



**2015 Demand Savings Methodology and Estimate  
Pacific Gas and Electric Company  
Home Energy Reports Program  
Nexant, 4/13/2017  
CALMAC ID PGE0446**

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 memo 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 2015. In this document we:

1. 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.
2. Describe the methodology used to estimate PMLR for HER using interval data, and
3. Apply the methodology to estimate PMLR for summer 2015 to include in the HER savings claims.

*1. 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.

*2. Proposed 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 for each of the three peak periods described above. 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.
  - 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 examined.
2. Calculate average per-household hourly impacts as the difference between average control and average treatment demand across the peak periods 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.

3. *Calculation of Peak Megawatt Load Reduction for 2015:* Using DEER’s definition of a three-day heat wave, peak periods in 2015 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](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, September 8 through Thursday, September 10, 2015 was identified as the peak heat wave in 2015.

To calculate peak demand savings, 60-minute interval data were collected for each treatment and control customer within each of the eleven HER experimental waves in field in summer, 2015. 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.

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. These values are shown for the peak heat wave period, September 8 through September 10, in Table 1 below. Customers experienced temperatures of about 96 degrees Fahrenheit during the period. The aggregate peak MW load reduction for this period was 36.37 MW, which is significantly greater than the peak reduction in 2014 of 21 MW. This is in part due to the addition of Wave 5 but could also be due to the maturation of Wave 4.

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. The Gamma waves and Wave One did not achieve statistically significant savings, but the peak demand savings are significant as a whole.



**Table 1: 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)	Aggregate Impact (MW)	95% Confidence Interval (kW)		Percent Impact	Temperature (F)
<b>BETA</b>	43,340	43,222	2.56	2.51	0.05	2.1	0.9	3.3	1.9%	98
<b>GAMMA</b>	50,579	50,557	1.69	1.67	0.02	0.8	-0.1	1.8	1.0%	98
<b>GAMMA ELEC</b>	25,363	25,436	1.41	1.39	0.02	0.4	-0.2	1.0	1.1%	98
<b>GAMMA REDUCED</b>	50,579	50,327	1.69	1.67	0.01	0.6	-0.4	1.5	0.7%	98
<b>WAVE 1</b>	65,492	261,602	1.62	1.58	0.04	9.4	6.2	12.7	2.2%	96
<b>WAVE 1 ELEC</b>	5,959	23,809	1.90	1.89	0.02	0.5	-0.6	1.5	1.0%	98
<b>WAVE 2 AREA 7</b>	37,981	60,865	1.13	1.10	0.03	1.7	0.7	2.6	2.4%	97
<b>WAVE 2 NOT AREA 7</b>	37,268	238,323	1.42	1.38	0.04	9.2	5.6	12.8	2.7%	94
<b>WAVE 3</b>	55,661	167,182	1.39	1.38	0.02	2.8	0.6	5.1	1.2%	95
<b>WAVE 4</b>	56,118	149,727	1.32	1.31	0.01	2.0	0.1	4.0	1.0%	95
<b>WAVE 5</b>	41,776	174,913	2.31	2.27	0.04	6.8	3.7	10.0	1.7%	99
<b>Average/Total</b>	470,116	1,245,963	1.63	1.60	0.03	36.4	29.4	43.4	1.8%	96

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 0.5 MW. After this adjustment, the peak load reduction for the HER program is 35.9 MW.



Peak reductions were also estimated for the CAISO and PG&E peak demand hours. The CAISO system peak occurred on September 10<sup>th</sup> from 4 PM to 5 PM. The impact of HERs during this hour was 31.8 MW, shown in Table 2.

