**Work Paper PGECOALL107**

**Home Energy Reports**

**Revision # 0**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**Home Energy Reports**

**Measure Codes – Procedural work paper**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Applicable Measure Codes:** |  |
| **Measure Description:** | Home Energy Reports is an information-based measure that provides usage feedback and comparisons of energy usage to similar residences. Information is provided via printed reports mailed to residential bill payers. The measure uses a random control trial whereby a homogeneous set of residential customers defined using multiple characteristics is randomly assigned either to receive reports (“treatment condition”) or not (“control condition”) for each experiment. Due to the unique composition of each randomized control trial, savings for this measure must be calculated for each experiment separately. |
| **Energy Impact Common Units:** | kWh, Therms per household |
| **Base Case Description:** | PG&E: Customers that are assigned to the control condition for any given experiment (“wave”). |
| **Base Case Energy Consumption:** | PG&E: The Base Case energy consumption is that of the average of residential customers assigned to the control condition for a given experiment. Since savings are calculated by comparing usage between treatment and control conditions for every wave separately, there is not a single numerical base case. |
| **Measure Energy Consumption:** | PG&E: The Measure Case assumes that the customer receiving the HER will act on it during the time he continues to receive them and after. Energy consumption of the treatment group is recorded from billing and is used for comparison to the control group. Savings due to other rebate programs will be subtracted from the Measure Case.to leave only those assume d to be from customers acting on the reports. (Households that are randomly-assigned to receive the usage feedback via mail-based reports) and its corresponding control condition (households that are randomly-assigned to not receive the reports). |
| **Energy Savings**  **(Base Case – Measure):** | PG&E: The energy consumption savings from the HER program is calculated by unique experiment by comparing usage between each treatment condition (households that are randomly-assigned to receive the usage feedback via mail-based reports) and its corresponding control condition (households that are randomly-assigned to not receive the reports). |
| **Costs Common Units:** | $ per household |
| **Base Case Equipment Cost ($/unit):** | PG&E: There is no action required for the Base Case, hence no cost. |
| **Measure Equipment Cost ($/unit):** | PG&E: This is not a “widget-based” measure. The changes in customer behavior resulting in energy savings have no identifiable cost. PG&E is conducting an analysis of rebate records and conducting home inventories to identify whether specific equipment has been rebated and claimed by other measures are drivers of energy savings. |
| **Gross Measure Cost ($/unit)** | Since the savings of the program are posited to be changes in customer behavior and PG&E is accounting for rebate related activity, the Measure Cost is zero.0 |
| **Measure Incremental Cost ($/unit):** | Source: PG&E These measures are considered ROB since this depends on customer behavioral action. Incremental cost is zero. PG&E is conducting home inventories to treatment and control households to identify whether specific equipment has been purchased to result in energy savings. |
| **Effective Useful Life (years):** | Source: PG&E The estimated useful life is approximated at 20 years. The length of the program may be shorter. At that point, PG&E will determine actual life of the measures based on subsequent billing data |
| **Measure Application Type:** | Replace on Burnout (ROB) |
| **Net-to-Gross Ratios:** | Source: Since these measures are evaluated by a billing analysis of changes in energy use in treatment vs. control households using billing analysis, NTG is built into the experimental design. Given this methodology, and the attribution analysis using utility rebate records for downstream measures and home inventories for upstream measures to avoid double-counting, NTG=1.0. |
| **Important Comments:** |  |

# Work Paper Approvals

The following Manager(s) approved this work paper through the PG&E Electronic Data Routing System under Routing Requisition # 2013-15423

|  |
| --- |
|  |
| **Grant Brohard**  Manager, Engineering Services |
| **Aaron Berndt**  Manager, Core EMS and Information Products |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Revision Date** | **Section-by-Section Description of Revisions** | **Author (Company)** |
| **Revision 0** | **3/01/2013** | **Home Energy Reports original work paper.** | **Steve Blanc, Brian Smith, Jim Wyatt (PG&E)** |
|  |  |  |  |

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# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

***Catalog Description***

*The purpose of the Home Energy Reports (HER) initiative is to reduce energy consumption by motivating no-cost energy conservation actions and self-installation of low cost energy savings measures. The HER program operates on the principle that, by providing customers information that compares a household’s energy use to that of similar households, customers will modify their behavior and/or make minor purchases which will lead to energy savings. The HER program employs randomized control trials, and the determination of energy savings is done via billing analysis which compares energy use between the treatment and control groups.*

