PG&E WHOLE HOUSE PROGRAM: MARKETING AND TARGETING ANALYSIS

Final

Prepared for:

PACIFIC GAS AND ELECTRIC COMPANY

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1.   EXECUTIVE SUMMARY

PG&E's Whole House[1] Program offers incentives to homeowners who complete multiple energy-saving home improvements in one integrated effort. These incentives reward customers for addressing home energy efficiency needs holistically instead of piece-by-piece. To receive support from the program, the house must be able to save at least 10% of its baseline energy use. The program was rolled out as a pilot in August 2010, with a large amount of ARRA-funded marketing through local governments and regional organizations. Since then, there has been a limited amount of direct marketing in support of the program by PG&E.

This report describes the key findings from a Whole House program targeting and marketing study that included surveying 615 PG&E customers (participants and non-participants) and conducting a pre-post billing analysis with 912 program participants.

In general, among the PG&E target population of homeowners, aided program awareness in the summer of 2013 was 34% and over 2,500 households in PG&E's territory had received rebates between the pilot launch date in 2010, and May 2013.[2]

Customers need assistance and motivation to make the leap from intent to take action to actually taking action in this program. This study identified ways that the program can both find potential participants (with intent to take action and with high savings potential) and some ways to best message to them that will help bridge the chasm from intent to do whole house upgrades to actually performing them. Specific findings from the report include:

Participant Characteristics: Through our participant survey, and a comparison of participants to the survey of the general population, we found that the participant population has several distinguishing characteristics: the majority of participants are higher income households with greater levels of education compared to non-participants and groups who have not completed the program. We also found that participants do not face constraints to program participation related to the structure or age of their home (a mean score of 9.1 out of 10 indicating a lack of constraint). As expected, participants expressed the lowest financial constraints to getting whole house retrofits. In other words, participants were able to overcome the major obstacle of the cost barrier to participation. Among this group of participants comfort is one of the strongest benefits of participation.[3] Reducing energy usage and saving money on energy bills (two related concepts) were also among the main program benefits.

Potential Target Population: The research isolated three types/categories of non-participants. Specifically we found that the targeted population breaks down into: and those with full intent (17%), those with limited intent to take action (66%), and those with no intent to do whole house upgrades (17% of the population of single-family homeowners). Notably, those with limited intent are very similar to participants in terms of awareness and knowledge, concern and personal responsibility as they relate to energy issues in the home. When we explored what specific actions the limited and full intent

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[1] The statewide program name changed in 2014 to the "Energy Upgrade California Home Upgrade" or just "Home Upgrade" Program.

[2] Notably, the billing analysis component of this study focuses on those households with both gas and electric (a total of 912 households).

[3] Note that this was asked after customers participated in the program.

customers intended to take, we found that approximately one fifth of homeowners plan to install insulation, or upgrade their windows, or HVAC equipment to ENERGY STAR models.

Barriers and Messaging: Financial constraints are the largest reason for not being able to take action to complete a home upgrade. The program needs to address financial constraints by making customers aware that there is financial support available. Financial support can come in the form of both incentives (currently offered) and increasing awareness of attractive financing options available to home owners. Further, self-efficacy and perceived behavioral control[4] are also large barriers to participation. Home comfort is a central issue for a large portion of the population. We found that those with intent demonstrate higher levels of awareness/knowledge and concern for home comfort than those without intent to retrofit. In addition to comfort, both finances (energy bills) and the environment resonate with some customers. However, neither is as unifying as comfort as a potential platform for program messaging. Our research shows the combination of home comfort and the environment is the most effective in explaining the different levels of customers' intentions, program engagement, and program completion.

Savings at the Household Level: At the site level (where electric and gas are combined), the large majority (70%) of participants achieved decreases in energy use of more than 5%. These savings reflect combined electric and gas savings. While most participants saved energy, about 1 out of every 8 participants (12%) increased energy use, with about half of these (i.e., 5% of the total population) seeing increases in energy use more than 15%. The increases on the high end are due to household behavioral and occupancy changes that were not assessed within the program criteria. We also found that gas was the main driver of savings at the site level. Overall, 74% of homes showed gas savings of 5% or more. Through an examination of the differences between energy "saver" and "non-saver" populations, and analytical models that predict high savers among the population of participants, we found some key characteristics of savers. We also found some patterns of super savers in the interviewed sample. These patterns are used to elaborate a bit on the results of the analytical models. Some of the key factors include:

- ➢ **Income:** Savers are more likely to have incomes of higher than $125K.
- ➢ **Home Tenure:** Savers are more likely to have been PG&E customers for more than 15 years.
- ➢ **Home Value:** Savers are more likely to have lower home values (i.e., between $200K and $500K).
- ➢ **Gas Usage:** Savers are most likely to have low or medium total gas bill amounts. This is particularly true for those in cooler zones or in older homes. The interviewed sample showed a great deal of variability among super savers and found baseline gas usage higher, on average, than in non-super-savers due to some very high gas energy users among super savers. On the whole, though, it is the low-to-medium gas users that are most likely to save. Note- savings are calculated on a percentage basis, not in terms of absolute energy saved.
- ➢ **Climate zone or weather:** Those with the highest savings are likely to live in cooler climate zones.
- ➢ **Age of home:** Those with the highest savings are likely to live **in homes built** before 1980. The sample of participants interviewed averaged even older homes (mean 1953) among super savers than in other groups.
- ➢ **Home size:** Over the whole participant population, those with the highest savings are likely to live in homes greater than 1,500 square feet. Among the interviewed sample, *super* saver homes average about 1600 square feet, which aligns with the larger pattern of the population.

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[4] Self-efficacy (SE) is the feeling people have about their ability to make things happen the way they want. Perceived behavioral control (PBC) is the extent to which people believe they have control over certain behaviors.

> However among those interviewed, the non-super-saver groups showed a high mean square footage (almost 1900 square feet), which was due to some extremely large homes in this category—up to 7000 square feet. Therefore, in general, larger homes are more likely to save energy, but extremely large homes may hold less potential (e.g. 7000 square foot homes) for being super savers.

Another finding from the interviewed sample of saver groups showed that the size of the retrofit project, as measured by rebate amount and number of measures installed, distinguished super savers from others, interestingly these variables did not come up in the CART[5] analysis as drivers of savings. Therefore this may be a phenomenon amongst the interviewed sample but not in the population. The interviews with program participants were most helpful in defining the source of negative savers and for analyzing information (such as occupancy and behavioral changes) not available for the whole population in program records. More survey research on this topic in the future with larger sample sizes may be warranted to truly understand the characteristics of super savers.

Based on the findings from our research, we recommend the following to help PG&E to target customers in such a way that will increase savings and program uptake.

Recommendation #1: Address Constraints in Messaging and Design: Financial constraints are the largest reason for not being able to take action. The program needs to address financial constraints by making customers aware that there is financial support available if they cannot afford the upfront cost of the retrofit.

Recommendation #2: Lead with Home Comfort Message But Add Environment: Home comfort is the dominant motivator for whole house upgrades. However, our research shows that environmental messaging, when combined with comfort messages, may be the most powerful of all messaging.

Recommendation #3: Consider New Potential Measure Bundles: Based upon customers' intent to install multiple measures in the near future, there are two potential bundles of measures that could be used for the basic path to help encourage participation.

Recommendation #4: Score and Micro-target Customers: The overall savings from this program are lower than expected. Targeting high savers would help to increase savings (and average savings per home) in the future. Based on our analysis of household-level savings, using a minimum of these 13 key variables, and the stage model that can predict who has intent to do whole house upgrades, PG&E can score its entire residential customer base to identify which customers are more likely to intend to take action along and which customers have the potential for high energy savings. This would help the program target the right customers with direct marketing and outreach.

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[5] CART stands for Classification and Regression Trees. It is a software program that splits a group of participants (in this case) into finer and finer subgroups that become purer and purer on the target variable, in this case, savings level. When the splitting stops, the final subgroups are defined by the variables that contributed to each split prior to the final subgroup, and the cut-points of those variables. At each stage, CART finds the variable in the dataset that best splits the current subgroup into two subgroups, and finds the optimal value on the splitting variable that best purifies the two subgroups.

2. METHODS

This report draws on three study components:

- A process evaluation conducted in coordination with SBW Consulting
- A marketing targeting analysis study which compared energy bills
- A behavioral change study

These findings, when integrated, provide insights on participants and non-participants, and how to improve marketing, targeting, and messaging tactics. The specific tasks that supported each effort are listed below. Below we described the analytical methods used for the analysis of the Whole House program.

2.1 PROCESS EVALUATION STUDY

This report draws upon surveys that were conducted as part of the PG&E Whole House Program Phase II Process Evaluation. Surveys included:

- Participant interviews from those participating in 2012 (n=100)
- Interviews with individuals that were believed to have initiated, but did not complete, the participation process:
  - o Energy Upgrade California website users but who did not complete the retrofit process (n=100)
  - o Individuals that contacted Build It Green (BIG) via their contractors in planning a retrofit, but did not complete the process (n=50)

Each of these tasks are described in more detail in the sub-sections below.

2.1.1 PARTICIPANT SURVEY SAMPLE DESIGN AND RESPONSE RATES

We selected the sample using program records received in July 2013, which included participants in various stages of project completion. We selected 2,226 participants whose rebates had been approved, even if a rebate check had not yet been sent. The sample frame was limited to participants who joined the program between February 15, 2012 and June 27, 2013, and excluded SMUD customers. PG&E offered customers a $50 incentive to complete the survey. We randomly called a sample of 663 and completed 100 interviews between June 24 and July 26, 2013. Using AAPOR[6] standards and formulas, we calculated a 16% response rate and a 60% cooperation rate. The 100 interviews provide data that is representative of the population at the 90% confidence interval with ±8% precision.

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[6] *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, AAPOR, 2011. http://www.aapor.org/AM/Template.cfm?Section=Standard_Definitions2&Template=/CM/ContentDisplay.cfm&ContentID=3156

2.1.2 ENERGY UPGRADE CALIFORNIA WEBSITE DROPOUT SURVEY SAMPLE DESIGN AND RESPONSE RATES

We selected the sample using program records received in April 2013, which included PG&E customers who created an action plan and/or contacted a qualified contractor through the Energy Upgrade California website. We did not place any date restrictions on the timing of when the customer used the website, but we excluded any customers who were in the program records indicating they had proceeded with a retrofit. We also removed any customers who did not provide valid phone numbers. Our final sample frame consisted of 874 total customers. Survey respondents received a $50 incentive for their participation. Ultimately, we completed 100 interviews from June 19 to June 25, 2013. Using AAPOR standards and formulas, we calculated a 20% response rate and a 53% cooperation rate.

2.1.3 BUILD IT GREEN DROPOUT SURVEY SAMPLE DESIGN AND RESPONSE RATES

We selected the sample using program records received in June 2013, which included PG&E customers who appear in BIG program records for receiving an assessment through the program, but did not fully complete a retrofit project. We did not place any date restrictions on the timing of when the customer received the assessment, but we excluded any customers who were in the program records as having completed any equipment installations through the program. We also removed any customers who did not provide valid phone numbers. Our final sample frame consisted of 307 total customers. Survey respondents received a $50 incentive for their participation. We tried to interview every participant in the sample frame and we called each multiple times. Ultimately, we completed 50 interviews from June 20 to June 28, 2013. Using AAPOR standards and formulas, we calculated a 21% response rate and a 54% cooperation rate.

2.2 MARKETING TARGETING ANALYSIS STUDY

The marketing targeting analysis was designed to estimate the savings for individual participants, to allow us to answer the questions of how many of the participants are saving energy, which participant households are saving, and how much they are saving. These estimates of individual participant savings were also used in the targeting analysis. We decided that the best approach was to use individual regressions, one for each participant household, so that the savings estimate for each household is truly specific. This allows us to interpret the estimate of energy savings as the participant would view their own savings.

This research effort was designed and executed to support the Whole House Program marketing and targeting efforts. The core goal of the research was to develop recommendations that will allow the program marketing team to better tailor and target customers. These analyses are limited to customers who use PG&E as both an electric and gas provider so that Opinion Dynamics was able to assess whole house energy usage changes. This research effort did not attempt to evaluate program impacts.

2.2.1   CUSTOMER-SPECIFIC BILLING ANALYSIS

The Evaluation Team conducted a pre-post comparison of the participant consumption data to estimate actual energy savings for each participant due to the Whole House program. Opinion Dynamics estimated the weather-corrected usage change of each household with a customer-specific linear regression model. The purpose of estimating energy savings is to inform program process, specifically marketing and messaging decisions through a targeting analysis. This billing analysis is designed to be the source of participant-specific savings estimates for use in the targeting analysis.

We used a linear regression model to estimate customer specific average daily consumption for electricity and another for gas. The model includes terms for program participation and weather, using HDD and CDD, both with a base of 65 degrees Fahrenheit. The form of the model is:

$$ADC_t = \beta_0 + \beta_1 Post_t + \beta_2 HDD_t + \beta_3 CDD_t + \beta_4 Post_t \cdot HDD_t + \beta_5 Post_t \cdot CDD_t + \varepsilon_t$$

Opinion Dynamics estimated savings for each customer for each fuel by first calculating their modeled usage over the post period, then setting the "Post" variable to zero which allows us to calculate their modeled usage "in the absence of the program" and finally subtracting the first estimate from the second to arrive at the estimate of savings. We also calculated combined savings by converting kWh and therm savings into kBTU savings and summing the savings estimates from the gas and electric models. These participant-specific savings estimates are then used in the targeting analysis.

