



**2015 Energy Efficiency Savings Estimates
Pacific Gas and Electric Company
Home Energy Reports Program
Nexant, 12/11/2017
CALMAC ID PGE0447**

1 Background and Methodology for Estimating Energy Savings Claims

Nexant completed estimates of energy savings resulting from Pacific Gas and Electric Company’s Home Energy Reports (HERs) Program for 2015 as part of its contract to provide early measurement and verification (early M&V) of the HERs Program for the 2013-2015 cycle. 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). A separate Nexant memo documents the methodology, calculations, and resulting estimates for Peak Megawatt Load Reduction resulting from the HER program for 2015.

The methodology used to estimate energy savings resulting from HERs is slightly different from that used by Nexant in 2014. 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.

$$kWh_{it} = a + b_t + c_t \cdot treatment_i + d \cdot pretreatment_kwh_{it} + e_t \cdot pretreatment_kwh_i + \varepsilon_{it}$$

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 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 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 2-1. The table displays the estimated HER impact before and after removing electric savings that we believe may have been double counted.

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.



Table 2-1: January 2015 through December 2015 HER Savings

Experimental Wave		Electric (in GWh)	Standard Error	Gas (in ,000 thms)	Standard Error	
Beta		10.0	1.0	327	57	
Gamma	Dual	Standard	5.7	0.8	125	36
		Reduced	4.9	0.8	144	36
	Electric-Only		3.4	0.5	–	–
	Gas-Only		–	–	7.3	–
Wave One	Dual		32.3	2.6	943	124
	Electric-Only		3.5	1.0	–	–
Wave Two	Not Area 7		28.4	2.7	977	139
	Area 7		6.2	0.8	332	44
Wave Three		17.7	1.9	591	87	
Wave Four		11.5	1.5	517	70	
Wave Five		19.7	2.2	496	105	
Wave Six		2.7	0.8	216	194	
Total		145.9	5.4	4,675	322	
Reduction for Upstream		-4.9	–	62	–	
Reduction for Downstream		-2.2	–	-51	–	
Adjusted Total		138.8	–	4,332	–	

*The Gamma gas-only values have been estimated as a proportion of the Gamma standard frequency values, and are not amendable to accurate standard error estimates.

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 2015 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 2015 the total estimated double counted downstream savings was 2.2 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 not incorporate the DEER load shapes was used in 2014 and the adjustment was 1.7 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 51,000 Therms. This is a very small adjustment to the total gas savings estimate.

The 2012 Home Inventory Survey described differences in the number of installed CFLs between HER treatment and control customers². This difference between treatment and control customers leads to a deemed energy savings that is attributable to HERs. The report estimated that each HER recipient installed approximately one more CFL than control group participants. In 2013, Nexant estimated the savings attributable to the Upstream Lighting Program. This year, PG&E restructured its ULP program by decreasing CFL buy-downs and increasing LED rebates. At PG&E's request, TRC estimated that the lighting savings overlap is approximately 2.2 GWh and 62,000 Therms for 2015. For details regarding this calculation, refer to DNV-GL's Review and Validation of 2015 Pacific Gas and Electric Home Energy Reports Program Impacts.

Tables 1-2 and 1-3 show how the aggregate savings values are calculated. It shows the number of treatment months, the estimated percentage impact,³ the average usage in the control group during 2015 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.

² Freeman, Sullivan & Co.. *Evaluation of Pacific Gas and Electric Company's Home Energy Report Initiative for the 2010–2012 Program*. 2013. CALMAC ID: ID PGE0329.01

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

Wave	# of Treatment Months	# of Treatment Months in 2015	% Impact	Average Monthly Control Load (kWh)	Average # of Treatment Customers	Aggregate GWh Impact
Beta	53	12	2.3%	813.5	44,447	10.0
Gamma Dual Standard	50	12	1.6%	574.3	51,525	5.7
Gamma Dual Reduced	50	12	1.4%	574.3	51,583	4.9
Gamma Electric-only	50	12	1.9%	563.7	26,667	3.4
Wave One Dual	47	12	1.8%	570.3	267,302	32.3
Wave One Electric-only	47	12	1.8%	650.0	25,587	3.5
Wave Two Non-Area 7	35	12	1.8%	544.6	243,564	28.4
Wave Two Area 7	35	12	1.7%	484.1	63,721	6.2
Wave Three	30	12	1.6%	543.0	172,766	17.7
Wave Four	22	12	1.2%	494.1	157,208	11.5
Wave Five	15	12	1.2%	751.0	182,548	19.7
Wave Six	4	4	0.5%	503.4	296,688	2.7
Total					1,583,605	145.9