*PG&E has engaged the vendor OPOWER to produce and deliver the reports. OPOWER is currently the largest and best established vendor in this domain. PG&E has engaged Freeman, Sullivan and Company (FSC) to assist in the experimental design and data analysis. FSC is an acknowledged expert in the design of information feedback experiments. The key objectives of this research initiative are as follows:*

1. *Estimate changes in residential energy consumption resulting from exposure to home energy reports for a wide range of PG&E residential customers with different characteristics for each experiment conducted.*
2. *Assess persistence of change resulting from the reports over a period of at least two years.*
3. *Estimate the impact of relative frequency of report delivery on energy consumption.*

***Program Restrictions and Guidelines***

*This program is an “opt-out” program whereby selected households are mailed the reports without explicitly requesting them. Since the household characteristics that define the sample frame for each experiment (e.g., climate zone, fuel type, energy usage, time since account was established, etc.) is unique, each experiment requires its own analysis of energy savings.*

***Terms and Conditions:*** *These are the actual rules for the specific measure(s) described in this workpaper. These form the basis of the savings and cost calculations for the measures. They must be presented EXACTLY as stated in the product catalog and customer materials.*

***Market Applicability:*** *The target for this program is single-family residences served by PG&E. See initial sampling plan5. This document contains the background and initial plan for the Home Energy Reports program as submitted to Energy Division of the CPUC in May 2011. Revisions will be made to the sampling plan to describe all experiments in the field.*

## 1.2 Product Technical Description

The Home Energy Report (HER) program operates on the principle that customers in the treatment condition that are provided periodic reports with energy use feedback and comparisons of energy use of similar neighbors will reduce their energy use compared to customers in the control condition who are not provided these reports. The impact of home energy reports experiments on energy use has been demonstrated in many jurisdictions by statistical comparisons conducted by multiple evaluation firms. The usage feedback that is the core of the reports is accompanied by tips on saving energy and suggestions to purchase more efficient equipment. The HER program employs a randomized control design whereby a homogeneous group of residential customers defined by key usage and demographic characteristics are randomly assigned to either receive the reports (the treatment group) or not (the control group). Random assignment ensures that the treatment and control groups are equivalent from a statistical standpoint, and the experimental design can test the hypothesis that the reports lead to energy savings in the treatment group. Other than the fact that the treatment group receives the reports, households in the treatment and control groups are treated in the same fashion with respect to all other utility interactions. The randomized control trial methodology provides a comparison group so that the effectiveness of the treatment can be determined with precision.

A number of independent evaluations of comparative usage programs around the country provide evidence of their effectiveness in reducing energy demand. A meta-analysis of HER programs conducted by Environmental Defense Fund demonstrates that households receiving the reports reduce energy demand by 1.8% on average, with the effectiveness of individual programs ranging from 0.9% to 2.9% [EDF]. Because the customer characteristics of each experiment are unique, savings for each experiment must be calculated on an *ex post* basis.

The HER experiments are keyed to accounts, not meters, so that attrition among participants can be taken into account. There are two sources of attribution:

1. Households requesting not to receive the reports (“opt-outs”). The HER experiments are run on an opt-out basis. In practice this means that a group of potential residential customers that are homogeneous (with respect to building type, geography, and average past energy usage) are randomly assigned to either treatment or control conditions. Reports are mailed to all households in the treatment condition. About one half of one percent (0.5%) of treatment households request that they not be sent reports (they “opt-out” of the program). Since households opting out of the program receive at least one report, they are considered to have received the treatment and they are retained in the experiment with respect to being included in the treatment group for the ex post billing analysis.
2. General attrition. Households that move away from their residence (e.g., moving, change of utility billing address). Attrition is estimated at 0.8% of the treatment group per month, depending on the precise customer characteristics that define each experiment. Attriting accounts are kept in the experiment until the meter is “stopped” at account closing.

To ensure that the energy savings claimed by HER is not duplicative of savings claimed elsewhere in the portfolio, two types of analysis will be undertaken:

1. Assessment of participation in direct rebate programs (“downstream” measures). A comparison of the relative uptake of downstream measures between treatment and control groups will be undertaken to determine whether there is a difference between the uptake of downstream measures between treatment and control groups.
2. Assessment of participation in manufacturer and reseller rebate programs (“upstream” measures). PG&E is undertaking home inventories of 800 randomly selected residences (half in treatment and half in control) to determine whether there is an increased uptake in the most important upstream measures which involve manufacturer (CFL and LED) and reseller (CFL, LED, and television) rebates.

