Avoided Energy Use for Home Energy Reports: Description of Methodology Used for Creation of Blended Load Shape

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Document Overview. This document was original drafted to memorialize the methodology by which the blended load shape was created for the Home Energy Reports measure. Some of this information is incorporated into Revision 1 of the Pacific Gas and Electric Home Energy Report Workpaper, PGECOALL107, as Input Appendices. Until such time as load shapes for this measure are updated, the information in this document is current and will be incorporated as an appendix to the first revision to the Home Energy Reports workpaper, SWWB004-01.

Rationale. The Home Energy Reports (HER) Workpaper (PGECOALL107, Home Energy Reports, Revision # 0, 3/1/2013) was produced prior to the analysis of the differences between the hourly energy use of customers assigned to HER treatment and HER control groups. Because no calculation of the avoided energy use was available, the HER Workpaper specified a conservative DEER Load Profile, Res. Refrigerator–Freezer Monthly (DEER:RefgFrzr_HighEff). As indicated in the HER Workpaper, the specified DEER Load Profile was a "strawman" suitable for initial valuation of the program.

Now that the majority of customers assigned to HER treatment groups have been treated for about two years or more, the actual load shape of avoided energy use was calculated by comparing the average usage of treated customers to that of control customers. This empirically-derived load shape will replace the use of the strawman load shape in a revision to the HER Workpaper that will be completed early in 2017.

Overview of HER Evaluation Framework. The HER sub-program uses experimental design whereby eligible residential customers are assigned randomly either to receive the treatment (mailing of reports with feedback of how household energy use compares to that of similar households) or a control group (this type of experiment is commonly referred to as randomized control trials (RCTs)). Currently PG&E has eight main HER experiments underway (named Beta, Gamma, and Waves One through Six).

To reduce sampling error and thereby improve the representativeness of the samples, stratified sampling was used to ensure that treatment and control groups are similar with respect to PG&E baseline territory (akin to climate zones) and to energy usage quartile. The result of using stratified sampling is that each HER experiment consists of homogeneous subgroups on key dimensions known to influence energy use (that is, climate and prior energy use). Random assignment results in treatment and control groups that are directly comparable: there is no need to control for differences between households assigned to treatment and control (such as weather, home size, or occupant characteristics). Energy savings calculations are conducted using a "difference-of-differences" (DID) approach whereby pre/post changes in energy consumption are calculated individually for treatment and control conditions, and subsequently these pre/post differences are subtracted from each other. DID is a commonly-used statistical technique applied to RCT data that calculates the effect of a treatment on an outcome (in this case, changes in energy use over time) by comparing the average changes over time in energy use in the treatment group compared to the control group.

Data source for the Load Shape Analysis. Hourly-level electric usage data from HER treatment and control customers was used to derive the shape of avoided energy use ("HER load shape") for the most recent calendar year available (2015). Given that about two years of HER treatment are required to reach near-maximum savings rates, usage data from treatment and control customers from the following HER experimental waves were included in this analysis:

- Beta (launched August 2011 with approximately 60,000 customers in treatment)
- Gamma (launched November 2011 with approximately 200,000 customers in treatment)
- Wave One (launched February 2012 with approximately 400,000 customers in treatment, and
- Wave Two (launched February 2013 with approximately 600,000 customers in treatment.

These experiments represent the majority of HER treatment households and savings. We do not expect that including other experiments would result in significant differences of load shape. The resulting calculations are found in the accompanying .csv file entitled **8760 HER load shape**.

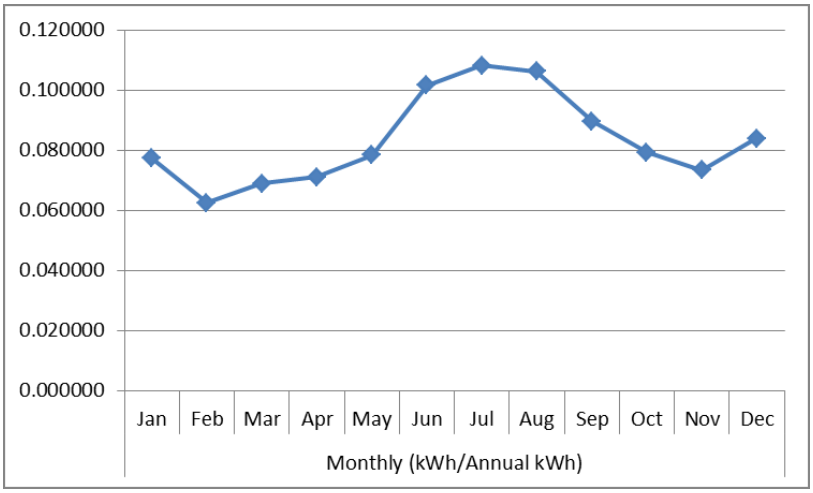
The process. The process consisted of two steps:

1) Creating of hourly avoided energy use load shapes for 2015, and
2) Matching these load shapes to approved DEER residential load shapes using an Excel-based tool "proxy tool" provided to PG&E by Brian Horii of E3. The tool is provided in the accompanying .xls file entitled **E3 Proxy Tool**.

Each of these steps is described below:

- *Creation of Hourly Load Shapes.* In September 2016, PG&E tasked HER vendor Opower to produce an avoided energy use hourly (8760) load shape (expressed in kWh) for 2015 for PG&E customers who had been enrolled in HER experiments for approximately two years or more. Opower used the DID technique described above to complete this task. The result was average hourly energy savings for each of the 8,760 hours in 2015. The empirically-derived avoided energy use load shape is presented below in both table and graphic forms.

kWh/ Annual kWh)	
Jan	0.0772986
Feb	0.0623938
Mar	0.0689485
Apr	0.070993
May	0.0782812
Jun	0.1016216
Jul	0.1081705
Aug	0.1062156
Sep	0.0896876
Oct	0.0791887
Nov	0.073398
Dec	0.0838028



- *Matching Hourly Load Shapes to Approved DEER Load Shapes.* E3 provided PG&E with an "E3 Proxy Tool" to create a blend of approved DEER load shapes that represent empirical 8760 load data. Note that the version of the E3 Proxy Tool is unique to PG&E as it is customized to the unique avoided costs for a specific year for PG&E. For other IOUs to replicate this process, a unique version of the E3 Proxy Tool will be required since the avoided costs are utility- and year-specific.
    - The first task to input the HER load shape into the DEER2011 hourly profile Excel sheet (available at the DEER Resources Website) to see allow for a visual comparison with approved DEER load shapes. We concluded that there is no good match between the HER load shape and any single approved DEER load shape.
    - E3 provided PG&E with the accompanying Excel tool, **E3Calc Proxy 2016**, that blends approved DEER load shapes to match the empirically-derived 8760 load shapes from HER. PG&E engineers entered the HER load shape into column C of the E3 Proxy Tool and, through trial-and-error, identified the blend of approved DEER load shapes (each falling between 0% and 100%) that most closely match the HER load shape. PG&E engineering staff identified a combination of two approved DEER load shapes (DEER:HVAC_Eff_AC and DEER:RefgFzrz_HighEff) as the two that most closely match the HER load shape. (Note that the E3 Proxy Tool assigns the percentages contributed from each of these two approved DEER load shapes uniquely for each climate zone.)
    - Now that the blended DEER approved load shape has been identified, it can be used as an input into the E3 Calculator to attribute present value avoided cost benefits to the HER measure that matches what the measure would have received had this specific load shape been included as one of the official DEER load shapes.