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

Wave	# of Treatment Months	# of Treatment Months in 2014	% Impact	Average Monthly Control Load (Therms)	Average # of Treatment Customers	Aggregate ,000 Therm Impact
Beta	53	12	1.1%	54.2	44,319	327
Gamma Dual Standard	50	12	0.6%	31.5	51,406	125
Gamma Dual Reduced	50	12	0.7%	31.5	51,454	144
Wave One Dual	47	12	0.9%	32.0	266,683	943
Wave Two Non-Area 7	35	12	1.0%	32.5	242,966	977
Wave Two Area 7	35	12	1.3%	34.5	63,572	332
Wave Three	30	12	0.9%	32.4	172,174	591
Wave Four	22	12	0.9%	29.8	156,623	517
Wave Five	15	12	0.6%	37.1	181,848	496
Wave Six	4	4	0.5%	35.9	295,005	216
Total					1,526,050	4,668



3 Electricity Savings Observed by Month

Table 3-1 presents the average percentage impact by month and the average monthly impact through the end of 2015 for every wave of the HER.

Table 3-1: 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									
January-15	2.2%	1.7%	1.3%	2.0%	1.4%	1.9%	1.5%	1.7%	1.5%	1.0%	0.8%	-
February-15	2.3%	1.7%	1.3%	2.2%	1.6%	2.2%	1.5%	1.6%	1.4%	0.9%	0.7%	-
March-15	2.3%	1.9%	1.6%	2.0%	1.7%	2.5%	1.7%	1.5%	1.5%	1.3%	0.9%	-
April-15	2.5%	1.8%	1.7%	2.3%	1.9%	2.8%	2.0%	1.6%	1.6%	1.4%	1.0%	-
May-15	2.5%	1.5%	1.4%	1.9%	2.0%	2.4%	1.9%	1.7%	1.8%	1.6%	1.2%	-
June-15	2.2%	1.5%	1.3%	1.5%	1.8%	1.3%	2.0%	2.1%	1.5%	1.3%	1.3%	-
July-15	2.3%	1.2%	1.0%	1.6%	1.9%	1.2%	1.9%	1.8%	1.6%	1.1%	1.4%	-
August-15	2.5%	1.4%	1.2%	1.9%	1.7%	1.0%	2.0%	1.8%	1.5%	1.0%	1.3%	-
September-15	2.2%	1.5%	1.3%	1.8%	1.8%	1.0%	1.9%	1.8%	1.5%	1.3%	1.3%	0.1%
October-15	2.3%	1.8%	1.7%	2.0%	1.9%	2.1%	1.8%	1.5%	1.5%	1.4%	1.7%	0.3%
November-15	2.2%	1.7%	1.5%	2.1%	1.8%	2.3%	1.6%	1.3%	1.6%	1.3%	1.5%	0.7%
December-15	2.2%	1.8%	1.4%	1.7%	1.8%	1.8%	1.3%	1.5%	1.7%	1.3%	1.1%	0.7%
Average**	2.3%	1.6%	1.4%	1.9%	1.8%	1.8%	1.8%	1.7%	1.6%	1.2%	1.2%	0.5%



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 2.5% in April, May, and August and smaller savings in the winter. 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 frequency of HERs on energy usage as well as the effect of HERs on customers with different fuel-types delivered by PG&E.⁴ 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 1.6% and the reduced frequency customers producing an average monthly savings of 1.4%. 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 and are both generating an average monthly electric savings of 1.8% respectively. Wave One Electric-only customers have a higher peak season savings than Wave One dual-fuel customers with 2.8% savings in the spring as opposed to the dual-fuel peak savings of 2.0% in the summer.

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. Wave Two customers not in Area 7 provide slightly higher average monthly savings, (about 20% higher on average), than those located in Area 7.

Wave Three customers have been receiving reports since July 2013. In 2015 they provided average monthly savings of 1.6%. These customers provided the most savings in May 2015 with a savings of 1.8%.

Wave Four customers began receiving reports in March 2014. In 2015 they provided monthly savings of 1.2%, with the highest savings of 1.6% in May.

Wave Five customers have been receiving reports since October 2014. They provided an average monthly savings of 1.2%.

Wave Six customers have only been receiving reports since September 2015. Their average savings for this short time period was .5%.

⁴ 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 3-2 displays the average monthly savings and average savings by month expressed in (kWh):⁵

In Table 3-1 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 about 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) 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 15% more on average than the Gamma reduced frequency HER recipients with 9.2 kWh in average monthly savings compared to 7.8 kWh. Gamma electric-only customers have an average monthly savings of 10.7 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 their first two months.