For the purposes of this work paper, we characterize savings based on kWh, kW or Therms per household. This will provide the regulators and others with a value for the program consistent with DEER. *A more thorough explanation of the design approaches and research techniques can be had at* Neenan and Robinson (EPRI) *[[1]](#endnote-1) and* State and Local Energy Efficiency Action Network (SEE Action)*[[2]](#endnote-2)*

Decision 09-09-047 (pg. 304)**[[3]](#endnote-3)** authorizes the IOUs to make savings claims for interventions that use a “neighbor comparison” approach and a randomized control test (whereby customers are assigned to either treatment or control conditions). Senate Bill 488, signed into law on October 11, 2009, requires the CPUC to evaluate certain residential benchmarking programs using an experimental design approach. The decision determining EM&V processes for the 2010-2012 portfolio (D. 10-04-029) provides for savings claims for behavior-based programs based on experimental design (pp. 40-42, see Conclusion of Law 18; OP 13)[[4]](#endnote-4). Based on these decisions, PG&E will make ex post savings claims for HER.

## 1.3 Measure Application Type

The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2011 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls*, defines the terms as follows:

Table  Measure Application Type[[5]](#endnote-5)

*Identifies the measure application type in the Measure Implementation table in DEER2011.*

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ER | Early retirement | *measure applied while existing equipment still viable, or retrofit of existing equipment* |
| ROB | Replace on Burnout | *measure applied when existing equipment fails or maintenance requires replacement* |
| NC | New Construction | *measure applied during construction design phase as an alternative to a code-compliant standard design* |

We are recommending that residential customers, on the basis of reports and recommendations sent to their homes, change their operation of energy using devices in their homes or change to more efficient ones absent participation in PG&E programs aimed at rebating such transactions. This program group of measures being defined as behavioral responses, and therefore has no corollary in the DEER transaction types. We would go so far as to say that we would require that CPUC develop a behavior modification transaction type to fit this class of measures. For the purposes of submitting this initial procedural description of the program, we will use the ROB designation as it is the only existing transaction type that approximates the circumstances of these measures.

## 1.4 Product Base Case and Measure Case Data

## 1.4.1 DEER Base Case and Measure Case Information

The DEER Use / Technology Table has no reference that would correctly categorize these program measures. These program measures are being counted as *ex post* savings pursuant to the guidance. Consequently the relevance of DEER impacts is moot. However, for the purpose of this document, we address these issues to clarify the difference between this program and an *ex ante* work paper measure.

*DEER Values: Measure-specific values found in the database for energy efficient resources*

*(DEER) including net-to-gross (NTG), estimated useful life (EUL) and unit energy savings (UES) are not applicable to comparative usage programs*[[6]](#endnote-6).

This is set of measures based on altering customer behavior through a periodic reporting system. It does not involve savings from any installed piece of equipment, control system or building feature. Consequently, the DEER data do not contain (not) the appropriate information for this (these) measure(s).

* ***Net-to-Gross Assumption: See 1.4.3.2***
* ***Effective Useful Life: See 1.4.3.2***
* ***In-service rate/first year installation rate: See 1.4.3.2***

## 1.4.2 Codes & Standards Requirements Base Case and Measure Information

This is set of measures based on altering customer behavior through a periodic reporting system. It does not involve savings from any installed piece of equipment, control system or building feature. Consequently:

* ***Title 20:*** These measures do not fall under Title 20 of the California Energy Regulations.
* ***Title 24:*** These measures do not fall under Title 24 of the California Energy Regulations.
* ***Federal Standards:*** These measures) do (not) fall under Federal DOE or EPA Energy Regulations***.***

## 1.4.3 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

***1.4.3.1 PG&E Home Energy Reports Initiative* *Sampling Plan[[7]](#endnote-7)***

The attached sampling plan lays out the sample frames for each experimental wave of HER. *Pacific Gas and Electric Company’s (PG&E’s) “home energy reports” (also referred to as a “comparative billing program”) is a behavior-based energy efficiency initiative. Mail based, customized reports that compare energy use of specific customers to the average energy use of similar households are provided over time to selected residential customers (a sample of the reports is provided in Appendix B). The initiative will also assess whether the reports cause customers to participate in other energy efficiency programs as tracked by PG&E’s internal databases.*

