06	-0.20	0.09	-17%
May-15	0.29	0.21	-0.08	-0.22	0.07	-27%
Jun-15	0.13	0.15	0.03	-0.08	0.13	21%
Jul-15	0.15	0.14	0.00	-0.10	0.09	-1%
Aug-15	0.16	0.14	-0.03	-0.13	0.07	-17%
Sep-15	0.20	0.19	-0.01	-0.11	0.09	-5%
Oct-15	0.15	0.10	-0.05	-0.17	0.07	-34%
Nov-15	0.62	0.39	-0.23	-0.49	0.03	-37%
Dec-15	0.25	-0.07	-0.32	-0.64	0.00	-129%
Jan-16	0.34	-0.20	-0.54	-0.84	-0.25	-159%
Feb-16	0.33	0.06	-0.27	-0.48	-0.06	-81%
Mar-16	0.17	0.14	-0.04	-0.21	0.14	-21%
Apr-16	0.17	0.11	-0.06	-0.21	0.09	-35%
May-16	0.09	0.09	-0.01	-0.15	0.14	-6%
Jun-16	0.10	0.12	0.01	-0.11	0.14	11%
Jul-16	0.16	0.17	0.01	-0.11	0.13	6%
Aug-16	0.16	0.14	-0.02	-0.15	0.11	-12%
Sep-16	0.09	0.09	0.00	-0.14	0.14	0%
Oct-16	0.08	0.07	-0.01	-0.16	0.15	-11%
Nov-16	0.48	0.39	-0.09	-0.32	0.15	-18%
Dec-16	0.38	0.02	-0.36	-0.71	0.00	-95%
Average	**0.25**	**0.17**	**-0.08**	**-0.17**	**0.00**	**-33%**

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

The PG&E system peak occurred on July 27th during the hour from 5 PM to 6 PM. The temperatures were slightly cooler than those during the CAISO peak and HER recipients provided a lower reduction of 35.9 MW during this peak.

Table A-2: PG&E System Peak Demand Reductions by Experimental Wave

Wave	Number of Control Residences	Number of Treated Residences	Control Load (kW)	Treatment Load (kW)	Impact (kW)	Percent Impact	95% Confidence Interval		Aggregate Impact (MW)	Temperature (F)
BETA	41,927	41,774	3.18	3.14	0.04	1.4%	0.01	0.08	1.9	93
GAMMA	48,410	48,384	2.43	2.42	0.01	0.4%	-0.02	0.04	0.4	97
GAMMA ELEC	23,996	24,093	2.09	2.06	0.03	1.2%	-0.01	0.06	0.6	98
GAMMA REDUCED	48,410	48,197	2.43	2.42	0.01	0.6%	-0.01	0.04	0.7	97
WAVE 1	62,770	250,356	2.19	2.15	0.04	1.8%	0.02	0.06	9.9	92
WAVE 1 ELEC	5,835	23,285	2.69	2.70	-0.01	-0.2%	-0.07	0.05	-0.2	98
WAVE 2 AREA 7	37,043	59,307	1.19	1.16	0.03	2.3%	0.01	0.05	1.6	86
WAVE 2 NOT AREA 7	35,719	228,372	1.88	1.85	0.03	1.8%	0.01	0.06	7.8	86
WAVE 3	52,342	157,352	1.83	1.81	0.02	1.3%	0.01	0.04	3.9	87
WAVE 4	51,571	137,643	1.72	1.71	0.01	0.7%	-0.01	0.03	1.6	88
WAVE 5	38,396	160,911	3.09	3.08	0.01	0.4%	-0.01	0.04	1.9	98
WAVE 6	41,229	258,230	1.78	1.76	0.02	1.3%	0.00	0.04	5.8	89
Average/Total	487,648	1,437,904	2.10	2.07	0.02	1.2%	0.02	0.03	35.9	91