⁵ 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 3-2: 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									
January-15	18.55	8.92	7.17	12.60	8.33	11.21	8.51	9.13	8.59	5.16	5.50	-
February-15	17.51	8.07	6.09	11.62	8.40	11.42	7.58	8.07	6.93	3.95	4.53	-
March-15	16.17	8.02	6.85	9.22	7.65	11.67	7.93	6.74	6.69	5.08	5.32	-
April-15	17.25	7.84	7.39	10.52	8.99	14.06	9.21	7.12	7.57	5.94	6.32	-
May-15	17.91	7.47	7.05	8.69	9.81	13.02	9.22	7.51	8.64	7.08	7.93	-
June-15	18.55	11.03	9.63	9.41	11.83	11.26	11.91	9.36	9.04	7.30	12.30	-
July-15	20.32	9.57	8.03	10.42	12.74	10.42	12.12	8.43	10.12	6.49	13.73	-
August-15	23.55	11.06	9.60	12.59	12.03	9.15	13.00	9.20	9.82	6.00	12.38	-
September-15	19.33	10.01	8.54	10.21	10.91	7.71	11.04	8.74	8.76	7.03	10.90	0.53
October-15	17.23	9.33	8.44	9.29	9.62	11.61	9.10	6.90	7.44	6.36	11.23	1.45
November-15	17.85	8.69	7.38	12.29	9.81	13.34	8.76	6.79	8.48	6.01	10.10	3.56
December-15	20.19	10.46	7.81	11.54	10.82	11.79	8.09	8.96	10.20	6.69	8.07	3.79
Average**	18.70	9.22	7.85	10.67	10.09	11.40	9.72	8.08	8.53	6.09	8.99	2.30

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



4 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 4-1 presents the average percentage impact by month and the average monthly impact through the end of 2015.

Table 4-1: 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							
January-15	0.9%	0.8%	1.1%	0.7%	0.9%	1.0%	0.7%	1.0%	0.3%	-
February-15	0.9%	0.8%	1.0%	1.0%	1.3%	1.3%	0.9%	0.9%	0.7%	-
March-15	1.0%	0.6%	0.6%	1.0%	1.2%	1.4%	0.9%	1.2%	0.6%	-
April-15	0.9%	1.2%	0.7%	1.3%	1.3%	1.5%	1.0%	1.1%	0.8%	-
May-15	1.3%	1.1%	0.7%	0.8%	1.6%	1.9%	1.0%	1.7%	1.2%	-
June-15	1.0%	0.4%	0.2%	0.7%	1.2%	1.6%	1.0%	0.9%	1.0%	-
July-15	1.0%	0.0%	-0.2%	0.8%	1.1%	1.4%	1.1%	0.5%	1.2%	-
August-15	1.3%	0.5%	0.2%	0.8%	0.9%	1.3%	1.0%	0.3%	0.8%	-
September-15	1.5%	0.5%	0.0%	1.0%	1.1%	2.4%	1.0%	0.9%	0.8%	0.4%
October-15	1.4%	0.7%	0.4%	1.1%	1.1%	1.9%	1.0%	1.1%	0.9%	0.3%
November-15	1.2%	0.5%	0.7%	1.2%	1.0%	1.1%	0.8%	0.8%	0.7%	0.5%
December-15	1.3%	0.4%	0.9%	0.8%	0.6%	0.8%	0.8%	0.7%	0.2%	0.6%
Average**	1.1%	0.6%	0.7%	0.9%	1.0%	1.3%	0.9%	0.9%	0.6%	0.5%

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. Curiously, some waves experience small negative gas savings during the summer months. Table 4-2 shows these savings in real (Therms) terms.



Table 4-2: Average per Customer Impact on Gas Usage by Wave (in Therms)

Month	Beta	Gamma		Wave One	Wave Two		Wave Three	Wave Four	Wave Five	Wave Six
		Dual		Dual	Not Area 7	Area 7				
		Standard	Reduced							
January-15	1.01	0.51	0.71	0.45	0.56	0.66	0.44	0.54	0.25	-
February-15	0.70	0.34	0.42	0.45	0.55	0.59	0.39	0.33	0.34	-
March-15	0.50	0.16	0.16	0.28	0.37	0.47	0.28	0.34	0.20	-
April-15	0.38	0.28	0.18	0.32	0.35	0.47	0.28	0.27	0.23	-
May-15	0.49	0.24	0.14	0.16	0.38	0.46	0.23	0.36	0.27	-
June-15	0.24	0.06	0.02	0.11	0.20	0.28	0.18	0.15	0.17	-
July-15	0.20	0.00	-0.03	0.10	0.16	0.20	0.16	0.07	0.19	-
August-15	0.28	0.07	0.03	0.11	0.13	0.18	0.15	0.05	0.13	-
September-15	0.34	0.07	0.01	0.14	0.17	0.38	0.15	0.13	0.13	0.05
October-15	0.44	0.12	0.07	0.19	0.20	0.37	0.19	0.20	0.19	0.05
November-15	1.17	0.27	0.37	0.60	0.49	0.57	0.42	0.36	0.42	0.23
December-15	1.68	0.32	0.71	0.64	0.46	0.59	0.59	0.50	0.21	0.41
Average**	0.61	0.20	0.23	0.29	0.34	0.43	0.28	0.27	0.23	0.18

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. Wave Six customers provide the least savings at 0.18 Therms per month, but this is likely due to the fact that Wave Six has only been receiving reports for a short time. Gamma Standard also produced very low savings compared to the rest of the waves at .20 Therms per month.