***1.4.3.2 IOU Proposal for Reporting Energy Savings for Comparative Usage Energy Efficiency Programs*** ***May 18, 2012[[8]](#endnote-8)***

***This document proposes utility reporting schemes for behaviorally based programs and sets the parameters for reporting savings and other inputs to CPUC.***

*Comparative usage programs provide utility customers feedback through reports showing household energy use and comparisons of energy use from similar neighbors. Through utility contact and communication, customers will modify behaviors and undertake actions and/or make energy efficient product purchases that result in energy savings. Recent legislation and Commission decisions (see Appendix One for a summary) provide for the California Investor- Owned Utilities (IOUs) to claim energy savings resulting from such “comparative energy usage programs.” Senate Bill 488, signed into law on October 11, 2009, defines a comparative energy usage program as “…a program pursuant to which an electrical corporation or gas corporation discloses information to residential subscribers relative to the amount of energy used by the metered residence compared to similar residences in the subscriber’s geographical area.”*

*Impacts of comparative energy usage programs can be assessed using experimental design whereby a target group of similar households are randomly assigned to receive the reports (“treatment”) or not (“control”). The random assignment ensures that the treatment and control groups are equivalent from a statistical standpoint such that the experimental design establishes whether the desired effects are more likely to occur in the intervention (or treatment) group due to the program. Households in the treatment and control groups are treated in the same fashion with respect to utility interactions outside of this particular intervention (such as exposure to marketing programs and recruitment to demand response programs).*

***How Energy Savings Result from Comparative Usage Programs***

*The impacts of home energy reports have been tested in several jurisdictions across the nation by independent evaluators. These findings are based on the results of Randomized Controlled Trial (RCT) experiments that were conducted in a manner that makes it likely that the results are reliable and replicable. By comparing energy usage of similar treatment and control groups, evaluations of RCT experiments employing comparative usage feedback result in energy savings rates of between 1% and 3% for electricity and between 0.5% and 1.5% for natural gas.*

*Energy savings resulting from comparative usage programs may be divided into three types of actions:*

*1. Behavioral changes or practices that affect equipment use (e.g., switching off lights, unplugging unused appliances, and adjusting thermostat settings to limit heating and cooling),*

*2. Behavioral changes in the purchase and installation of equipment not rebated by the current IOU EE incentives programs (depending on the programs offered by a particular utility, these may include purchase and/or replacement of HVAC filters, door and window seals, and “smart” power strips, etc.), and*

*3. Behavioral changes in the purchase and installation of energy efficient equipment rebated by the current IOU EE incentive programs.*

**Base Case Costs and Measure Case Costs**

**Costs DEER Version and Impact Ids**

* The [Base Case / Measure Case / Incremental] Costs were derived from *IOU Proposal for Reporting Energy Savings for Comparative Usage Energy Efficiency Programs* Study directly, they match the intended measures for climate zones and building types and ages.
  + - *Incremental Measure Costs (IMC) and Negative Therm Interactive Effects. As is detailed above, comparative usage programs cause energy savings through behavior change and equipment purchases. IMCs and negative Therm interactive effects will be treated in the following manner for each class of energy savings as detailed below. Energy savings resulting from:*
  + *Behavioral changes (such as adjustment of thermostat and water heater settings) have no IMCs or known interactive effects, so none will be reported.*
  + *Equipment purchases that, as determined by utility records (for downstream measures) and by home inventories and surveys (for upstream measures), have been claimed through another utility program and will be omitted from savings claims for comparative usage programs* as these analyses are developed*, to avoid double-counting. Since savings claims for comparative usage programs will not include energy savings attributable to these types of purchases, IMCs and negative Therm effects will be reported through the savings claims for those equipment purchases[[9]](#endnote-9).*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Costs ($)** | | |  |
| **Building type** | **Bldg Vintage** | **Climate Zone** | **Base Case** | **Measure Case** | **IMC** | **Specific study reference** |
| **RES** | **ALL** | **ALL** | **0** | **0** | **0** | **See Study.** |

**Effective Useful Life:**

* The Effective Useful Life estimates were downloaded from the “*IOU Proposal for Reporting Energy Savings for Comparative Usage Energy Efficiency Programs”* Study directly, they match the intended measures for climate zones and building types and vintages.