2.2.2   TARGETING ANALYSIS: CLASSIFICATION AND REGRESSION TREE (CART) ANALYSIS

The purpose of the targeting analysis is to understand how the following factors influence energy savings:

- ➢ Geography and climate

- ➢ Program and project characteristics (e.g. Contractor used or types of energy upgrades made)

- ➢ Demographic characteristics

- ➢ Household characteristics

Understanding how these factors relate to differences in program-induced energy savings provides insight that PG&E can use to further refine its targeting and messaging approaches.

We first sorted the participants into the following groups by their billing analysis estimated savings:

- ➢ "Super Savers" are homes that decreased gas or electric usage by 30% or more or combined usage by 20% or more after the program intervention

- ➢ "Positive Savers" are homes that decreased combined usage by 5% or more after the program intervention

- ➢ "Neutral Savers" are homes with combined usage that changed less than 5% as a result of program participation

- ➢ "Negative Savers" are homes that increased usage by 5% or more after the program intervention

CART is a modeling technique that identifies the parameters that are most influential and predictive at explaining the dependent variable. In this case, the dependent variable is membership in one or more of the groups above. CART analysis is ideally suited for narrowing down the set of core predictors of the dependent variable and identifying sub-groups of participants that are more or less likely to save energy.

We ran a CART analysis using a variety of participant household characteristics that contractors collected during audit visits to participant households as well as information about the households from Targetbase, a database of household characteristics. We ran a large number of CART analyses to sift through all these variables to identify the core variables that are the most influential in explaining the dependent variable. We selected models to report on that do a good job of classifying participants into the correct savings group and give us useful information about groups of participants who might benefit from marketing effort.

2.3 BEHAVIOR CHANGE STUDY

2.3.1 OVERVIEW OF SURVEYS FIELDED

After pre-testing questionnaire items in a survey of California homeowners (n=186) we fielded five surveys with the final items to collect the behavior change data for the current study. The five surveys were targeted to five different populations within the PG&E customer base:

- **General Population/Non-Participant Survey (n=264):** This survey included homeowners in PG&E service territory who did not appear in Whole House program records as having engaged with the program in any way. Survey respondents were offered a $50 incentive for their participation and the response rate was 9%. Each survey respondent was weighted for age according to U.S. Census county-level, owner-occupied housing data.
- **Web dropout (n=100):** This survey included PG&E customers who created a project action plan and/or made contact with qualified contractors on the Energy Upgrade CA website, but had not completed a home energy assessment according to program records. This survey was coordinated with the process evaluation which is completed and available on CALMAC. Survey respondents were offered a $50 incentive for their participation. Details provided in Section 2.1.2.
- **BIG dropout (n=50):** This survey included PG&E customers who appeared in BIG program records but did not fully complete a project. This survey was coordinated with the process evaluation. Survey respondents were offered a $50 incentive for their participation. Details provided in Section 2.1.3.
- **2012 Participant survey (n=101):** This survey included 2012 participants and was coordinated with the process evaluation. Survey respondents were offered a $50 incentive for their participation. Details provided in Section 2.1.1.
- **2011 Participant survey (n=100):** This survey included 2011 participants (N=430), some of whom participated in the 2011 Process Evaluation Survey which is completed and available on CALMAC. The survey was fielded July 31st, through August 5th 2013. Survey respondents were offered a $50 incentive for their participation and the response rate was 27%.

Each group of survey respondents represented a type of program participant (from true non-participants to full participants) and therefore behavior change; however, we divided the original survey respondents into new groups based on their survey responses as shown in Table 1 below.

Table 1. Reclassification of Respondents Based on Survey Responses - # of Respondents

Original Classification	Reclassification Categories						
	Gen Pop No Intent	Gen Pop Limited Intent	Gen Pop with Intent	Post Web Dropout	Post Audit Dropout	Participant	Total
General Population (non-participant)	44[a]	175[b]	45[c]	-	-	-	264
Web Dropout (partial participant)	-	-	-	47[f]	31[d]	22[e]	100
BIG Dropout (partial participant)	-	-	-	-	33[d]	17[e]	50
2012 Participant (full participant)	-	-	-	-	-	101	101
2011 Participant (full participant)	-	-	-	-	-	100	100
Total	44	175	45	47	64	240	615

[a] These 44 respondents had no intent to complete a home energy upgrade in the next 2 years, i.e., score less than 7 on "BI1. I intend to invest in a major home energy upgrade within the next two years" using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', nor had any intention to complete two or more of the following upgrades in the next two years: Perform air sealing; Perform duct sealing or duct insulation; Install attic, wall, or floor insulation; Upgrade windows, doors or skylights; Upgrade to ENERGY STAR appliances; Upgrade to ENERGY STAR heating or cooling equipment

[b] These 175 respondents had no intent to complete a home energy upgrade in the next 2 years, i.e., score less than 7 on BI1 (see note above) but have intention to complete two or more of the upgrades listed in the note above.

[c] These 45 respondents plan complete a home energy upgrade in the next 2 years, i.e., score of 7 or more on BI1 (see note above).

[d] These 64 respondents across two surveys stated they received audits but then decided not participate in the program as indicated in responses to PR1D "Has an Energy Rater come to your home to conduct an energy assessment to see if you qualify for incentives for home energy upgrades through the Whole House Program?"; PR1C "Did the Energy Rater recommend any upgrades that you could install in your home through the Whole House program?"; and PR3 "Have you decided whether you will conduct work on your home through the Whole House program?".

[e] These 39 respondents across two surveys stated they received audits and would participate in the program as indicated in the three items listed in the note above.

[F] These 47 respondents did not proceed after signing up on EUC website.

2.3.2 OVERVIEW OF SURVEY ITEMS

Across the five surveys, we collected data assessing the reasons that might motivate homeowners to invest in energy efficiency across multiple behavior stages. Central to this research was testing the behavior change model (see Figure 1) as it applied to three different motivational domains defined to be major drivers of investment in energy efficiency retrofits, i.e., "home comfort", "environmental" or "financial" (paying energy bills). The model shown here is a stage model that describes the typical stages that people move through toward the end of changing a specific behavior, when the change is deliberate. Each questionnaire item had the potential to map to multiple concepts, including:

- one of the three motivational domains;
- one of five behavioral stages (Figure 1) ranging from awareness/knowledge to behavior change;

- either general intent to save energy or to take EUC program-specific actions.

For example, the item "I sometimes worry whether there is enough money to pay my energy bill" maps to a level of concern for finances. We created the questionnaire items for this study or modified them from past studies based on the behavior change framework.[7]

Figure 1. Behavior Change Model
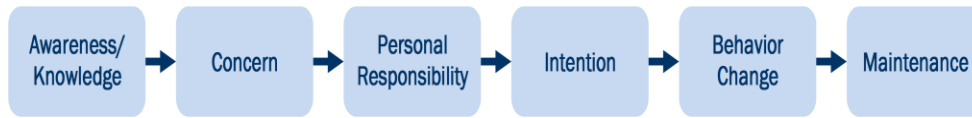
We also developed survey items to measure three additional concepts, which can engender or thwart energy efficiency intent and behavior. Self-efficacy (SE) is the feeling people have about their ability to make things happen the way they want. Perceived behavioral control (PBC) is the extent to which people believe they have control over certain behaviors. Family, friends, colleagues (FFC) reflects the influence these key people may have on an individual's behavior.

2.3.3   DERIVING CONSTRUCT MEASURES

We sought items or combinations of items that could reliably measure the various constructs that are of interest in this study. By construct, we mean the underlying psychological concepts (e.g., financial knowledge, concern with comfort, responsibility for the environment, etc.) that are tied to energy efficiency intent and behavior and distinguish participants from non-participants. We created the constructs from the model's theoretical framework and statistical patterns in respondents' scoring of items on 0 to 10 scales, which represented their levels of agreement, awareness, concern, etc. Lower scores generally indicated low levels and higher scores generally indicated high levels. The research team assessed reliability and validity through an examination of the distribution of responses, scalability, and construct validity (these concepts are more fully described in Appendix A). Appendix A includes a table that lists the 18 final constructs used in the analysis as well as the items that compose each one.

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[7] This included McClaren, M.S., A. Dunn, and J. Peters. 2013. "*akAB Theory: Moving from Theory to Application*". In Proceedings of the International Energy Program Evaluation Conference. Chicago, IL: International Energy Program Evaluation Conference. Other work that developed or validated the model are: Randazzo, K.V., & Peters, J.S. *Reconsidering What We Measure: A White Paper*, 2011; Peters, J.S., Spahic, M.S., Dunn, A., & Randazzo, K.V., *2011-2012 General Households Population Study in California*, CALMAC Study ID: SCE0321, 2012; Randazzo, Peters, Chen, Smith & Fessel, *Refining and AKA-B Model for Greater Behavior Change*, Proceedings of Behavior Energy & Climate Change Conference, 2012; The Cadmus Group, 2010-2012 *PG&E and SCE Multifamily Energy Efficiency Rebate Program (MFEER) Process Evaluation and Market Characterization Study*. CALMAC Study ID: PGE301.01.

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3.   DETAILED FINDINGS

3.1   OVERVIEW AND PROGRAM DESCRIPTION

Program Design and Marketing to Date

PG&E's Whole House Program offers incentives to homeowners who complete multiple energy-saving home improvements in one integrated effort. These incentives reward customers for addressing home energy efficiency needs holistically instead of piece by piece. To receive support from the program, the house must be able to save at least 10% of its baseline energy use. The program was rolled out as a pilot in August 2010, with a large amount of ARRA-funded marketing through local governments and regional organizations. Since then, there has been a limited amount of direct marketing in support of the program by PG&E.

PG&E's marketing has largely focused on one-on-one, face-to-face opportunities with customers such as community events and supporting contractors' face-to-face marketing tactics. As part of its efforts to support contractors, PG&E has provided co-marketing opportunities to contractors. PG&E is also working to drive customers to the PG&E program website, and plans to implement other digital marketing efforts in the summer of 2014. The messaging to date has included information around the incentives, the ability of the program to lower energy bills, home comfort, helping the environment, and support by qualified contractors.

In general, among the PG&E target population of homeowners, aided program awareness in the summer of 2013 was 34% and over 2,500 households in PG&E's territory had received rebates between the pilot launch date in 2010, and May 2013.[8]

Figure 2. Whole House Program Awareness

n=264

Aware 34%

Unaware 66%

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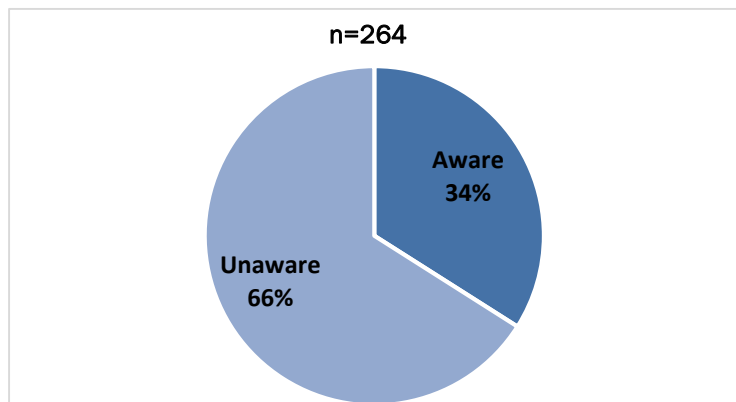
[8] Notably, the billing analysis component of this study focuses on those households with both gas and electric (a total of 912 households).

Note: Respondents were asked: The Energy Upgrade California Whole House Program provides rebates for homes that receive a full set of energy improvements. Have you heard about such a program?[9]

Study Design and Key Research Questions

This report integrates key findings from a Whole House program targeting and marketing study focused on the following research questions:

- ➢ Who is participating in the program and why?

- ➢ What percentage of the non-participant population could be a target, and with what offerings?

- ➢ Why do some customers drop out or decide not to move forward?

- ➢ What messages will resonate with targeted homeowners – those most likely to participate?

- ➢ Who is saving energy, and what are the drivers of savings?

- ➢ Why do some households increase energy use after an energy retrofit?

- ➢ How can PG&E target customers to increase savings and uptake?

Throughout the write-up below, we discuss the findings from each study that speak to the research questions above. This includes the findings from our behavior change study. Throughout this report, we show the data and concepts from our behavior study where we could reliably measure and define the various constructs from the behavior change model.[10]

3.2   PARTICIPANT CHARACTERISTICS: WHO IS PARTICIPATING AND WHY?

When comparing participants (full and partial, or dropouts) to the general population, we found that the participant population has several distinguishing characteristics. First, the majority of participants and dropouts (customers who expressed interest in the program but did not fully participate) are higher income households. Participants and dropouts also have higher levels of education compared to non-participants (Table 2).

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[9] (can't fit on prior page?) The survey described a "full set" of home energy improvements or upgrades as follows: By "full set" we mean the completion of several home improvements at the same time designed to save electricity or natural gas. These improvements might include sealing areas around windows and doors, insulating walls and attics, insulating hot water systems, updating the HVAC system, and installing high-efficiency appliances.

[10] By construct, we mean the underlying psychological concepts (e.g., financial knowledge, concern with comfort, responsibility for the environment, etc.) that are tied to energy efficiency intent and behavior. We use these constructs to distinguish participants from non-participants. For more information on what each construct entails please refer to Appendix A.