5 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.

$$kWh_{it} = a + b_t + c_t \cdot termination_i + d \cdot pre_termination_kwh_{it} + e_t \cdot pre_termination_kwh_i + \varepsilon_{it}$$

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 two tables and their associated figures below present electric energy savings estimates for terminated and continued customers. 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 1, 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.



5.1 Persistence of Electricity Savings

Table 5.1 summarizes the persistence of electricity savings for the Gamma Standard Treatment group. Over all the months in the study, the difference between the Continued and Terminated groups was about 34%. In other words, the savings from customers who had received HERs for approximately 2 years dropped by approximately 34% during the 27 months after which the treatment was withdrawn. 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 21% in the first year and increased to about 30% in the next year. So, the effect of treatment appears to persist and it is reasonable to assume it is decaying at the rate of about 20% per year.

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 1.6% (see table 3-1). 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 27 months reduces the treatment effect by about 34%. 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 6% and about 62%.

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 whole period 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 27 months after customers receive their last reports.



Table 5-1: Gamma Standard Electric Energy Savings – Terminated vs. Continued

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	9.85	9.87	-0.02	-3.00	2.97	-0.2%
Dec-14	9.67	7.63	2.04	-0.98	5.06	21.1%
Jan-15	8.70	6.34	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%
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	8.75	8.36	0.38	-3.48	4.25	4.4%
Dec-15	10.36	9.54	0.82	-3.06	4.70	7.9%
Jan-16	10.04	8.44	1.60	-2.06	5.27	16.0%
Feb-16	9.62	9.10	0.52	-3.45	4.48	5.4%
Mar-16	8.20	5.85	2.35	-1.30	6.01	28.7%
Apr-16	8.02	5.35	2.67	-1.70	7.04	33.3%
May-16	8.44	2.43	6.01	0.78	11.23	71.2% *
Jun-16	11.31	2.44	8.87	2.87	14.88	78.4% *
Jul-16	13.08	0.28	12.80	6.33	19.26	97.9% *
Average	10.06	6.64	3.41	0.61	6.22	33.9% *