**Table 2: CAISO System Peak Demand Reductions by Experimental Wave**

Wave	Number of Control Residences	Number of Treated Residences	Control Load (kW)	Treatment Load (Kw)	Impact (kW)	Aggregate Impact (MW)	95% Confidence Interval		Percent Impact	Temperature (F)
<b>BETA</b>	43,325	43,207	3.05	3.01	0.04	1.9	0.4	3.3	1.4%	97
<b>GAMMA</b>	50,553	50,532	2.10	2.09	0.01	0.7	-0.5	2.0	0.7%	98
<b>GAMMA ELEC</b>	25,349	25,411	1.70	1.69	0.01	0.2	-0.6	1.0	0.4%	98
<b>GAMMA REDUCED</b>	50,553	50,301	2.10	2.10	0.01	0.3	-1.0	1.5	0.2%	98
<b>WAVE 1</b>	65,468	261,486	2.00	1.96	0.04	9.3	5.0	13.5	1.8%	96
<b>WAVE 1 ELEC</b>	5,957	23,789	2.28	2.29	-0.01	-0.2	-1.5	1.1	-0.3%	98
<b>WAVE 2 AREA 7</b>	37,966	60,838	1.28	1.25	0.02	1.4	0.2	2.6	1.8%	95
<b>WAVE 2 NOT AREA 7</b>	37,256	238,234	1.73	1.69	0.03	7.7	3.0	12.4	1.9%	92
<b>WAVE 3</b>	55,622	167,073	1.69	1.68	0.01	2.4	-0.5	5.3	0.9%	93
<b>WAVE 4</b>	56,072	149,620	1.60	1.59	0.01	1.7	-0.8	4.2	0.7%	94
<b>WAVE 5</b>	41,738	174,770	2.83	2.80	0.04	6.4	2.3	10.4	1.3%	100
<b>Average/Total</b>	469,859	1,245,261	1.98	1.96	0.03	31.8	22.8	40.7	1.3%	95



The PG&E system peak occurred on August 17<sup>th</sup> during the hour from 5 PM to 6 PM. Although temperatures were cooler than those during the CAISO peak, HER recipients provided slightly greater savings during the PG&E system peak.

**Table 3: 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)	Aggregate Impact (MW)	95% Confidence Interval		Percent Impact	Temperature (F)
<b>BETA</b>	43,527	43,391	3.17	3.13	0.04	1.7	0.3	3.2	1.3%	92
<b>GAMMA</b>	50,826	50,784	2.40	2.38	0.02	1.3	-0.1	2.6	1.0%	97
<b>GAMMA ELEC</b>	25,552	25,647	2.02	1.99	0.03	0.7	-0.2	1.6	1.4%	97
<b>GAMMA REDUCED</b>	50,826	50,575	2.40	2.40	0.01	0.4	-0.9	1.7	0.3%	97
<b>WAVE 1</b>	65,814	262,803	2.21	2.17	0.04	10.7	6.3	15.2	1.8%	92
<b>WAVE 1 ELEC</b>	5,984	23,953	2.66	2.66	0.01	0.1	-1.3	1.6	0.2%	98
<b>WAVE 2 AREA 7</b>	38,153	61,166	1.33	1.30	0.03	1.8	0.7	3.0	2.2%	86
<b>WAVE 2 NOT AREA 7</b>	37,458	239,401	1.90	1.87	0.03	8.3	3.4	13.3	1.8%	87
<b>WAVE 3</b>	56,041	168,249	1.88	1.85	0.03	4.9	1.9	8.0	1.6%	88
<b>WAVE 4</b>	56,706	151,262	1.76	1.75	0.01	1.3	-1.4	3.9	0.5%	89
<b>WAVE 5</b>	42,171	176,544	3.11	3.08	0.03	4.5	0.3	8.7	0.8%	97
<b>Average/Total</b>	473,058	1,253,775	2.19	2.16	0.03	35.9	26.8	44.9	1.3%	91



4. *Pre-existing differences between treatment and control.* To account for any pre-existing differences in peak demand between treatment and control customers prior to their selection for participation in the Home Energy Reports experiments, each wave was examined separately. 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 2015 (as defined in [http://www.cpuc.ca.gov/uploadedFiles/CPUC\\_Public\\_Website/Content/Utilities\\_and\\_Industries/Energy -  
\\_Electricity\\_and\\_Natural\\_Gas/EEPpolicyManualV5forPDF.pdf](http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPpolicyManualV5forPDF.pdf) ). 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 for the summer immediately after the onset of treatment. The pre- and post-treatment differences are presented in Table 4. The pre-treatment difference is less than .02 kW for each experimental wave.