Table 2. Key Participant Characteristics

Characteristic	Gen Pop No Intent (A)	Gen Pop Limited Intent (B)	Gen Pop with Intent (C)	Post Web Dropout (D)	Post Audit Dropout (E)	Participant (F)
Income						
Less than $75k	61% DEF	53% DEF	52% DEF	34%	28%	30%
$75k or more	39%	47%	48%	66% AB	72% ABC	70% ABC
Education						
Less than college	39% DEF	56% DEF	54% EF	19%	20%	22%
College or more	61%	44%	46%	81% AB	80% ABC	78% ABC

Note: Uppercase letters within a cell indicate significance at the 90% level between the value in that cell and the value corresponding to the letter column so that the two statistics can be compared with confidence.

Overall, these characteristics help to explain some of the reasons why participants face fewer barriers to participation than the general population. Not surprisingly, the behavior change model study shows that participants are less constrained related to financial resources, as well as to the age or structure of their home. As shown in the table below, on a scale from 0 to 10 where 0 is 'Not at all agree' and 10 is 'Completely agree', participants almost all agree that they could both afford to complete a full set of energy upgrades, and that the structure of their home allowed them to complete these actions (constraints construct). This score is significantly higher than that for the dropouts or non-participant groups.

Table 3. Constraints Faced by Participants (Scale 0-10)

Group	Mean Score on Constraints Construct
Participant	9.1
Post Audit Dropout	4.3
Post Web Dropout	4.0
General Population – Full Intent	4.7
General Population – Limited Intent	4.5
General Population – No Intent	4.3

These results demonstrate that those who participate in the program are able to overcome the most significant barriers: home condition and financial resources.

In addition to understanding constraints, we also sought to understand the benefits of the program. Our findings show that customers participating in the program realize three (3) key benefits. As shown in the figure below, participants place significant value on improved home comfort.[11] Reducing energy usage and saving money on energy bills (two related concepts) are also among the main program benefits that customers experience. These three are higher than the value of helping the environment,

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[11] Note that this question was asked after customers participated in the program and is based upon what they realized when finished with the program, not what their expectations prior to the program may have been

health related benefits, and increases in home market values, although these are also cited as benefits by a significant portion of program participants.

When we used the survey data to model what predicts intent and engagement with the program[12], we found that concerns in all customer types predict level of intent among the general population, but that only constraints predicted drop out (or conversely, program completion) once the customer had engaged with the program. In other words, concerns about comfort, finances, and environment predict intent and engagement with the program, but they lose power to predict what happens after engagement. This is aligned with what is known from the literature regarding the likelihood to follow through on self-reported behaviors; Customers may intend to make changes, but they do not always take action. We explore this important issue further below.

Figure 3. Participant Program Benefits Experienced
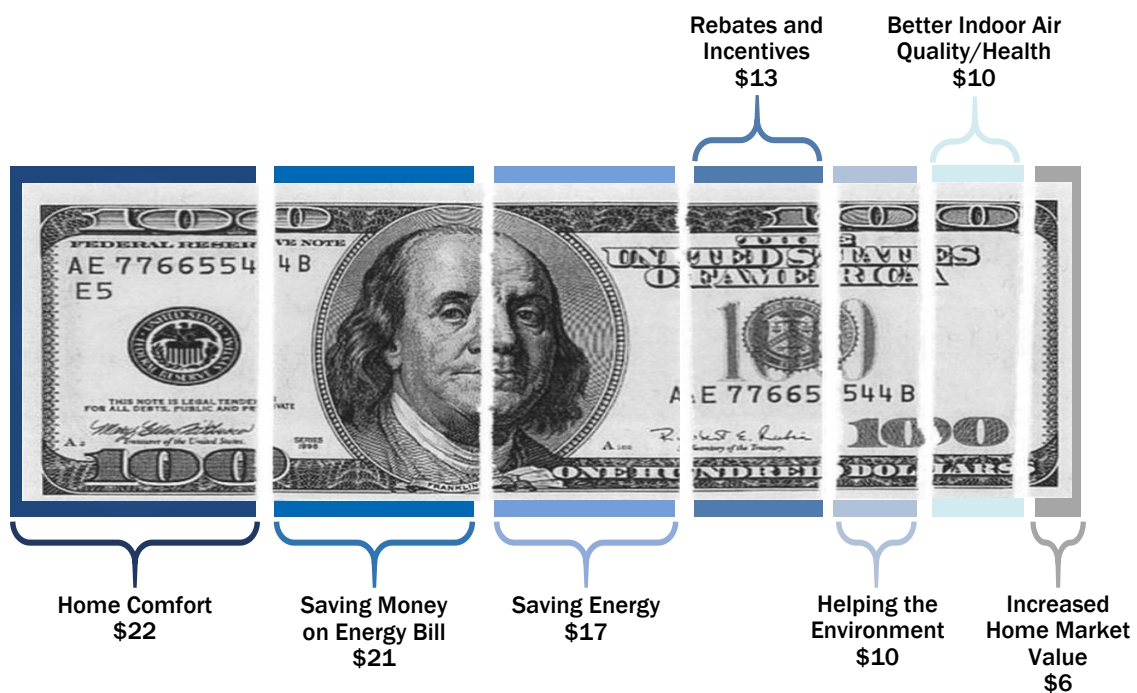
"Considering the cost of your recent retrofit and these main benefits that you experienced, if you were to express the value of each of these benefits by distributing 100 dollars across your list – how much out of 100 dollars would you pay for...?"

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[12] We estimated models separately for program-engaged customers and PG&E's general population of homeowners. Each model included concepts from both the behavior change model and non-stage concepts.

3.3 NON-PARTICIPANTS: WHAT PERCENTAGE OF THE NON-PARTICIPANT POPULATION COULD BE A TARGET, AND WITH WHAT OFFERINGS?

The research explored "intent to take action" among a general population of non-participating homeowners to identify targeting opportunities. Specifically, the research explored two areas of intent: (1) intent to complete a full set of upgrades in the next two years and (2) intent to complete two or more specific upgrades in the next two years. Through questions in each of these areas, the team isolated three categories of non-participants: those with no intent to take action (17%), those with limited intent (66%), and those with full intent (17%), where full intent refers to completing a full set of home upgrades such as what would qualify for the Whole House program.[13]

Figure 4. Non-Participant Classification Flow Diagram
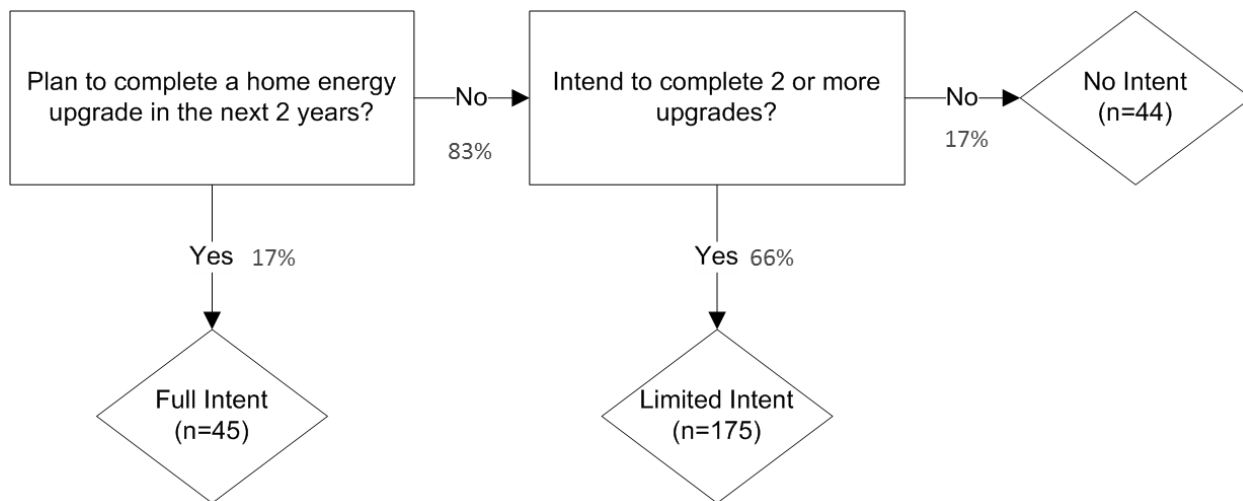
As illustrated in Figure 4, there is a large percentage of the non-participant population that has some intent to make home upgrades that can be tapped. In general, those with no intent to take action should not be targeted by the program while those with full intent may come into the program with relatively little direct outreach or messaging.

Notably, the findings surrounding intent to take action are based on a series of self-reported questions about intentions. While this approach is a stronger indicator of potential participation than just asking the individual directly about likelihood to participate, it does rely on self-reported responses, which do not fully align with actual actions. As such, some of these households will not ultimately install measures or participate in the near future.

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[13] The six upgrades we asked about were 1) Performing air sealing; 2) Performing duct sealing or duct insulation; 3) Installing attic, wall, or floor insulation; 4) Upgrading windows, doors or skylights; 5) Upgrading to ENERGY STAR appliances; and 6) Upgrading to ENERGY STAR heating or cooling equipment

To better understand these groups, the Opinion Dynamics team explored the characteristics, along the various behavioral stages, for each group. Among the general population groups, we see a steady increase in scores across the motivational domains indicating that as individuals exhibit higher levels of awareness/knowledge (A/K), concern and personal responsibility they move closer to taking action or changing their behavior – proceeding thru the stages in Figure 1. As shown, each subsequent general population group demonstrates advancement along the behavioral stages from those with no intent. This trend is shown for the three stages in Table 4 below.

Table 4. Comparison across General Population Groups

Domain	Awareness/Knowledge			Concern			Personal Responsibility		
	No Intent (A)	Limited Intent (B)	Full Intent (C)	No Intent (A)	Limited Intent (B)	Full Intent (C)	No Intent (A)	Limited Intent (B)	Full Intent (C)
Comfort	7.0	7.9^A	7.8	6.8	8.0^A	8.5^{AB}	7.9	7.7	9.2 ^{AB}
Financial	5.2	7.4^A	7.7^A	5.5	6.5	7.5 ^{AB}	6.3	7.3 ^{A}	8.3 ^{AB}
Enviro.	5.9	6.7^A	7.6^{AB}	6.0	6.5	7.9^{AB}	5.2	6.2	7.6^{AB}

Note: Uppercase letters within a cell indicate significance at the 90% level between the value in the cell and the value(s) in cells corresponding to the lettered columns. In addition, the values were calculated by averaging the survey items—scored on 0 to 10 scales— that compose the construct. The greater the value, the more the group is aware of, concerned about, or feels personally responsible for topics related to energy-efficiency in the home.

In addition, our study explored self-efficacy and perceived behavioral control, two concepts that further impact customer behavior. They are not stages in the stage model, but are included in a larger causal model that can help explain why customers do and do not move to a more advanced stage. These specific concepts are probably most powerful in explaining why customers do not proceed from personal responsibility to intention to behavior change. We define these terms as follows:

➢ Self-efficacy is the feeling people have about their ability to make things happen the way they want. A high level of self-efficacy reveals that customers believe in their ability to make the targeted behavior changes.

➢ Perceived behavioral control gets at the fact that one may or may not have control over some household behaviors. For example: parents with children in the home realize that they cannot control all energy usage.

Similar to the awareness/knowledge, concern and personal responsibility trends above, we see a marked increase in self-efficacy and perceived behavioral control scores as customers intend to take greater actions or move forward with program activity. Participants and dropouts exhibit significantly higher levels of self-efficacy and perceived behavioral control than all members of the general population – those who have not taken any program steps. Further, those in the general population with limited and full intent to take installed similar program-incented measures exhibit significantly more self-efficacy and perceived behavioral control than those with no intent.

Figure 5. Self-Efficacy and Perceived Behavioral Control among the General Population, Dropouts and Participants
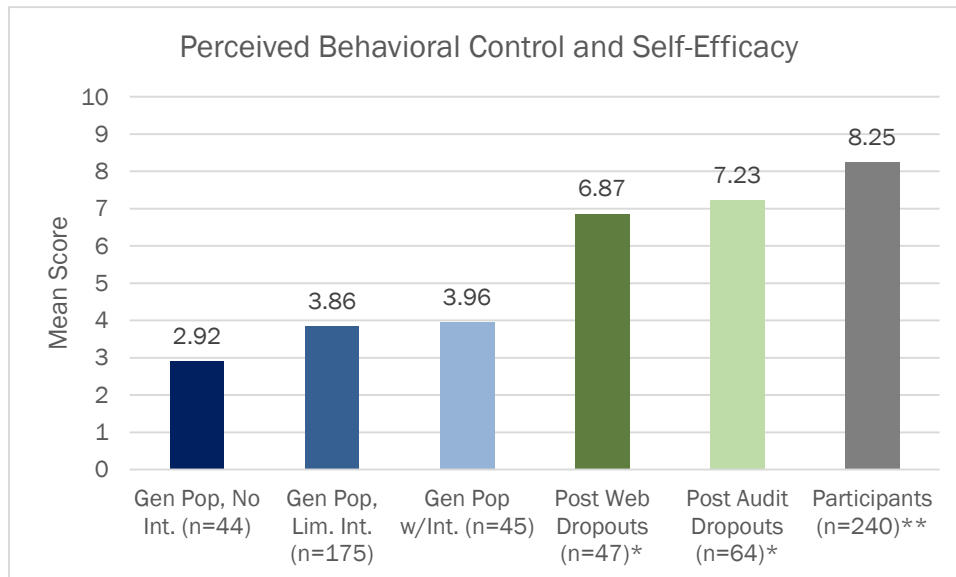
Note: * indicates significance at the 95% level compared to the general population groups. ** indicates significance at the 95% level compared to all other respondent groups.