Figure 5-1: Gamma Standard Electric Energy Savings – Terminated vs. Continued

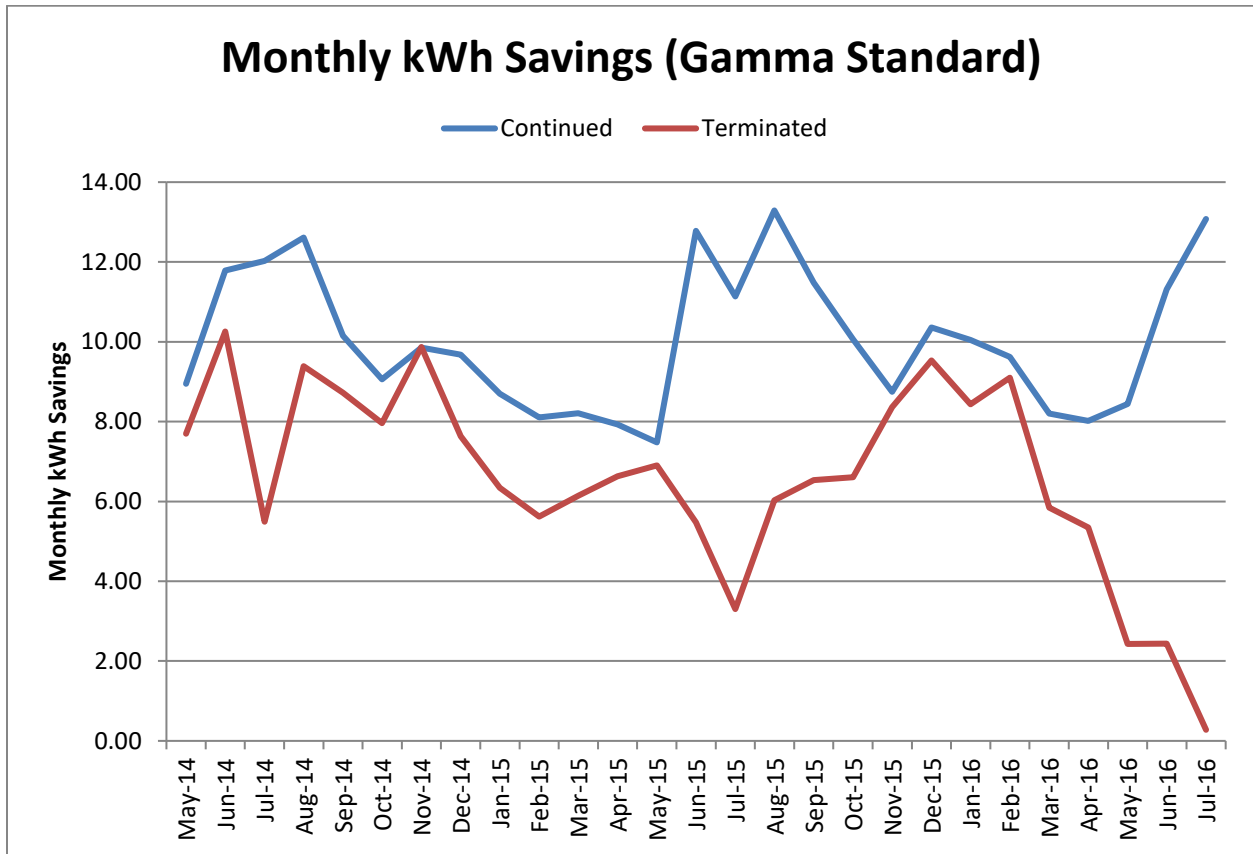
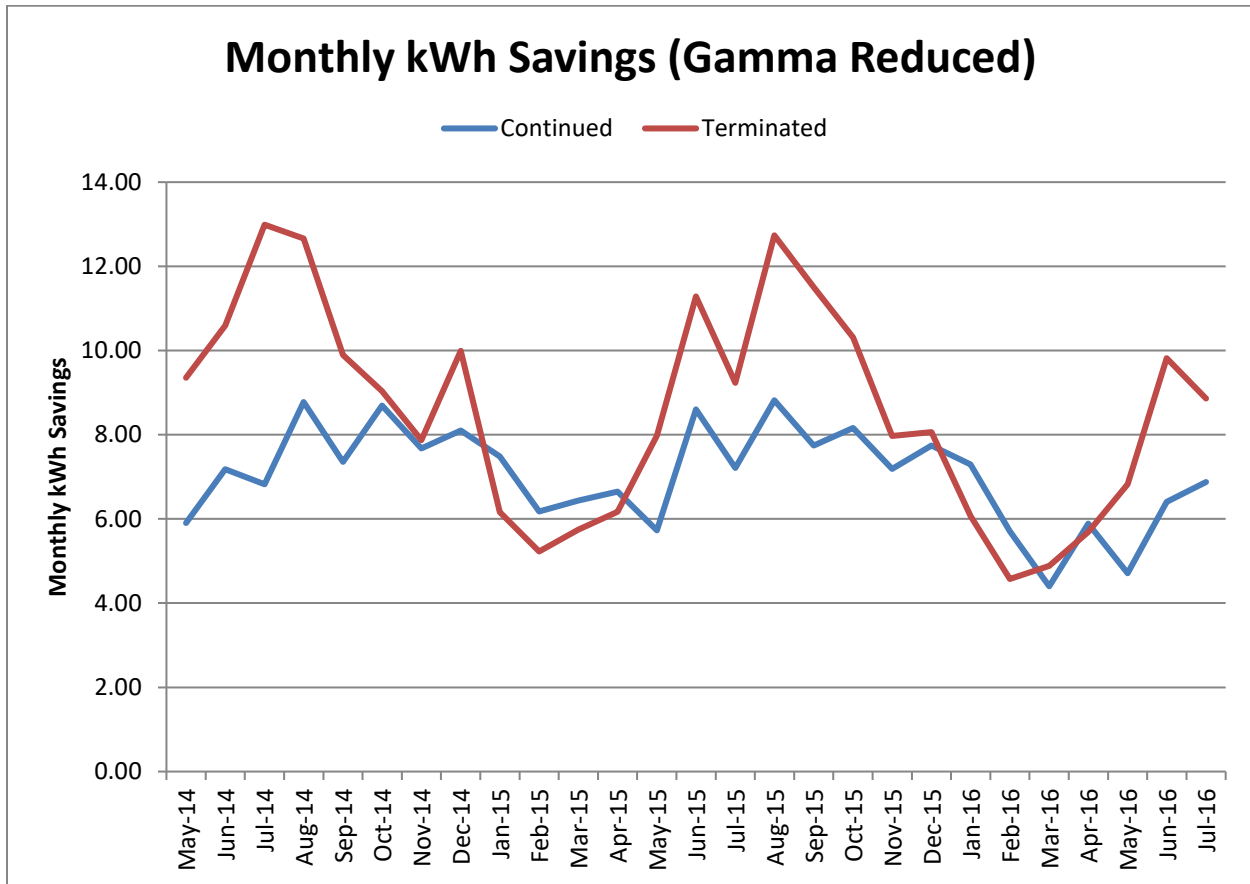