EUL is the estimate of the median number of years that the measures installed under an energy efficiency program are still in place and operable (retained). The intent of comparative usage programs is to affect behavioral change, and studies in multiple jurisdictions confirm that energy savings continues for as long as comparative usage reports are provided to households. Some recent studies indicate that there are residual effects from these programs that continue after cessation of report deliveries. PG&E will claim savings as measured by energy usage in the treatment groups compared to the control groups for the duration that the reports are mailed. PG&E will undertake studies to understand the decay rate of the treatment effect should a particular program or measure be terminated.**[[10]](#endnote-10)**.

As a result, PG&E is claiming the savings on a quarter to quarter basis for all “Waves” of the program. The EUL will be 20 years for each Wave from the start of report deliveries, stipulating that the EUL will shorten to an appropriate length determined by study should the program end for any particular wave or group of customers.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Building type** | **Bldg Vintage** | **Climate Zone** | **EUL (yrs)** | **RUL (yrs)** | **DEER Version** | **Impact IDs** |
| **RES** | **ALL** | **ALL** | **20** | **DNA** | **From Study** | **From Study** |

**Net-to-Gross Assumption:**

The Net to Gross Ratio assumptions are noted below. Because of the nature of the program and the method of analysis, any further application of net to gross is considered redundant.

Table 2 below summarizes all applicable Net-to-Gross ratios for programs that may be used by this measure.

Table 2 Net-to-Gross Ratios

|  |  |  |
| --- | --- | --- |
| **Program Approach** | **NTG** | **Study Reference** |
| Home Energy Reports | 1.0 | See Below |

* Net-to-Gross (NTG). NTG is an adjustment made so that only energy efficiency gains that are a direct result of an energy efficiency program are reflected. We propose that NTG be treated for each of the types of savings resulting from behavioral programs:
  + Behavioral changes in practices and equipment installations resulting from the treatment will be reported without additional NTG adjustment. By definition, experimental design isolates the unique impact of the comparative usage program to the treatment group, so the reported results will be “net” impacts.
  + Equipment purchases that have been rebated and claimed by another utility program will not be included in the savings claim, so any NTG adjustment would be made through the savings claims for those measures rather than through savings claims for behavioral programs. Consequently no NTG adjustment would be applicable[[11]](#endnote-11)

**In-service rate/first year installation rate**:

* The in-service rates are not relevant to this particular set of measures since savings are derived from actions taken as the result of the communications with the customer. ISR = 1.0

***1.4.3.3 Evaluation, Measurement and Verification (EM&V) of Residential Behavior-Based* *Energy Efficiency Programs[[12]](#endnote-12)***

*This report provides guidance and recommendations on methodologies that can be used for estimating energy savings impacts resulting from residential behavior-based efficiency programs. Regulators, program administrators, and stakeholders can have a high degree of confidence in the validity of energy savings estimates from behavior-based programs if the evaluation methods that are recommended in this report are followed. These recommended evaluation methods are rigorous in part because large-scale behavior-based energy efficiency programs are a relatively new strategy in the energy efficiency industry and savings per average household are small. Thus, at least until more experience with the documentation of energy savings with this category of programs is obtained, rigorous evaluation methods are needed so that policymakers can be confident that savings estimates are valid (i.e., that the estimates are unbiased and precise)*.

The document discusses techniques *for ensuring that the estimated savings impacts for a behavior-based energy efficiency program are valid for a given program participant population and a given time frame (the first year[s] of the program); this is commonly referred to as* internal validity. *Methods for ensuring internal validity are well established and are being utilized by several behavior-based programs.*

It also discusses *several evaluation design and analysis factors that affect the internal validity of the estimated savings impact: the evaluation design, the length of historical data collection, the estimation method, potential evaluator conflicts of interest, and the exclusion of data from households that opt out of a program or close accounts during the study period*. It also discusses *methods for avoiding the double counting of energy savings by more than one efficiency program.*

The contribution of this document is the derivation and definition of the operative mathematical models underlying this series of program interventions. These models can be seen in Section 2.1 and are pulled directly from this work.

## 1.4.4 Assumptions and Calculations from other sources—Base and Measure Cases

There are no further data or calculations provided for the support of the measures in this work paper.