In summary, the general population groups with some level of intent can be described as follows:

➢ Those with **limited intent** show: (1) increased levels of awareness and concern for home comfort, the environment, and energy bills, (2) a greater sense of personal responsibility for the environment and finances (energy bills), and (3) greater levels of self-efficacy and perceived behavioral control compared to the general population with no intent.

➢ The **full intent** group distinguishes itself from the other general population groups based on their higher level of expressed interest and intent to take action. A key aspect of this is the high level of personal responsibility and at least moderate levels of self-efficacy and perceived behavioral control, which are not seen in the other non-participant groups.

To better understand the differences among members of the general population, we also examined how the general population compares to those who have participated or begun the process and dropped out. Overall, the research indicates that similarities exist between those with limited intent and participants making them a prime group for program marketing efforts. Figure 6 provides the first indication of this from the comfort domain revealing those with limited intent are on par in terms of the concepts of awareness and concern around comfort – as those who actually participated. Where they score lower is in the dimension of personal responsibility.

Figure 6. Few Differences on Comfort in General Population Compared to Participants
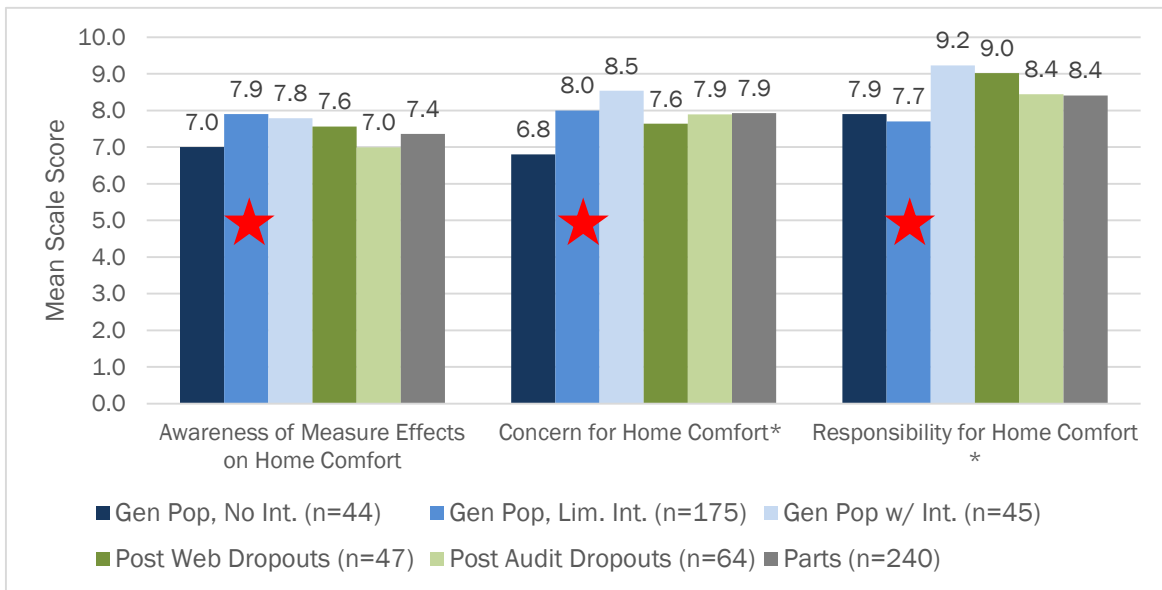
Note: * denotes significant differences among means (ANOVA F <.05)

As shown in Figure 7, those in the general population with limited intent are also closely aligned with dropouts and participants on awareness/knowledge, concern and personal responsibility for finances (energy bills).

Figure 7. General Population and Participant Comparison on Energy Bill Awareness and Attitudes
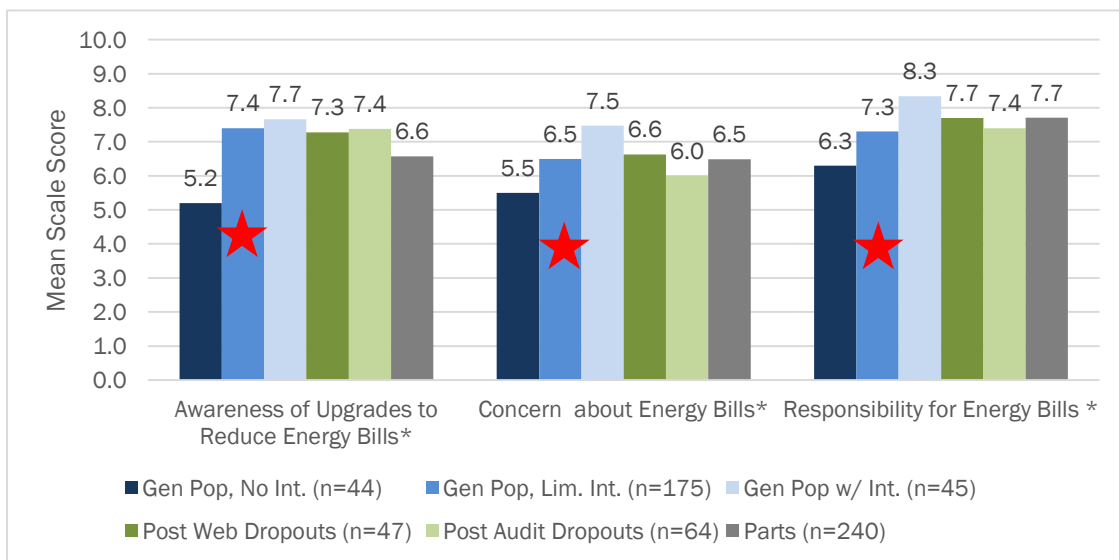
Note: * denotes significant differences among means (ANOVA F <.05)

We found similar trends when looking at the environment (Figure 8). While those with full intent tend to provide the highest mean scale score, those within limited intent generally rate the items in a way that is consistent with those who have engaged with the program.

Figure 8. General Population and Participant Comparison on Environment
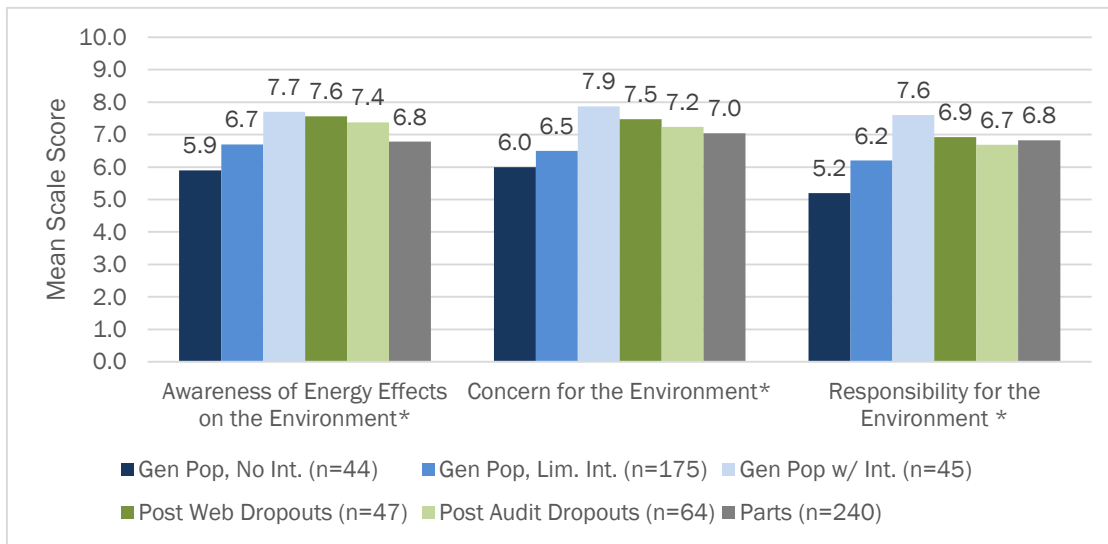
Note: * denotes significant differences among means (ANOVA F <.05)

Targeted Program Offerings

In exploring how best to market the Whole House program to residential customers, the research team considered whether different program offerings of energy efficiency measures might appeal to them and therefore potentially increase the likelihood of participation. As part of this effort we explored what specific actions customers intended to take and found that approximately one fifth plan to install insulation, or upgrade their windows, or HVAC equipment to ENERGY STAR models. These measures represent a combination of items from the current Basic and Advanced program packages.

Table 5. Measures of Interest within the General Population of Homeowners (non-participants)

Measures	Current Package	Have Intention	Already Did It	No Intention
Attic, wall, or floor insulation	Basic/Advanced	21%	37%	43%
Upgrade windows, doors or skylights	Advanced	20%	36%	44%
Upgrade to ES heating or cooling equipment	Advanced	20%	32%	48%
Air sealing	Basic/Advanced	13%	25%	62%
Duct sealing and insulation	Basic/Advanced	12%	36%	52%

This data can provide insights on possible bundles of measures that might be offered to customers through the basic path. In particular, when the team looked at the relationship between customer intent to install different measures, i.e. intention to install one measure tends to accompany the intention to install another, we found some fairly strong relationships between the measures. Specifically, certain groups of measures tended to occur together within customer responses. As a result, we present two potential bundles for the basic path below.

Table 6. Potential Measure Bundles

Potential Bundle	Measures
Bundle #1	• Attic, wall or floor insulation • Duct sealing and insulation[a] • HVAC system upgrades
Bundle #2	• Attic, wall or floor insulation[b] • Windows, doors or skylights • ENERGY STAR appliances

[a] Correlation with insulation (r=0.51, n=264, p<.01, two tails) and HVAC upgrades (r=0.41, n=264, p<.01, two tails)

[b] Correlation with windows/doors (r=0.41, n=264, p<.01, two tails) and appliances (r=0.43, n=264, p<.01, two tails)

Additionally, if the program is interested in encouraging the uptake of air sealing as a measure (which is not a measure that many customers "intend" to take), staff could consider including it in one of the bundles presented above. As shown in Table 5, customers are less likely to complete air sealing on their own.

3.4 DROPOUTS & DELAYED: WHY DO SOME CUSTOMERS START THE PROCESS, BUT DROP OUT?

This research explored barriers to participation through a survey with dropout customers. When we dug deeper to better understand what distinguishes those who go through the program from those who initiate (or intend) to participate but drop out, interestingly, those who have intent but do not fully act generally look the same as participants in terms of their demographics with the exception of ethnicity and age. (Table 7).

Table 7. Key Dropout and Participant Characteristics

Characteristic	Post Web Dropout (A)	Post Audit Dropout (B)	Participant (C)
Income			
Less than $75k	34%	28%	30%
$75k or more	66%	72%	70%
Education			
Less than college	19%	20%	22%
College or more	81%	80%	78%
Ethnicity			
Non-White	47%[c]	36%[c]	22%
White	53%	64%	78%[AB]
Age			
54 or younger	81%[BC]	56%	53%
55 or older	19%	44%[A]	47%[A]

Characteristic	Post Web Dropout (A)	Post Audit Dropout (B)	Participant (C)

Note: Uppercase letters within a cell indicate significance at the 95% level between the value in that cell and the value corresponding to the letter column. Lowercase letters indicate significance at the 90% level.

They also bear similarities to participants in terms of their Concern and Personal Responsibility around comfort (Figure 9).

Figure 9. Mean Value of Comfort Awareness/Knowledge, Concern and Personal Responsibility among Dropouts and Participants
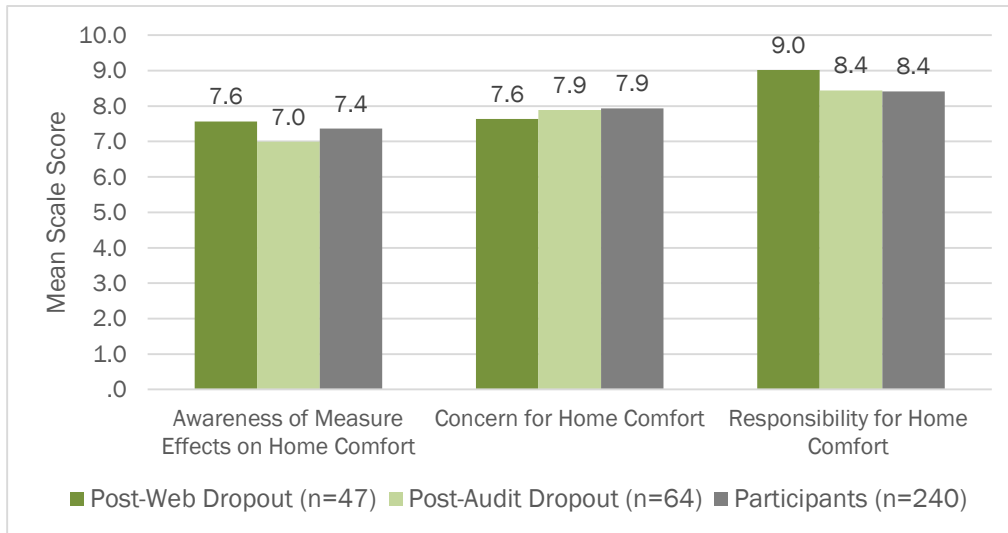
However, there are also a couple of important differences:

> **Financial Constraints:** Financial constraints are the largest reason for not being able to take action (mean score of 4.0 and 4.3 for web and audit dropouts respectively compared to 9.1 for participants (Table 3)). Key reasons for not participating in an audit or the program include the cost of the assessment and that the upfront costs of the upgrades are high.[14]

> **Self-Efficacy and Perceived Behavioral Control:** Self-efficacy and perceived behavioral control related to saving energy generally are also lower among those who drop out, indicating a need to help customers understand how they can save energy (Figure 10) so they can see the path to doing it.