Table 5-2: Gamma Reduced Electric Energy Savings – Terminated vs. Continued

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	7.68	7.87	-0.20	-2.62	2.22	-2.6%	
Dec-14	8.10	10.00	-1.89	-4.69	0.90	-23.4%	
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%	
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	7.19	7.97	-0.78	-4.28	2.71	-10.9%	
Dec-15	7.74	8.07	-0.32	-3.96	3.32	-4.2%	
Jan-16	7.29	6.07	1.22	-2.19	4.63	16.7%	
Feb-16	5.70	4.57	1.13	-2.50	4.76	19.8%	
Mar-16	4.40	4.89	-0.49	-4.50	3.53	-11.0%	
Apr-16	5.89	5.69	0.20	-3.59	3.99	3.4%	
May-16	4.71	6.83	-2.12	-6.83	2.60	-44.9%	
Jun-16	6.41	9.82	-3.41	-8.95	2.14	-53.2%	
Jul-16	6.88	8.86	-1.98	-8.09	4.13	-28.8%	
Average	7.06	8.65	-1.60	-4.02	0.83	-22.6%	

Figure 5-2: Gamma Reduced Electric Energy Savings – Terminated vs. Continued



5.2 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 5-3 indicates that savings decline by about 64% for Gamma Standard customers who no longer receive HERs. Notably, the declines in gas savings are much higher in winter 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 overall and statistically significant in winter 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 20% to 108%. 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.



Table 5-3: Gamma Standard Gas Energy Savings – Terminated vs. Continued

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	18.4%
Dec-14	0.60	-0.08	0.68	0.34	1.02	112.6%
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%
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	149.6%
Dec-15	0.48	-0.02	0.50	0.07	0.94	104.2%
Jan-16	0.45	0.12	0.34	-0.06	0.74	74.5%
Feb-16	0.40	0.11	0.29	0.00	0.58	71.8%
Mar-16	0.27	0.07	0.20	-0.02	0.42	74.0%
Apr-16	0.19	0.17	0.02	-0.15	0.18	9.9%
May-16	0.11	0.15	-0.04	-0.19	0.12	-34.4%
Jun-16	0.09	0.14	-0.06	-0.19	0.08	-62.0%
Jul-16	0.11	0.07	0.04	-0.10	0.17	34.9%
Average	0.23	0.08	0.15	0.05	0.25	64.1%

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Figure 5-3: Gamma Standard Gas Energy Savings – Terminated vs. Continued