***1.4.5 Time-of-Use Adjustment Factor***

We are required by CPUC decision 06-06-063 dated June 29, 2006 to apply time-of-use (TOU) adjustment factors on residential A/C and commercial A/C (packaged and split-system direct-expansion cooling) measures only. Since PG&E is not claiming electric Demand savings, the TOU adjustment factor is 0.

The specific values and results are summarized in

Table 4.

Table 4 TOU Adjustment Factors

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure** | ***kWAC*** | ***kWTotal*** | **%** |
| AC unit etc. | 0 | 0 | 0 |

***1.5 Summary of Inputs for Savings Calculations***

The following table provides references to sections that document the inputs for calculation:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Input Variable** | **Variations** | **Base Case 1 Average Value** | **Base Case 2 Average Value** | **Measure Case Average Value** | **Reference Section** |
| **Electric Savings** | SFm only | N/A | N/A | *ex post* | *Section 1.4.3.4* |
| **Gas Savings** | SFm only | N/A | N/A | *ex post* | *Section 1.4.3.4* |
| **Hours of operation** | SFm only | N/A | N/A | N/A | *Section 1.4.3.2* |
| **Full Cost** | SFm only | N/A | N/A | 0 | *Section 1.4.3.2* |
| **Incremental Cost** | SFm only | N/A | N/A | 0 | *Section 1.4.3.2* |
| **EUL /RUL** | SFm only | N/A | N/A | 20 years | *Section 1.4.3.2* |
| **NTG** | One | N/A | N/A | 1.0 | *Section 1.4.3.2* |
| **ISR** | Applies --No | N/A | N/A | 1.0 | *Section 1.4.3.2* |
| **TOU Factor** | *A/C projects only* | N/A | N/A | **0.0** | *Section 1.4.5* |

# Section 2. Calculation Methods

## 2.1 Electric Energy Savings Estimation Methodologies

* This section describes the overall ex post analysis technique for calculating savings resulting from this program. There are no ex ante values calculated as the result of this section.
* This measure includes HVAC interactive effects savings, as noted in 1.4.3.2
* This measure is not an Early Retirement measure.

The electric and gas savings are taken directly from billing data collected on the members of each of the control and treatment groups of each wave as described in sections 1.2 and 1.4. The analytical analysis of the data requires the following assumptions:

1. The calculation of savings derives from a panel-based regression analysis whereby the aggregate energy use of the control group and that of the treatment group are compared over a period of time. This is discussed in Section 1.4.3.3 and other References (see Reference List). The beginning and ending billing aggregates are compared using regression analysis to determine a mean value of difference in the savings or increases in use.
2. The participants are counted based on rules set out in 1.2 and 1.4, opt outs are continued to be counted while move outs are not. The number of participants in each group constituting the control and treatment groups is counted as the participants in the group at the end of the test period.

So the analysis is

Energy saved = Average change in energy use (average energy saved) for the control group - Average change in energy use (average energy saved) for the treatment group

Or**[[13]](#endnote-13)**

S = [∑ ∑ y*it* **-**∑ ∑ y*it* ]**-**

*i* ≡ treatment group t ≡ preprogram *i* ≡ treatment group t ≡ post program

[∑ ∑ y*it* **-**∑ ∑ y*it* ]

*i* ≡ control group t ≡ preprogram *i* ≡ control group t ≡ post program

where[[14]](#endnote-14)

y*it* = µ*i* + βtreat*i* +ᵟMonth of Sample*i* +ε*it* where;

µ*i* = Household fixed effects

βtreat*i* = indicating whether household is in the treatment or control groups

β = estimated household savings impact,

ᵟMonth of Sample*i* =a time variable indicating the month of the data sample from 1 to the last month the sample (e.g.,1 to 36 )

ε*it =* error

*i* = household in a designated group

*t* = time in the test, indicated here as the “end” of the test period.

Since our intent for the purposes of this work paper is to define the process of calculating the savings for the *ex post* analysis of the program and as noted in 1.2 and various sections of 1.4, this includes the effects of opt outs, “move outs” and other statistical variances during the treatment period. Since we are using billing data for randomly selected user quartiles and weather areas, these variables are also considered to be accounted for. The further analysis of participants for rebate activity and the 400 household plug survey should account for the participation in PG&E rebate programs. Interactive effects are built in due to the use of billing data.