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[14] Note that the findings from the process evaluation indicate that financing would have helped many dropouts.

Figure 10. Differences in Perceived Behavioral Control and Self-Efficacy across Dropouts and Participants
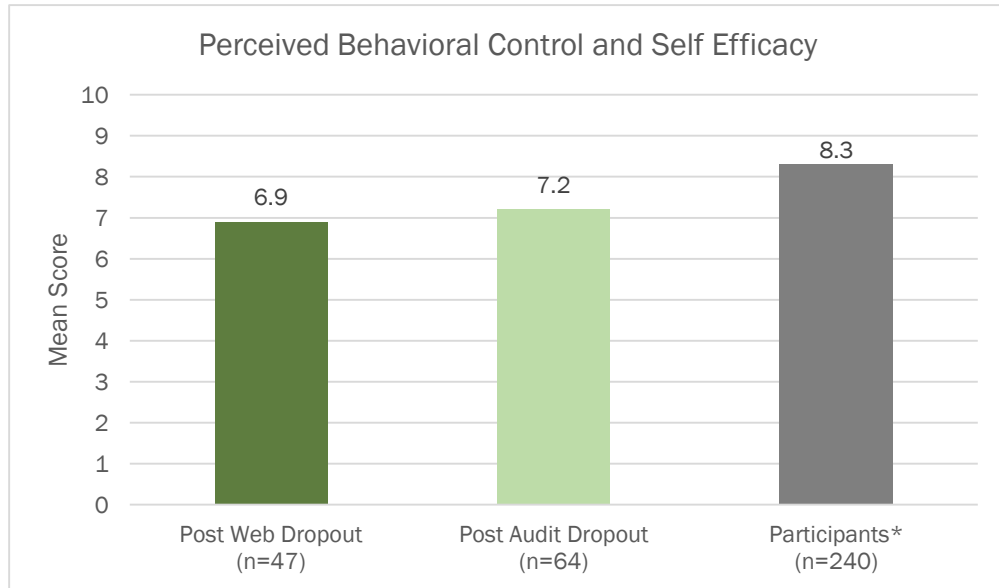
While not a "reason" for dropping out, we also found a difference on our measures of environmental concern, which can help to inform messaging discussed in the next section.

➢ **Environmental Concerns:** When we look at the environmental domain, we see that a higher proportion of dropouts are very concerned about the environment compared to participants and the general population. This indicates that while environmental concern is an important motivator for many customers (i.e., getting them to inquire about the program), it is not sufficient to get customers through this program due to the aforementioned barriers.

Figure 11. Concern for the Environment among Dropouts
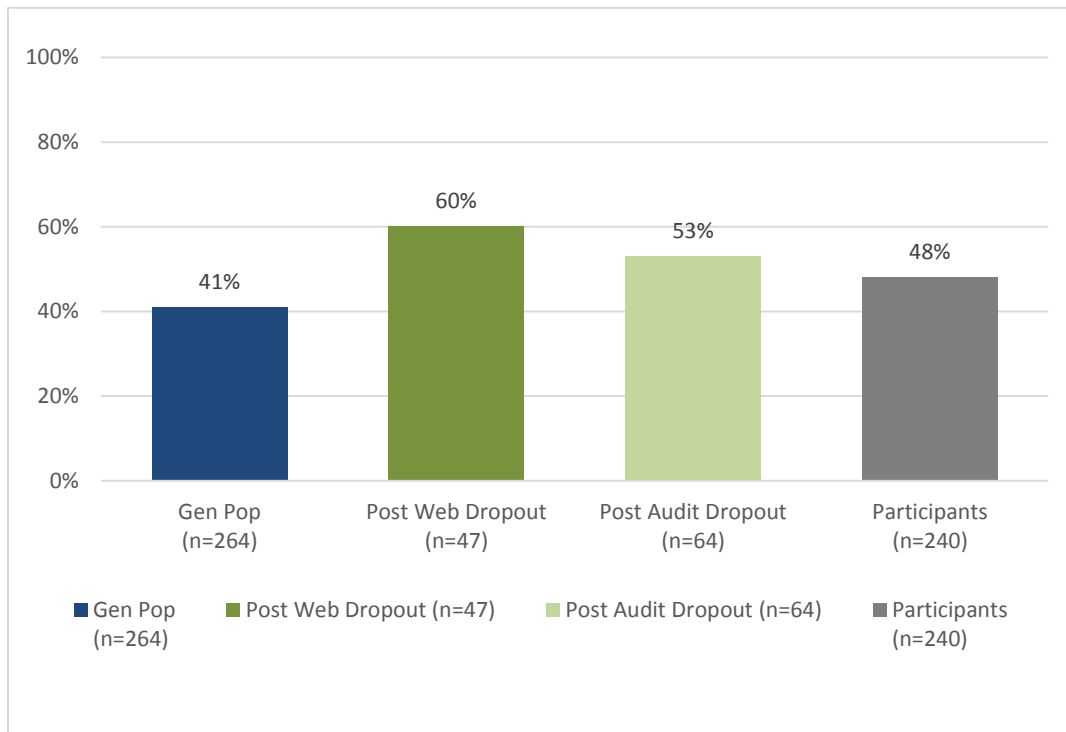
Ultimately, what our analysis shows is that constraints eclipse motivations when realities are finally faced. In modeling work done by our team, we found that, while there are differences across participants and dropout groups on stage model concepts in all domains, when constructs about perceived constraints were introduced into the models, everything else in the model became non-significant. In other words, various motivations in the stage model predict intention and getting to the program, but after that, it is all about what can stop the interested customer: constraints.

3.5 MOTIVATORS: WHAT MESSAGES WILL RESONATE WITH TARGETED HOMEOWNERS?

Overall, the data we collected from research with the general population of homeowners showed that comfort is the dominant motivator and resonates with customers in each of the general population groups, particularly those with limited and full intent.

Comfort Related Messaging

Comfort is a central issue for a large portion of the population. When we compared those with full and limited intent to those with no intent, we found that those with intent demonstrate higher levels of concern and personal responsibility for home comfort than those without intent (Figure 12). The groups do not differ significantly on awareness, suggesting some homogeneity among the general population. The intention groups are quite different in concern (especially between no- and limited-intent groups), and in feeling personally responsible for addressing the concern. In the latter case, the major difference is between full-intent customers and the others is quite substantial. In both concern and personal responsibility, the differences overall, are statistically significant, but more importantly, some (noted above) are substantively significant in size.

Figure 12. Mean Value of Comfort Awareness/Knowledge, Concern and Personal Responsibility between General Population Groups
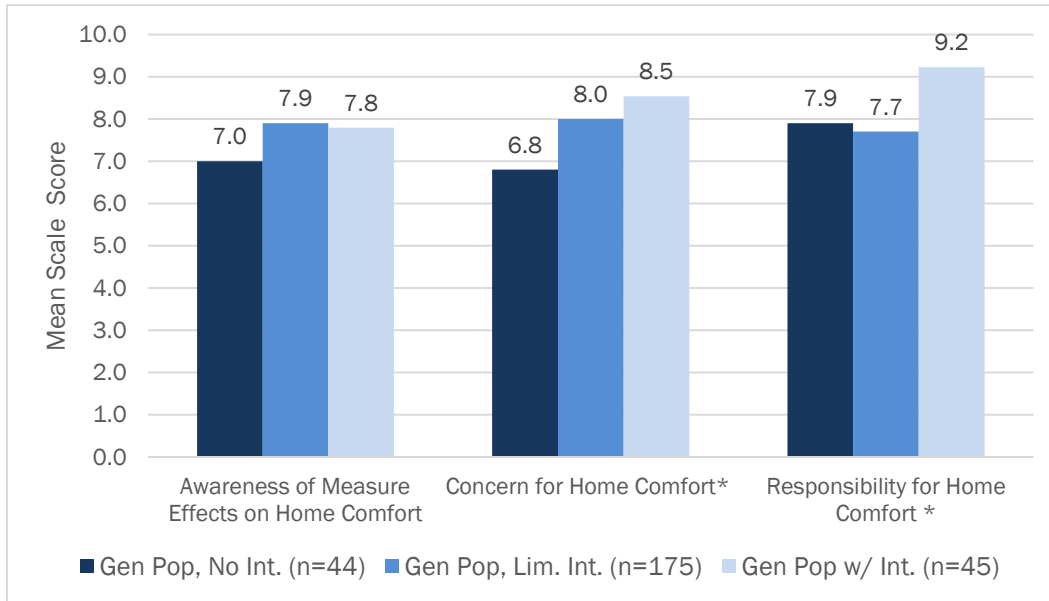
Note: * denotes significant differences among means (ANOVA F <.05)

Overall, about three-quarters of all respondents (74%) express high levels of perceived personal responsibility for home comfort, which is the highest rating for any motivational domain.[15] To gather additional insight on those who are likely to find comfort related messaging salient, we compared individuals who were more motivated by comfort to those who were less motivated. The individuals who are more motivated to take action as a result of comfort-related messages are more likely to be older (55 years or older), have lower incomes (less than $75,000), and be less educated.

Table 8. Key Characteristics of those with High Personal Responsibility for Comfort

Characteristic	Personal Responsibility for the Comfort		
	Low (A)	Medium (B)	High (C)
Age			
Younger than 55	62%	61%C	45%
55 or older	38%	39%	55%B
Income			
Less than $75,000	35%	44%	60% AB
$75,000 or more	65%C	56%C	40%
Education			
No college	50%	48%	55%

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[15] The research team looked at measures of personal responsibility to assess the inclination to take action. In particular, individuals that provided ratings between 8 and 10 were considered to have high levels of personal responsibility.

Characteristic	Personal Responsibility for the Comfort		
	Low (A)	Medium (B)	High (C)
College or higher	50%	53%	45%

Note: Uppercase letters within a cell indicate significance at the 95% level between the value in that cell and the value corresponding to the letter column.

Other Potential Messaging Strategies

In addition to comfort, the team assessed the degree to which homeowners feel responsibility for finances (energy bills) and the environment. As we discuss below, both issues resonate with some customers. However, neither is as unifying as comfort as a potential platform for program messaging.

Financial Related Messaging

Overall, 49% of the general population of homeowners feel personally responsible for controlling their energy costs. This is significantly lower than the percentage of homeowners who feel personal responsibility for home comfort as presented above (74%). However, we see a similar trend in terms of engagement with energy bills (knowledge and concern) increasing with intent to take action (Figure 13).

Figure 13. Mean Value of Financial Awareness/Knowledge, Concern and Personal Responsibility between General Population Groups
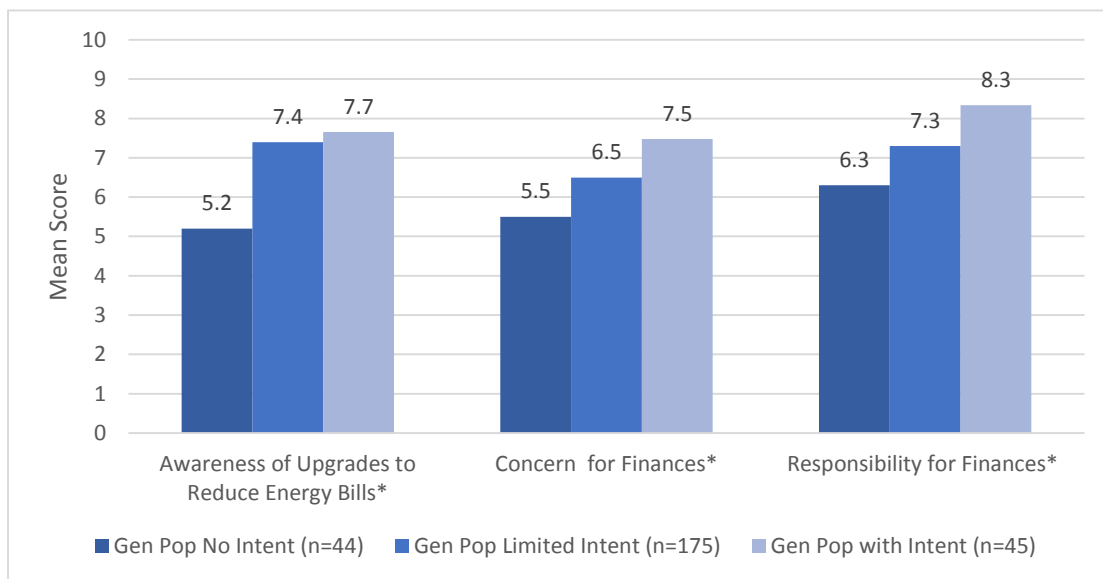
Note: * denotes significant differences among means (ANOVA F <.05)

Similar to the approach described under comfort, we compared individuals who were more motivated by finances to those who were less motivated to better understand the best audience for financial related messaging if employed. The individuals who are more motivated to take action as a result of financial messages are more likely to be Caucasian and have moderate incomes (less than $75,000) compared to those with medium levels of personal responsibility.

Table 9. Key Characteristics of those with High Personal Responsibility for Finances (Energy Bills)

Characteristic	Personal Responsibility for the Finances		
	Low (A)	Medium (B)	High (C)
Ethnicity			
White	51%	82%AC	69%
Non-White	49%B	18%	31%B
Income			
Less than $75,000	37%	33%	48% B
$75,000 or more	63%	67%C	52%

Note: Uppercase letters within a cell indicate significance at the 95% level between the value in that cell and the value corresponding to the letter column.