**Table 4: Differences between Treatment and Control Peak Demand During Pre Treatment and Post Treatment Periods**

Experimental Wave	Treatment Period	Heatwave Start	Heatwave End	Control Customers	Treatment Customers	Average Control Customer Demand 2-5 PM (kw)	Average Treatment Customer Demand 2-5 PM (kw)	Difference (kw)	95% Confidence Interval	
Beta - Aug. 2011	Pre Treatment	20-Jun-11	22-Jun-11	46,639	46,511	2.80	2.80	0.00	-0.02	0.01
	Post Treatment	8-Aug-12	10-Aug-12	44,755	44,885	2.44	2.38	0.06	0.05	0.08
Gamma Standard - Nov. 2011	Pre Treatment	20-Jun-11	22-Jun-11	87,424	87,453	1.82	1.83	0.00	-0.01	0.01
	Post Treatment	8-Aug-12	10-Aug-12	84,243	84,320	1.91	1.90	0.01	0.00	0.02
Gamma Reduced - Nov. 2011	Pre Treatment	20-Jun-11	22-Jun-11	57,061	57,170	1.98	1.97	0.00	-0.01	0.02
	Post Treatment	8-Aug-12	10-Aug-12	54,637	54,724	2.04	2.02	0.02	0.01	0.03
Wave One - Feb. 2012	Pre Treatment	20-Jun-11	22-Jun-11	79,940	319,402	1.82	1.80	0.01	0.00	0.02
	Post Treatment	8-Aug-12	10-Aug-12	79,737	318,557	1.78	1.74	0.04	0.03	0.05
Wave Two - Area 7 - Feb 2013	Pre Treatment	8-Aug-12	10-Aug-12	43,078	69,069	0.94	0.94	0.00	-0.01	0.00
	Post Treatment	1-Jul-13	3-Jul-13	43,202	69,241	1.18	1.16	0.02	0.01	0.03
Wave Two - Not Area 7 - Feb. 2013	Pre Treatment	8-Aug-12	10-Aug-12	41,121	264,738	1.49	1.49	0.00	-0.01	0.01
	Post Treatment	1-Jul-13	3-Jul-13	41,244	265,751	1.82	1.80	0.02	0.01	0.04
Wave Three - Jul. 2013	Pre Treatment	8-Aug-12	10-Aug-12	64,599	193,829	1.46	1.45	0.00	0.00	0.01
	Post Treatment	1-Jul-13	3-Jul-13	64,620	193,927	1.78	1.78	0.00	-0.01	0.01
Wave Four - Mar. 2014	Pre Treatment	1-Jul-13	3-Jul-13	73,834	196,922	1.67	1.67	0.00	-0.01	0.01
	Post Treatment	23-Jul-14	25-Jul-14	68,467	182,773	1.19	1.19	0.01	0.00	0.02
Wave Five - Oct. 2014	Pre Treatment	23-Jul-14	25-Jul-14	49,737	207,940	2.10	2.10	0.01	0.01	-0.01
	Post Treatment	8-Sep-15	10-Sep-15	41,776	174,913	2.31	2.27	0.04	0.02	0.06

\* Rounding errors may make these small numbers misleading



After estimating the preexisting differences in treatment and control peak demand, the peak demands savings were estimated using a difference-in-differences approach in addition to the approach described above. This alternative approach had less than a 0.1 MW effect on the final estimate, and is therefore unnecessary. Given the negligible differences in peak demand prior to treatment, we conclude that assignment to treatment and control conditions was sufficiently random and that no adjustments to the peak demand savings estimates are necessary.