## 2.2. Demand Reduction Estimation Methodologies

* PG&E does not intend to claim Electric Demand Savings from the HER program at this time. The company may reconsider its position should analysis and studies of the program reveal kW savings that can be verified under the appropriate ED approved procedures.

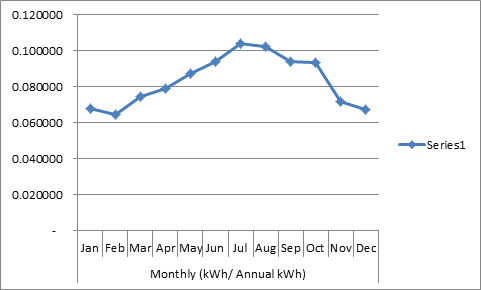
## 2.3. Gas Energy Savings Estimation Methodologies

* This section describes the overall ex post analysis technique for calculating savings resulting from this program. There are no ex ante values calculated as the result of this section.
* This measure includes HVAC interactive effects savings, as noted in 1.4.3.2
* This measure is not an Early Retirement measure.

The gas energy savings for each measure follow the same process as do the electric savings except they utilize gas billing data rather than electric billing data for the affected households.

*Section 3. Load Shapes*

The load shape for this program is, in fact, determined by actual billing data adjusted ex-post by rebate participation and statistical analysis. We expect that load shapes for the impacts of the program can be generated to determine daily and monthly results for E3 analysis of the program. However, this analysis is not as yet complete and we have provided a “strawman” Load Profile suitable for initial valuation of the program.



This is the monthly load shape for   RES      DEER:RefgFrzr\_HighEff (Target Sector and Electric End Use Shape) from the E3:

## 3.1 Base Case Load Shapes

The most conservative load shape which fits the linear nature of the data over monthly periods chosen for this measure is the DEER: Res. Refrigerator –Freezer Monthly shape. See Table 6 for a list of all Building Types and Load Shapes. See the KEMA report [31] for a more thorough discussion regarding the load shapes for this measure.

Table 6 Base Case Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **E3 Alt. Building Type** | **Load Shape** |
| Single Family Residence | RES | DEER:RefgFrzr\_HighEff |

## 3.2 Measure Load Shapes

The measure load shape for this measure is determined based on the applicable residentialmarket sector and the Refrigerator Freezer end-use. This load shape is from the same as the base case due to the statistical and random nature of the savings generated by this program and is shown by the load shapes listed below.

Table 7 Measure Case Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **E3 Alt. Building Type** | **Load Shape** |
| Single Family Residence | RES | DEER:RefgFrzr\_HighEff |

# Section 4. Base Case & Measure Costs

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period Gross Measure Cost (RUL)** | **Second Baseline Period Gross Measure Cost (EUL – RUL)** |
| ***NC (new construction)*** | EUL | Calculated as Incremental Measure Cost | N/A |
| ***ROB(replace on burnout)*** | EUL | Calculated as Incremental Measure Cost | N/A |
| ***ER (early retirement)*** | RUL/  EUL-RUL | Calculated as Full Gross Measure Cost | Calculated as Negative Full Gross Base Case Cost |

## 4.1 Base Case(s) Costs

The following Measure Application Type is appropriate to this program. The Base Case Costs are:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline**  ***(Control Group)*** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Base Case Cost** |
| *All* | ROB | *Existing Customer Behavior* | *0* | *0* | *0* | *0* |

*All costs are noted as $ per measure unit*

## 4.2 Measure Case Costs

The following Measure Application Types) is appropriate to this program. The Measure Case Costs are:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Measure Usage**  **(Treatment Group)** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Measure Case Cost** |
|  | ROB | *Resulting Customer Behavior* | *0* | *0* | *0* | *0* |

*All costs are noted as $ per measure unit*

## 4.3 Incremental & Full Measure Costs

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Gross Measure Cost**  **(RUL Period/First Baseline)** | **Gross Measure Cost**  **(EUL-RUL Period/ Second Baseline)** | **Incremental Measure Cost** |
| ROB | Measure Equipment Cost  – Base Case Equipment Cost | N/A | Measure Equipment Cost  – Base Case Equipment Cost |

# *4.3.1 Gross Measure Cost*

Gross Measure Cost is the cost to install an energy efficient measure per the CPUC calculators. This definition implies a different meaning depending on the Measure Application type.