Environment Related Messaging

Overall, 36% of the general population of homeowners feel personally responsible for doing what they can to reduce their impact on the environment; the smallest percentage relative to comfort and finances. However, as noted in Section 3.4, program dropouts gave higher ratings on the environmental scales compared to the general population. As a result, while the environment may serve as an initial motivator for some customers, it is not enough to overcome barriers to participation such as financial constraints.

As a result, while Figure 14 illustrates that awareness/knowledge, concern and personal responsibility for the environment all increase as customers exhibit greater intent to take action, environmental messaging is the least likely to consistently resonate with the target population.

Figure 14. Mean Value of Environmental Awareness/Knowledge, Concern and Personal Responsibility between General Population Groups
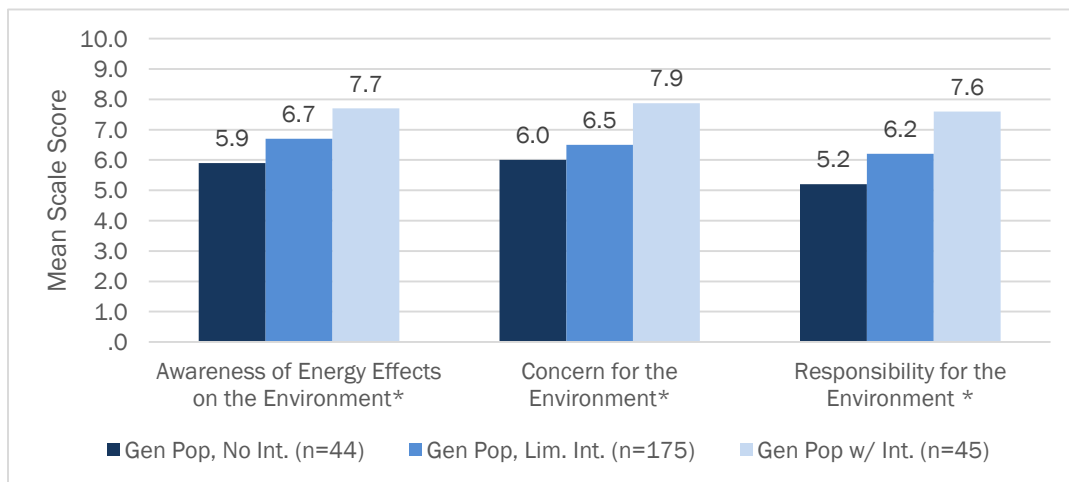
Note: * denotes significant differences among means (ANOVA F <.05)

As with the other domains, we compared individuals who are more motivated by the environmental messages to those who are less motivated. Individuals who are more motivated by environmental messages tend to have the following characteristics: higher levels of education (i.e., completed college or higher) and almost three quarters are white (Table 10).

Table 10. Key Characteristics of those with High Personal Responsibility for Environment

Characteristic	Personal Responsibility for the Environment		
	Low	Medium	High
Education			
No college	41%	33%	37%
College or higher	59%	67%	63%
Ethnicity			
White	80%	73%	71%
Non-White	20%	27%	29%

However, before dismissing the environmental motivation, we pursued analyses that considered more than one construct at a time. The team found that the combination of comfort and environmental concerns was a combination that predicted a great deal: level of intent, program engagement (at least registering on the website), and program completion. No other combinations of domains predicted these steps beyond what each individual domain of concern predicted by itself. As such, environmental messaging, when combined with comfort messages, may be the most powerful of all messaging. (Note that this analysis is based upon comparing coefficients from regression models).

Multiple Messaging

Several themes emerged in studying the motivations and constraints that customers experience specifically for those implementing home energy upgrades. One such theme is that comfort is the most widespread motivation for customers to consider these upgrades, followed by financial and then environmental motivations, as measured by concerns and personal responsibility in these domains. Customers who express these feelings are well along in the stages of change (See Figure 4), this data tells us that these motivational domains can be used to generate messages for customers. Based on our findings from the analysis of individual motivational domains, comfort is clearly the most potentially powerful, and environmental concerns the least.

However, our team's analyses went beyond these individual motivations and considered combinations. There are three possible combinations of motivational domains, as addressed in this study, but only one proved effective in explaining customers' intentions, program engagement, and program completion: comfort paired with environment. This would imply that messaging that emphasizes this combination, which includes one self-interest and one altruistic motivation, may be the most powerful in general. But some customer groups will respond more strongly to any one type of message than others. It may be important to identify which customer groups would be most effectively targeted with which message. Our team provided some ideas about how to identify customers invested each domain of concern.

Figure 15. Behavior Change Model

Analyses that combined stage model concepts as well as non-stage concepts such as self-efficacy and constraints revealed that the things that motivate customers to consider the types of actions offered by the program are different than the things that cause them to drop out once engaged. Specifically, all domains of motivation studied here can contribute to forming the intention to take these actions.

One variable, a composite of all domains of concern was better at predicting intention than any one individual motivation variable. A second predictor of intent was self-efficacy/perceived behavioral control, which measured general efficacy about energy management, not program-specific self-efficacy (which is also predictive but less illuminating than the general measure). On the other hand, predicting which customers move further through the program and on to completion is done best by considering constraints. Concerns can bring customers to the table, but real or perceived constraints, both financial and structural, are what keep interested customers from completing the process.

In comparing the results of this study of PG&E's Whole House Program to a similar study in Vermont, another important point comes up for consideration, especially for future studies. The Whole House Program is a very expensive program. We hypothesized that environmental concerns seem to be a motivator in PG&E territory, but this was not sufficient to motivate customers to completion, probably due to the cost of these actions. In Vermont, however, the participants were more environmentally concerned than any other group, and the program was comparably expensive there. The difference may lie in the fact that heating fuel costs are much higher in the Vermont climate than they are in northern California. If we had measured the customers' anticipated (if not actual) return on investment, this may have explained PG&E's dropouts who appeared to be very concerned about the environment or other issues. In other words, as in other domains (e.g. environment and comfort as described earlier) customers may be more likely to make a big energy upgrade expenditure when there is both an altruistic and a self-interest motivation to do so. Customers may care about the environment and feel good when they do something beneficial for it, but a self-interest motive like comfort or financial benefit may be necessary for some to take that step.

As we have noted in the previous section, dual motivations that might be characterized as combining altruistic (environmental) and self-interest (comfort) motivations seem to be most powerful in keeping customers engaged through to project completion. In Vermont, the combination of environmental concern and concern with very high energy bills may have been an especially powerful combination of motives, taking those customers through to the end. There may have been an implicit calculation of ROI that joined the environmental motivation. We recommend that future studies measure the customer's anticipated financial gain from an expensive energy upgrade.

3.6   UNDERSTANDING SAVINGS AT THE HOUSEHOLD LEVEL: WHO IS SAVING AND WHAT ARE THE DRIVERS?

We examined savings at the household level for 912 participants who had both electric and gas through PG&E. While not fully representative of the PG&E customer population (i.e., it does not include electric-only households, or homes that used propane, nor households where only electric records were available because their gas provider was not PG&E), the examination of this population allowed us to understand how total energy changed at the household level. As described in the methods section, we ran our analysis to understand: (1) changes in gas use, and (2) changes in electric use. We then combined our findings to determine (3) total energy changes at the household level.

How Many and How Much Are Households Saving?

At the site level, the large majority (70%) of participants achieved decreases in energy use. (See Figure 16 below.) There were also some households (18%) that fell within 5% of the "no change" mark, and are thus considered in our analysis as not having enough change to determine the direction of the change. The remaining households (12%) saw increases in energy use.

We examined savings both in terms of percentage changes, and absolute changes in savings. Both analyses are described below.

Percentage change seen by customers

The program requires savings of 10% or more (as determined through an engineering model projection), and the marketing of this effort seeks to promote even greater savings. As such, we examined savings as a percentage of total energy use to see who experienced changes greater than 10%, how many saw higher levels of savings (i.e., savings of over 20 or 30%), and what the highest-saving households were saving.

Based on our analysis, 59% of the participants in our analysis showed savings of 10% or more, thus reaching the required program savings.

There were also a number of households who fell into the categories of "high (more than 20%)" and "super (more than 30%)" savers: 33% saved more than 20% of their bill, while 12% saved more than 30%.[16]

As shown in the figure below, there were also a couple of households that saved around 50% of their total energy use. The total number of households in this category is small, and we expect that part of the energy savings is due to factors beyond the criteria required for program participation, much as increased energy use was found to relate to non-program household changes for surveyed participants.

Figure 16. Marketing Billing Analysis Results: Combined (Gas and Electric) Changes in Energy Usage n=912 homes
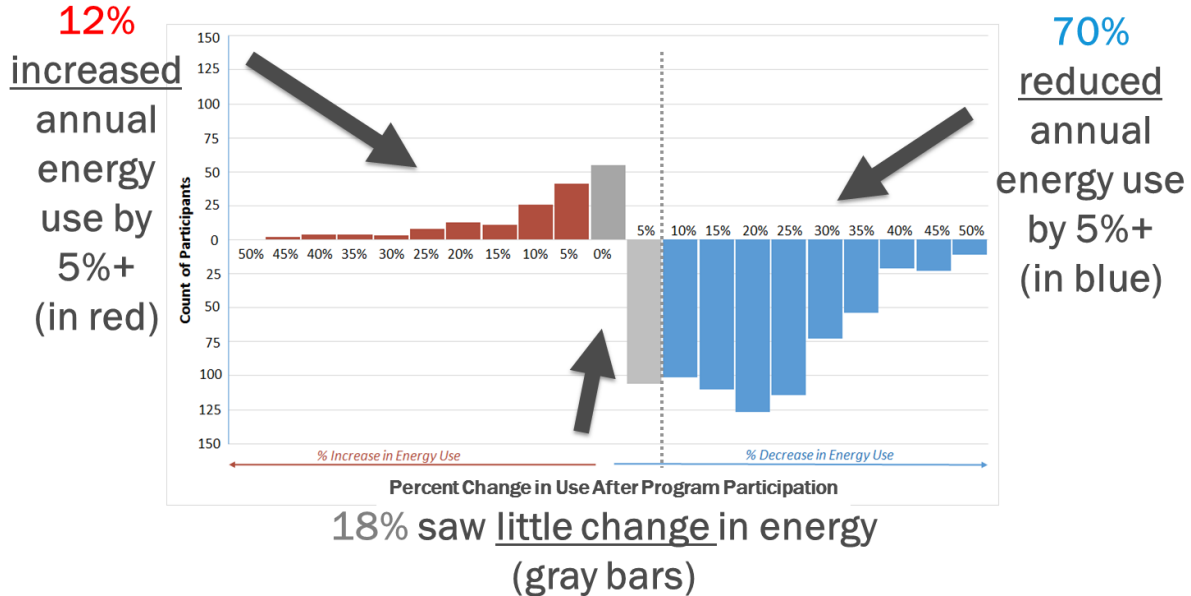
While most participants saved energy, about 1 out of every 8 participants (12%) increased energy use, with about half of these (i.e., 5% of the total population) seeing increases in energy use of more than

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[16] Note that we use this highest group of savers (>30%) in our analysis of the drivers of savings.

15%. The distribution of homes with increases, however, rapidly drops off, as shown in the graphic above. The increases in many of these households are likely due to changes in the home that were not directly related to participation requirements. This is discussed more in Section 3.7.

Total or absolute changes

We also looked at the absolute savings of participants who increased their energy use and participants who reduced their energy consumption. This is the total quantity, not percentage of savings. The graph below shows the distribution of absolute savings among negative savers (114 customers, or 12% of total sample, marked in red) and positive savers (637, or 70% of total sample, marked in blue). In the negative saver group, participants increased their energy consumption by between 1,284 and 68,858 kBtus. However, positive savers have a greater magnitude of savings than negative savers, their magnitude of savings ranged from a low of 1,828 to high of 161,919 kBtus.

Figure 17. Magnitude of kBtu Usage Amongst Negative and Positive Savers
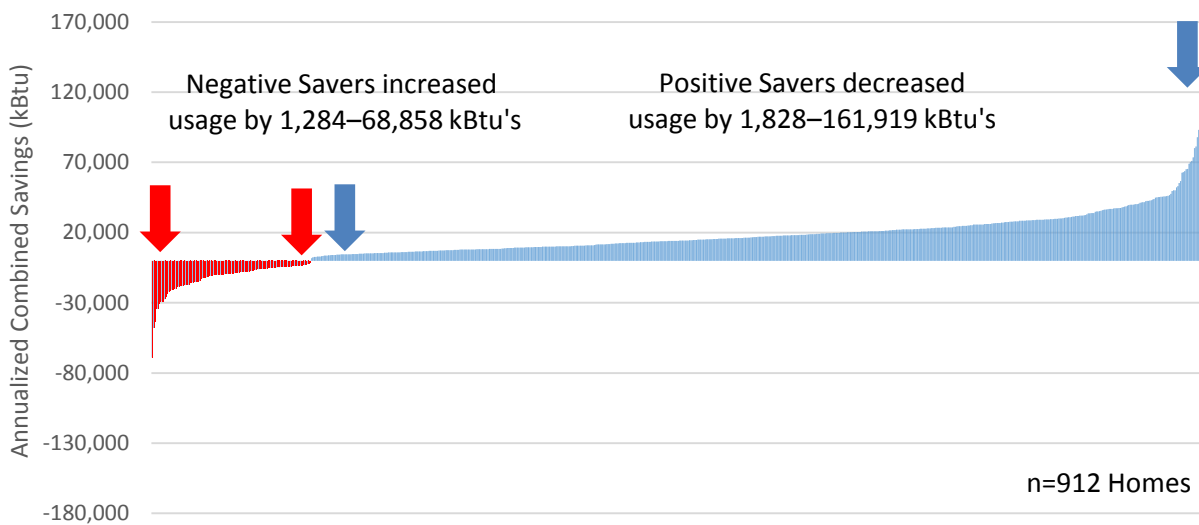
Overview of aggregate changes by fuel type

A side by side comparison of electric changes, gas changes, and changes in total energy use is shown in the graphic below. This graphic shows the population in aggregate, with increasing savings for each household as you move from left to right. The graphic also demonstrates how gas is the largest driver of savings. As shown in the graphic below, 43% of gas customers, compared to only 16% of electric customers, saved more than 20% of their usage.