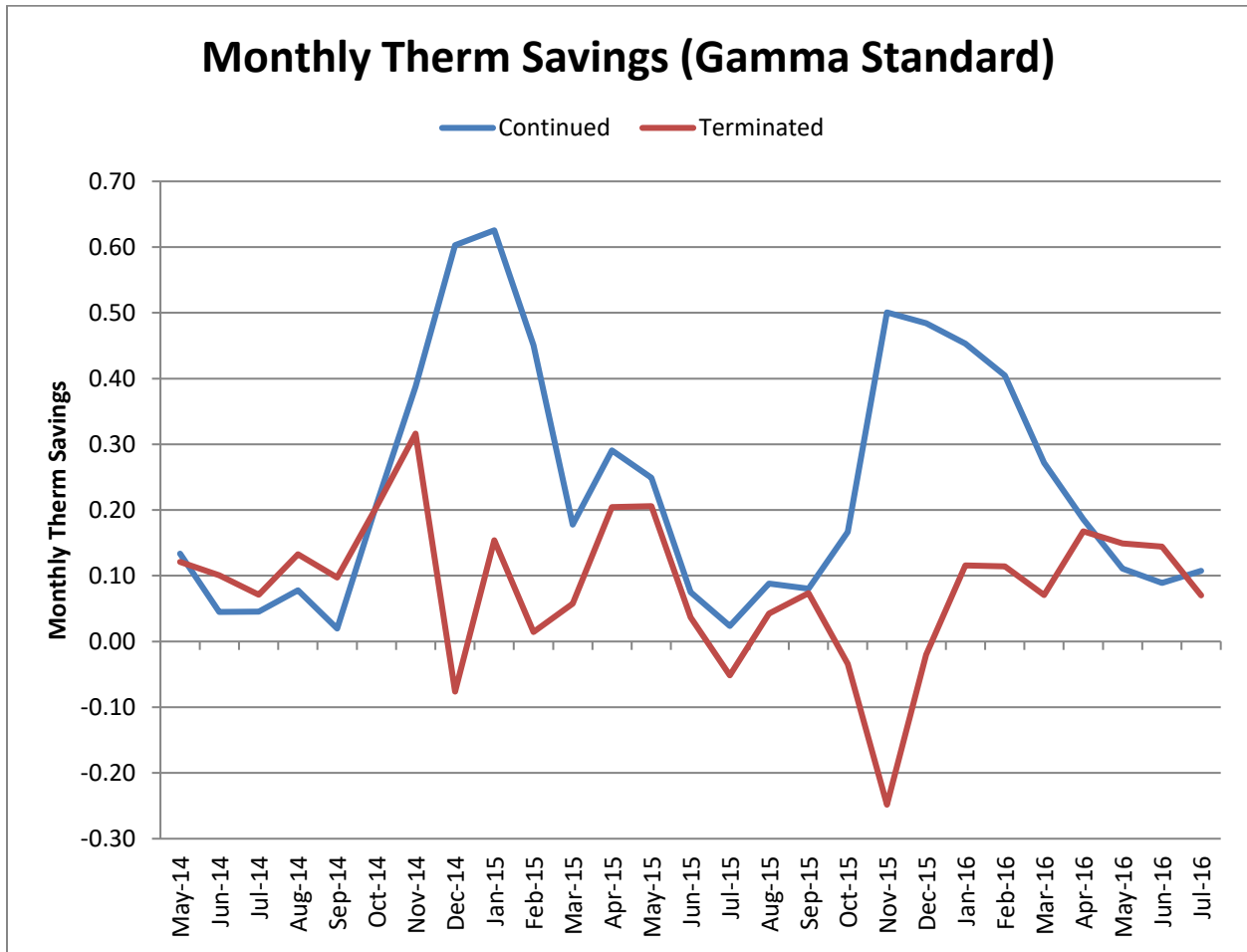


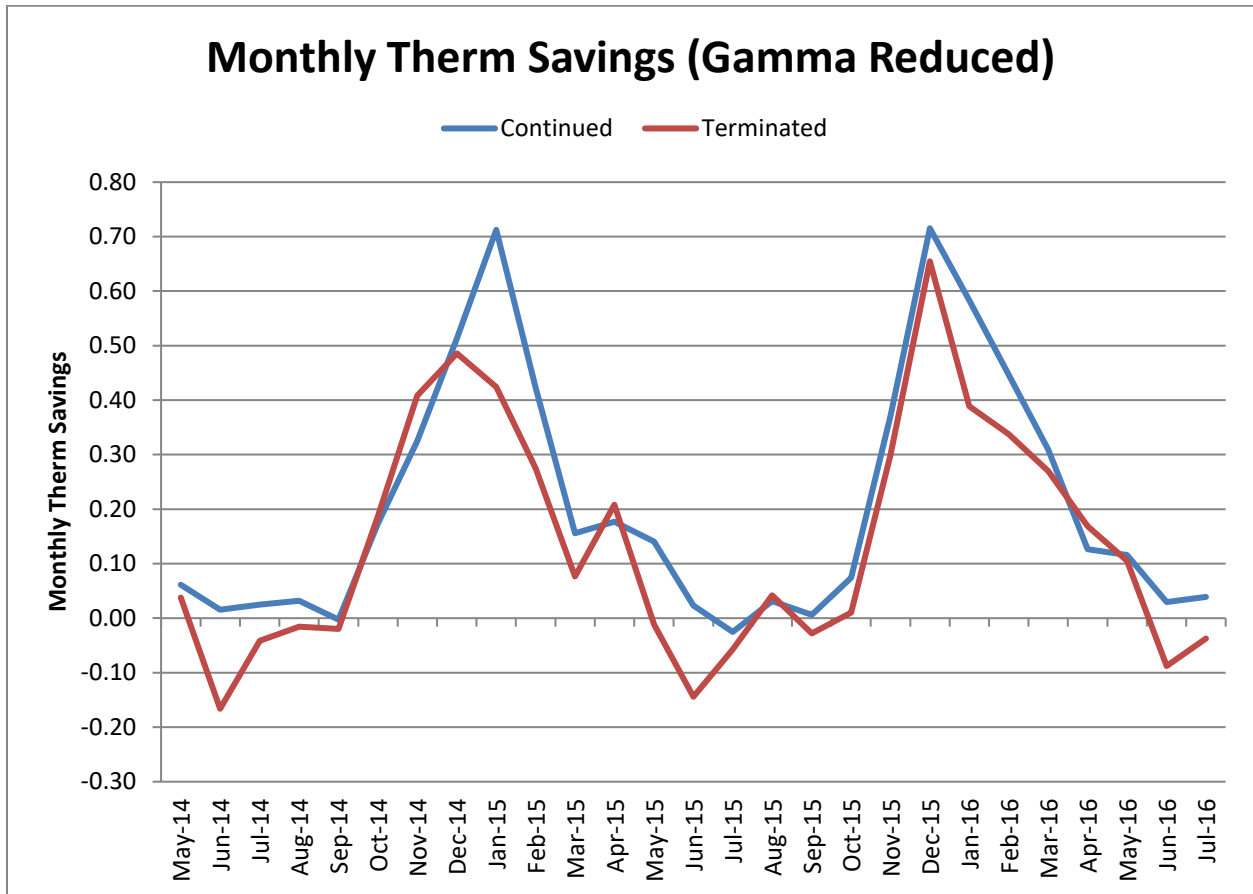
Table 5-4 displays the difference in gas savings for Gamma Reduced customers who continued and were terminated from treatment. Gas savings reduced by about 33% for this group over the entire duration of the experiment. However, this reduction is not statistically significant, again because of the relatively 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.