This Measure Application Type is **ROB**, so the Gross Measure Cost (GMC) is represented by the equation below:

GMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: We assume that, unless stated otherwise, the measure case labor and base case labor are assumed to be the same value reducing the equation to the following:

GMC = Measure Equipment Cost – Base Case Equipment *Cost*

*GMC = $0.00 per (unit) - $ 0.00 per (unit) = $0.00 per unit*

# *4.3.2 Incremental Measure Costs*

Incremental Measure Cost is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure. While IMC has a straightforward definition depending on the Measure Application type, the equation does vary.

This Measure Application Types is **ROB** so the Gross Measure Cost (GMC) is represented by the appropriate equation below:

IMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: Unless stated otherwise the measure case and base case labor costs are typically the same, reducing the equation to the following:

IMC = Measure Equipment Cost – Base Case Equipment Cost

*IMC = $0.00 per (unit) - $ 0.00 per (unit) = $0.00 per unit*

**Summary Table for Section 4**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Measure ID** | **Measure Application Types** | **Base Case Total Cost** | **Measure Case Total Cost[[15]](#endnote-15)** | **Gross Measure Case Cost** | **Incremental Measure Cost** |
|  | ROB | **0** | **0** | **0** | **0** |

# Input Appendices

Email from Doug Naaf to Steve Blanc, 12/11/12 9:44AM

This is the monthly load shape for RES DEER:RefgFrzr\_HighEff (Target Sector and Electric End Use Shape) from the E3:

This is about as flat a load shape as the E3 has, varying from .06 to a little over .10, per month.

|  |  |
| --- | --- |
| **Monthly (kWh/ Annual kWh)** |  |
| Jan | 0.068159 |
| Feb | 0.064584 |
| Mar | 0.074515 |
| Apr | 0.078836 |
| May | 0.087198 |
| Jun | 0.094059 |
| Jul | 0.103834 |
| Aug | 0.102265 |
| Sep | 0.093883 |
| Oct | 0.093235 |
| Nov | 0.071865 |
| Dec | 0.067569 |

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Davis, Matt; *Behavior and Energy Savings, Evidence from a Series of Experimental Interventions;* Environmental Defense Fund; 2011

Agnew, Ken, etal.; *Mo’Power to the Customer: An evaluation of a Duel Fuel Home Energy Reports Program;* KEMA

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Allcott, Hunt and Rogers, Todd; *The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation;* October 16, 2012

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**Endnotes**

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2. State and Local Energy Efficiency Action Network (SEE Action); Evaluation, Measurement and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations; May 2012; [www.seeaction.gov](http://www.seeaction.gov) [↑](#endnote-ref-2)
3. California Public Utilities Commission, Decision 09-09-047 September 24, 2009 -- Application of Southern California Edison Company (U338E) for Approval of its 2009-2011Energy Efficiency Program Plans and Associated Public Goods Charge (PGC) and Procurement Funding Requests, Date of Issuance 10/1/2009; pg. 304 [↑](#endnote-ref-3)
4. California Public Utilities Commission, Decision 10-04-029 April 8, 2010 -- Application of Southern California Edison Company (U338E) for Approval of its 2009-2011 Energy Efficiency Program Plans and Associated Public Goods Charge (PGC) and Procurement Funding Requests, Date of Issuance 4/21/2010, pp.40-42 [↑](#endnote-ref-4)
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6. PG&E CES EM&V Dept.; *IOU Proposal for Reporting Energy Savings for Comparative Usage* *Energy Efficiency Programs,* May 8, 2012 Revision; pg 4 [↑](#endnote-ref-6)
7. PG&E CES EM&V Dept. *PG&E Home Energy Reports Initiative* *Sampling Plan* May 17,2011 Revision [↑](#endnote-ref-7)
8. PG&E CES EM&V Dept.; *IOU Proposal for Reporting Energy Savings for Comparative Usage* *Energy Efficiency Programs,* May 8, 2012 Revision; pg 4 [↑](#endnote-ref-8)
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13. State and Local Energy Efficiency Action Network (SEE Action); pg. 64. [↑](#endnote-ref-13)
14. Ibid, pg. 63 [↑](#endnote-ref-14)
15. SCE, Measure Cost Revision 5 revised for PG&E by S.L. Blanc 2012

    [↑](#endnote-ref-15)