Figure 18. Marketing Billing Analysis: Changes in Energy Use by Fuel Type (n=912 homes)
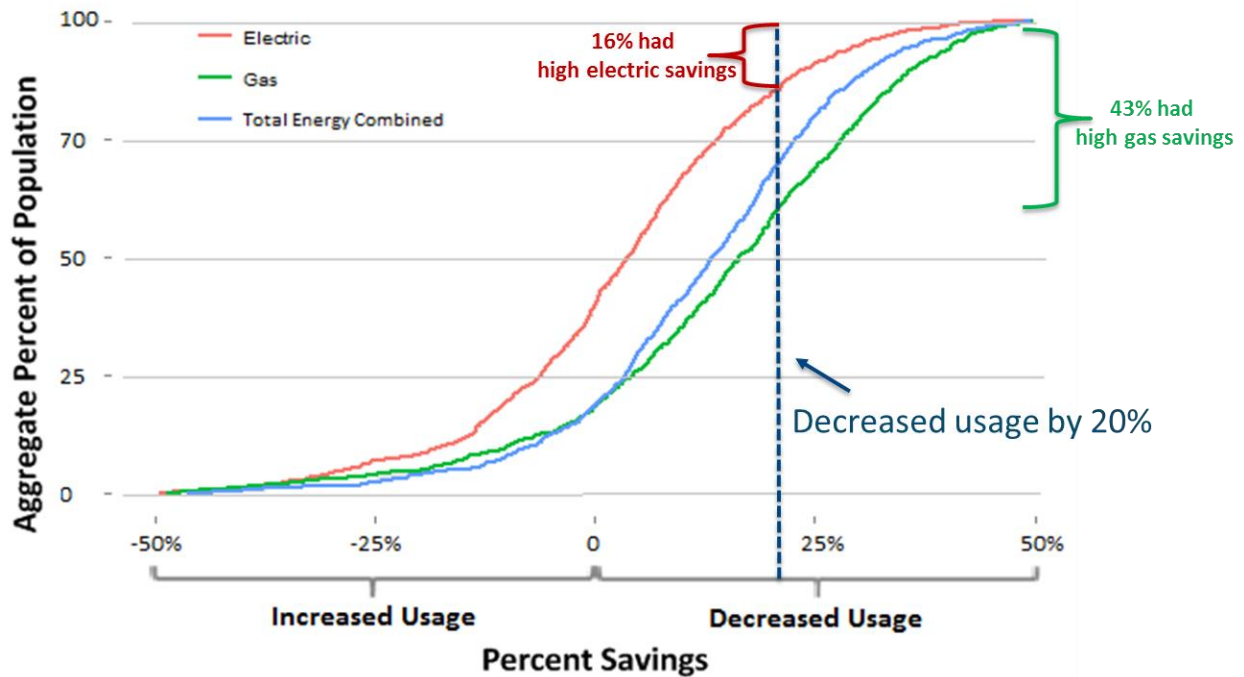
Figure Note: This figure shows the distributions of gas, electric and combined savings, as such, gas and electric savings percentages are not aligned (vertically or horizontally) by household; the figure can only be used to find aggregate percentages.

Interestingly, at the site level, gas and electric savings were not correlated. Electric use sometimes increased among those who saved the most gas. Moreover, as shown above, a much higher percentage of customers increased electric consumption post-program, as compared to gas consumption.

Overall, the large majority of homes (74%) showed gas savings of more than 5%, and many of these were high savers. Further, 43% had gas savings of over 20% (See Figure 19).[17] Electric savings were not as high. Only 43% saw electric savings more than 5% and only 15% saw electric savings over 20% (see Figure 20).

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[17] 24% of homes saved 30% or more gas savings. This group is the "Gas Super Savers" group that we used in the targeting analysis.

Figure 19. Gas Savings, By Percentage Difference (n=912 homes)

74% saw gas savings of 6% or more

| 6% | 4% | 3% | 13% | 9% | 22% | 43% |

Increase in usage between 21%-68%
Increase in usage between 11%-20%
Increase in usage between 6%-10%
Little change in usage (within 5%)
Decrease in usage between 6%-10%
Decrease in usage between 11%-20%
Decrease in usage between 21%-50%
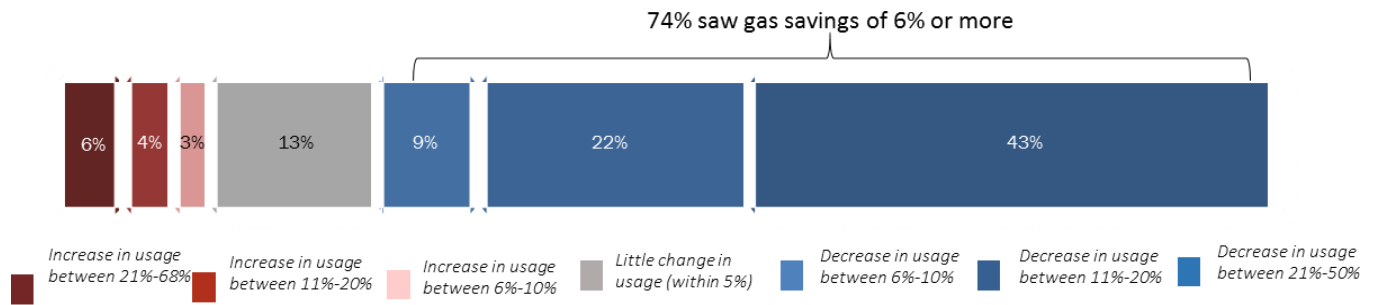
Figure 20. Electric Savings, By Percentage Difference (n=912 homes)

43% saw electric savings of 6% or more

| 10% | 10% | 7% | 27% | 14% | 17% | 15% |

Increase in usage between 21%-68%
Increase in usage between 11%-20%
Increase in usage between 6%-10%
Little change in usage (within 5%)
Decrease in usage between 6%-10%
Decrease in usage between 11%-20%
Decrease in usage between 21%-50%
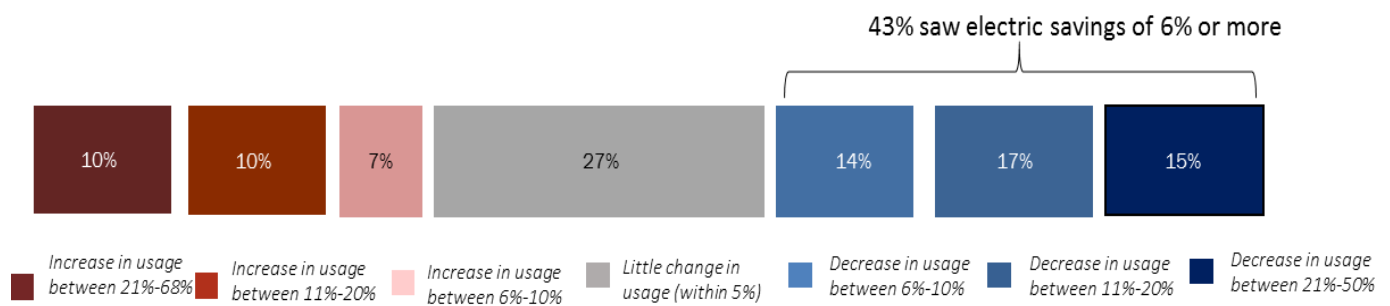
Who is Saving?

Our research also explored differences between "saver" and "non-saver" populations. Specifically, we explored around 200 database variables provided to us by PG&E. This included participant data, customer data, and data purchased from Targetbase. Looking at direct comparisons between savers and non-savers (excluding those in the neutral category), we found that there were no significant differences in any of the available psychographic information (i.e., data on lifestyles). There were also several basic demographic and household characteristics that were not significantly different between the populations. However, there were five key areas where there were significant differences between savers and non-savers. These include:

- **Income:** Savers are more likely to have incomes of higher than $125K.
- **Home Value:** Savers are more likely to have lower home values (i.e., between $200K and $500K).
- **Home Tenure:** Savers are more likely to have been PG&E customers for more than 15 years.
- **Ethnic Group:** Savers are more likely to fall into "Other", which is the group that includes the Caucasian population.
- **Gas Usage:** Savers are most likely to have low or medium total gas bill amounts. (Note that this could potentially be due to the fact that those with higher usage are more likely to have made changes in the home that could lead to increases.)

The table below shows the findings from this straight comparison of database variables.

Table 11. Comparison of Variables Where Significant Differences Occurred[18]

Customer Characteristics	Total Participants	Savers	Non-Savers
Total Participants	912	637	114
Income (n=)	831	582	101
Less than $30,000	3.9%	4.1%	4.0%
$30,000 - $59,999	16.2%	16.0%	16.8%
$60,000 - $79,999	18.8%	17.7%	15.8%
$80,000 - $124,999	25.3%	24.2%	35.6%*
Greater than $124,999	35.9%	38.0%*	27.7%
Home Market Value (n=)	859	598	107
Less than $200,000	14.6%	13.7%	16.8%
$200,000-$499,999	31.2%	32.9%*	18.7%
More Than $500,000	54.2%	53.3%	64.5%*
Ethnic Background (n=)	853	595	105
Asian	11.6%	11.8%	14.3%
Black	2.3%	2.2%	1.0%
Hispanic	6.9%	5.0%	17.1%*
Other (includes Caucasian)	79.1%	81.0%*	67.6%
Tenure with PG&E in Years (n=)	873	611	107
0 to 10 Years	30.4%	27.2%	42.1%*
10 to 15 Years	23.8%	23.1%	20.6%
More Than 15 Years	45.8%	49.8%*	37.4%
Total Gas Billing Amount Category (n=)	871	610	106
Low	33.8%	35.6%*	24.5%
Medium	51.8%	52.8%	48.1%
High	14.5%	11.6%	27.4%*

Note: Neutral savers are not shown in this table

In addition to reviewing the data provided, we also used the available psychographic, demographic, customer and participant data to develop models to help us understand what predicts savings. Specifically, we used a classification and regression tree model (CART), which is a modeling technique that allows sorting through a multitude of data to determine the characteristics most predictive of the different saver groups. Through the use of the CART models, we identified which variables are related to participant savings.

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[18] The "Neutral Savers," who changed usage <5%, are included in the "Total Participants" column, but are not included in either the "Savers" or "Non-Savers" columns.

Because of the differences in contribution of electric and gas savings to the overall savings and different factors driving electric and gas savings, we conducted CART analysis by fuel type and combined savings. We ran multiple models across a variety of savings categories and selected the best fitting models for the following groups of savers. This included the following models: (1) households saving >30% combined energy savings, (2) households in the top quartile % and absolute for combined energy savings, and (3) households with >30% gas savings.[19] We also explored electric only models and found that these had a very poor fit (i.e. none of the variables from the participant database or Targetbase were good predictors of electric savings), so they are not presented here.

➢ **Model 1: >30% savings gas and electric combined** - High and Super Saver Characteristics (>30% savings gas and electric combined) were defined by the following key characteristics:

- **Cooler climate zones:** Over and above anything else, climate zone was the largest predictor of higher savings. Households in cooler climate zones showed a larger propensity to save. Specifically, this included areas with an average weather of <14.5 degrees Celsius (<58 degrees Fahrenheit). As such, those in warmer climate zones are less likely to save. This is consistent with the fact that savings are largely driven by gas savings – heating related. Among the warmer climate zones, savings are higher when electric opportunities are higher (3-5 quintile variable in Targetbase) and homes are older (built before 1975).

- **Lower gas bill amounts**: Second to climate zone, the lower gas bill category predicted higher savings. Note that this is a somewhat counterintuitive finding: lower gas bill categories are the most likely to save. These are households that are "small" users of gas (of three categories: S, M, L). Please note that it is easier to realize a large percentage change when compared to a smaller base amount.

➢ **Model 2: households in the top quartile for both % and absolute for combined energy savings** - For households in the top quartile by both percentage and absolute savings (KBtus), the model is slightly different. These homes were defined by larger homes and older homes that have participated in multiple programs. The details included:

- **Homes that participated in other PG&E programs (more than 2):** Homes that have participated in other programs, save the most. Those who participated in fewer programs were less likely to save. This variable included participation in the following programs:
  - CARE - California Alternate Rates for Energy
  - FERA - Family Electric Rate Assistance
  - Life Support - For Power Outages
  - BPP - Balanced Payment Plan
  - CSOL - Customer Service Online
  - climate smart - voluntarily balance out their energy-related greenhouse gas emissions (Started 2007)
  - daccess - direct Access, allows eligible customers to purchase their electricity directly from third party
  - smart rate - save money and gain more control on your summer electric bills
  - smart ac - avoid energy supply emergencies
  - smart home - Also Smart meter - device that connects your home to the electric grid

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[19] See Appendix G for the details of each model.