Table 5-4: Gamma Reduced Gas Energy Savings – Terminated vs. Continued

Month	Monthly Therm Energy Savings		Energy Savings Impact for Terminated Group	90% Confidence Interval		Percent Savings Impact
	Continued	Terminated				
May-14	0.06	0.04	0.02	-0.11	0.16	38.2%
Jun-14	0.02	-0.17	0.18	0.05	0.32	1173.7% *
Jul-14	0.02	-0.04	0.07	-0.05	0.18	267.2%
Aug-14	0.03	-0.02	0.05	-0.08	0.17	148.4%
Sep-14	0.00	-0.02	0.02	-0.11	0.15	-567.8%
Oct-14	0.17	0.19	-0.01	-0.15	0.12	-7.9%
Nov-14	0.32	0.41	-0.08	-0.33	0.16	-25.7%
Dec-14	0.51	0.49	0.03	-0.32	0.37	5.4%
Jan-15	0.71	0.42	0.29	-0.04	0.61	40.5%
Feb-15	0.42	0.27	0.15	-0.10	0.39	35.0%
Mar-15	0.16	0.08	0.08	-0.10	0.26	50.9%
Apr-15	0.18	0.21	-0.03	-0.21	0.14	-17.7%
May-15	0.14	-0.01	0.15	-0.04	0.35	108.2%
Jun-15	0.02	-0.14	0.17	0.04	0.30	726.2% *
Jul-15	-0.03	-0.06	0.03	-0.09	0.15	-125.9%
Aug-15	0.03	0.04	-0.01	-0.13	0.11	-33.7%
Sep-15	0.01	-0.03	0.03	-0.10	0.17	532.8%
Oct-15	0.07	0.01	0.06	-0.10	0.23	86.0%
Nov-15	0.37	0.30	0.07	-0.29	0.43	19.4%
Dec-15	0.72	0.65	0.06	-0.38	0.50	8.5%
Jan-16	0.58	0.39	0.19	-0.21	0.60	33.3%
Feb-16	0.45	0.34	0.11	-0.18	0.40	24.4%
Mar-16	0.31	0.27	0.04	-0.19	0.27	12.7%
Apr-16	0.13	0.17	-0.04	-0.22	0.14	-33.2%
May-16	0.12	0.11	0.01	-0.16	0.18	9.4%
Jun-16	0.03	-0.09	0.12	-0.04	0.27	395.3%
Jul-16	0.04	-0.04	0.08	-0.08	0.23	196.2%
Average	0.20	0.14	0.07	-0.04	0.17	33.1%

Figure 5-4: Gamma Reduced Gas Energy Savings – Terminated vs. Continued





6 Introduction of eHERs

In April 2014, ~220,000 HER recipients in Wave One, Wave Two, and Wave Three began receiving electronic HERs (eHERs) in addition to paper HERs. 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, 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 6-1 presents the number of customers in the baseline, treatment and control groups by experimental wave.

Table 6-1: 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.

Tables 6-2 and 6-3 display the electric energy savings estimates for the baseline and eHER treatment groups for waves One and Two respectively. Customers in Wave One who received eHERs saved approximately 21% more electricity over the 20 months of the study than those who received only HERs. While customers in Wave Two, who had received reports for a shorter period of time before receiving eHERs saved approximately 29% more electricity. These results suggest the eHERs increase energy 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., ~1.6%) 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. The 90% confidence interval for the impact of providing eHERs is between 0.0% and ~60%.

PG&E has not yet 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 6-2: 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	6.9	6.2	-0.7	-3.5	2.0	-11%
Average	4.4	5.3	0.9	-0.9	2.7	21%



Table 6-3: 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	7.7	8.6	0.9	-1.9	3.8	12%
Average	4.5	4.6	0.0	-1.9	1.9	0%

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, but those sent to customers in Wave Two did not.



Table 6-4: 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%
Average	0.34	0.43	0.09	0.02	0.16	26%



Table 6-5: 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	-0.33	-0.65	-0.01	-129%
Average	0.26	0.19	-0.07	-0.15	0.01	-26%