- o   winter_10_20 - Winter Gas Savings program
- o   liee - Low Income Energy Efficiency
- o   ebpp - electronic bill presentment and payment

This supports the idea that those who have a history of participating in PG&E programs are comfortable with the programs and perhaps have confidence in PG&E's recommendations.

Among those who engage with the utility through participation in two or more programs, the highest savers tend to be those with:

- **Larger homes:** Homes over 1,500 square feet.

- **Older homes:** Homes built before 1980.

➢ *Model 3: households with >30% gas saving* - Since gas is the biggest driver of savings, we also looked at what predicts gas savings. These "super saver" households, saving more than 30% of their overall gas use, were also older homes (built before 1980) with lower gas bill amounts (small gas users). Again, the fact that this lower gas bill category predicted savings is somewhat counterintuitive. While older homes with medium use were not as likely to be super savers, among this secondary group, those with larger electric bills are more likely to save, particularly if they are located in the western part of PG&E's territory (longitude<= -122), and had installed HVAC as part of the program. Note that this is the only time when a "measure" showed up in models notably, older homes with high gas usage, and newer homes (built after 1980), were not as likely to save based on this model.

Across all models, therefore, we found that the key drivers of savings included:

- **Climate zone or weather:** Cooler climate zones
- **Age of home:** Homes built before 1980
- **Home size:** Homes greater than 1,500 square feet
- **Gas usage:** The smallest of three gas categories
- **Electric opportunities in the household** (highest two quartiles from the variable in Targetbase[20])
- **Engagement with utility through number of rates and non ee-programs** (specifically more than 2 programs from the variable in Targetbase)

Note that our analysis was limited by the information available to us since we used only secondary data available through Targetbase, PG&E customer, and Whole House participant databases. While the breadth of the data available was vast (over 200 variables), it was not comprehensive. There may be other factors (such as changes in the household) that are not included in our analysis that could explain savings or the levels of savings. We discuss this for the group that increased savings, in the section below.

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[20] Targetbase – a marketing database that contains a variety of geographic, household, sociodemographic and other characteristics. The data are generally derived through secondary data sources, census and magazine subscriptions being some of them, and can be matched to each individual customer.

3.7   WHY DO SOME HOUSEHOLDS INCREASE ENERGY USE AFTER RETROFIT?

To examine contributing factors to energy savings beyond the measures installed, we analyzed survey data (i.e. self-reported household changes, behavior changes, and attitudes) from a sample (n=119) of the customers included in the billing analyses. Additional survey attempts were made in early 2014 (multiple calls, voice messages and attractive incentives up to $50 for a 10 minute survey) to get more negative and super savers in the analysis, however, the sample pool was exhausted for this effort. While 90/10 precision is preferable for negative and positive savers, the number of cases is enough to explore some trends between groups at this time.[21]

Table 12. Population and Survey Counts by Saver Type

	Negative Savers	Neutral Savers	Positive Savers	Super Positive Savers	Total
Precision at 90%	+/-12%	+/-19%	+/-12%	+/-14%	+/-7%
Customers in Billing Analysis	114	161	525	112	912
Total Survey Data	32	17	44	26	119

We combined the marketing billing analysis results, customer attitude, household change, and program tracking data into one dataset. Using this data, we set out to answer the following research questions:

- Understand what distinguishes customers that are able to save the most energy; in particular determine whether behavior and/or attitudes are important ingredients to fulfilling the most savings potential.

- Explain why some customers use more energy after program participation

The findings below address these research questions.

Table 13 provides the overall picture of the household and behavior changes made by each saver group post-retrofit. The data show that negative savers are more likely to have additional occupants in the home compared to all other saver groups.

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[21] It is also worth noting that the error that may be present in any of our estimates for these groups will not be due to sampling error, which is what the precision and confidence levels are based on. We attempted a census, so any estimates in error would come from non-response bias. Nevertheless, we report the traditional statistics that do give the reader a sense of how much variation there was in the answers provided by these groups.

Table 13. Household Changes Post-Retrofit (multiple response)

	Negative Savers	Neutral Savers	Positive Savers	Super Savers
	n=32	n=17	n=44	n=26
1. HOUSEHOLD OCCUPANCY CHANGES	66%	35%	36%	23%
New house/recently moved in	6%	29%	18%	8%
Recently retired	19%	0%	18%	8%
More people moved in	44%	6%	7%	0%
Added a child/expecting child	22%	0%	5%	8%
2. ADDED HEATING/COOLING LOAD	22%	6%	2%	15%
No operational HEATING before but have central heat now	19%	6%	0%	12%
No operational A/C before but have central AC now	9%	0%	0%	4%
Added square footage	3%	0%	5%	0%
3. COOLING BEHAVIOR CHANGES/TAKE BACK	22%	24%	23%	4%
Had Central A/C before but setting lower temperature	13%	12%	20%	0%
Had Central A/C before but using it more often	13%	12%	5%	4%
4. HEATING BEHAVIOR CHANGES/TAKE BACK	50%	53%	39%	19%
Had Central Heating before but setting higher temperature	22%	41%	27%	8%
Had Central Heating before but using it more often	34%	24%	14%	15%

Super Savers

Super savers are distinguished by several categories of factors, including behavior and financial attitudes, as well as baseline conditions, and the size of the project. In terms of behaviors, they are characterized as much by what they do not do as by what they do. For example super savers, , compared to other groups:

- Do NOT report additional occupants after the retrofit

- Do NOT report setting their thermostats up in the winter or down in the summer

On the other hand, they disproportionately, and statistically significantly have:

- Smaller, and older homes, and

- Higher baseline gas usage, but

- Somewhat larger projects, as measured by the number of measures installed and the size of the rebates they received

In terms of attitudes, when we compare the super savers to all other groups, super savers are significantly less concerned with paying energy bills than the other groups.

Table 14. Comparing Super Savers to All Others

	All Others	Super Savers
	n=93	n=26
Number of measures installed (Mean)	4.4	5.0
Household increased occupancy (%)	19%	0%
Take-back-Any (%)	53%	23%
Air Conditioning take-back-Any (%)	23%	4%
Heating take-back-Any (%)	45%	19%
Set heating thermostat higher	28%	8%
Number of measured post-installation electric behaviors that would increase usage (Mean)	0.08	0.67
Number of measured post-installation gas behaviors that would increase usage (Mean)	1.2	.42
Year built (Mean)	1961	1953
Conditioned square feet of residence (Mean)	1,889	1,601
Rebate check amount (Mean)	2,778	3,280
Pre-program daily therm usage (Mean)	1.6	2.1
Concern about paying energy bills (Mean)	6.6	5.2

Table note: All factors shown are statistically significant at less than 0.05, 2-tailed

The attitudes across all saver groups are shown in Table 15. Most differences are not significant amongst groups due to small sample sizes with the exception of the concern over paying energy bills as noted above and in the table below. While other differences are not statistically significant, the data does show some interesting trends at this time. The data show that negative savers are more concerned with comfort and less concerned with the environment than other groups. Further, super savers are less concerned with financial issues (less concern with the cost to heat/cool their homes and less worry over having enough money to pay their energy bills). The data show some trends; however the effects of attitudes are complex and can only be fully understood with a larger sample size.

Table 15. Attitude Comparison across Saver Groups

	Negative Savers	Neutral	Positive Saver	Super Positive Savers
Mean Comparisons	n=31	n=16	n=34	n=24
COMFORT OVERALL CONSTRUCT	8.3	7.9	7.6	7.4
Concern about keeping your home free from drafts and uneven temperatures	8.2	7.8	7.6	6.6
Agreement with very uncomfortable living in house with bad drafts and uneven temperature	8.3	8.0	7.6	8.2

	Negative Savers	Neutral	Positive Saver	Super Positive Savers
ENVIRONMENT OVERALL CONSTRUCT	**6.9**	**7.6**	**7.3**	**7.3**
Concern about Global warming	6.6	7.0	7.3	7.2
Agreement with I am very concerned about how energy use affects the environment.	7.4	7.9	7.4	8.0
Agreement with I am very concerned about the environmental impacts of power plants	6.7	7.9	7.2	6.8
FINANCIAL OVERALL CONSTRUCT	**6.3**	**6.8**	**6.7**	**5.2****
Concern about The cost of heating or cooling your home	7.5	7.8	8.2	7.0
Concern about finding ways to control your home's energy costs	8.1	8.2	8.3	6.7
Agreement with: I sometimes worry there is enough money to pay my energy bill	3.5	4.2	3.5	1.8
OTHER ATTITUDES				
Agreement with: My household uses electricity or natural gas without thinking much about how it impacts our utility bills.	4.0	6.4	5.2	4.3
Agreement with: I know people who talk about their homes being drafty and having uneven temperatures.	6.1	7.3	6.7	5.0

**Table note: Statistically significant at less than 0.05, 2-tailed when compare to all other saver groups

Negative Savers

A number of factors help explain why some participants actually increased their usage after participating in the program. All factors that we discuss are statistically significant results. Specifically,

Two-thirds of all negative savers experienced changes to household occupancy (Table 13), and 44% of negative savers reported increases in occupancy compared to less than 5% of all other saver categories combined

The main driver of negative savings is increased number of residents in the home (Table 13 and Table 16)

However, other types of factors were involved as well. For instance, baseline conditions and attitudes are related to negative savings. Here are some of them (all statistically significant):

- Baseline usage was significantly lower among negative savers

- Project size was significantly smaller among negative savers (Table 16, as measured by the size of the rebate)

- Negative savers were very concerned about comfort, and more so than other groups

An index of measured behaviors that would tend to increase usage were very related to negative savings (Table 16, electric and gas).

Table 16. Comparing Negative Savers to All Others

	All Others	Negative Savers
	n=87	n=32
Household increased occupancy (%)	5%	44%
Take-back-Any (%)	41%	59%
Used heat more (take back) (%)	16%	34%
Number of measured post-installation electric behaviors that would increase usage (Mean)	0.4	0.9
Number of measured post-installation gas behaviors that would increase usage (Mean)	0.8	1.5
Concern about comfort (Mean)	7.6	8.3
Rebate check amount (Mean)	3,002	2,567
Pre-program daily therm usage (Mean)	1.3	1.8

Table note: All factors shown are statistically significant at less than 0.05, 2-tailed

Among negative savers, when we asked them in an open-ended fashion to explain why they are using more energy, their answers were similar to the explanations seen above. As such, respondents predominantly noted increases in household occupancy, and the increased use of heaters. When asked why respondents used their heating more often, they referred factors not related to behavior change such as increased occupancy (children) and colder weather.

Change Combinations

Focusing on behavior and household change, Table 17 provides specific breakdowns of the combinations that were reported by the negative savers in our sample, and the other groups are included for comparison.

Table 17. Unique Combinations of Household & Behavior Changes Post-Retrofit

	Negative Savers	Neutral Savers	Positive Savers	Super Savers
	n=32	n=17	n=44	n=26
Only one of the categories applied				
Household Occupancy Changes ONLY	16%	12%	27%	19%
Added Heating / Cooling Load ONLY	3%	6%	2%	8%
Cooling Behavior Changes / Take Back ONLY	6%	6%	5%	4%
Heating Behavior Changes / Take Back ONLY	9%	24%	18%	12%
Combinations of two or more categories applied				
Household Occupancy Change & Load Change	13%	0%	0%	0%
Household Occupancy Change & Heat Take Back	25%	12%	5%	0%
Household Occupancy Change & Heat/AC Take Back	9%	12%	2%	0%

	Negative Savers	Neutral Savers	Positive Savers	Super Savers
Household Occupancy Change & AC Take Back	0%	0%	2%	0%
Load Change & Heat Take Back	0%	0%	0%	4%
Load Change & AC Take Back	3%	0%	0%	0%
AC Take Back & Heat Take Back	3%	6%	14%	0%
Household Occupancy Change & Load Change & Heat Take Back	3%	0%	0%	4%
No Household Occupancy Change, Load Change or Take Back	9%	24%	25%	50%
Total	100%	100%	100%	100%

Additional Questions

PG&E asked to include some additional questions to the survey fielded in early 2014 targeting negative and positive savers. These results are summarized in Table 18 and Table 19. Note that due to the nature of when these questions were added to survey efforts, the number of customers responding is not representative of the participant population. However, this data is presented for illustrative purposes.

Table 18. Interest in Other Energy Saving Offerings

"PG&E is interested in findings ways to help you save energy. Would you like…"	Negative Savers (n=18)	Super Savers (n=18)	Total (n=36)
Additional $200 for saving certain amount (% yes)	78%	89%	83%
More information or education about usage (% yes)	67%	50%	58%
Use home energy monitor (% yes)	72%	39%	56%

Table 19. What else do you think would help your household to save even more energy? (multiple response)

	Negative Savers (n=18)	Super Savers (n=18)	All (n=36)
Nothing	33%	28%	31%
Windows	11%	17%	14%
More insulation	17%	11%	14%
Better technology, monitoring, info	11%	11%	11%
Solar	0%	11%	6%
Roof fan	0%	6%	3%
No children	0%	6%	3%
Energy saving appliances	0%	6%	3%
Better incentives	0%	6%	3%

	Negative Savers (n=18)	Super Savers (n=18)	All (n=36)
Lighting upgrades	6%	0%	3%
Don't know	17%	0%	8%

3.8 RECOMMENDATIONS FOR: HOW PG&E CAN TARGET CUSTOMERS TO INCREASE SAVINGS, AND UPTAKE?

Customers need assistance to make the leap from intent to take action to actually taking action in this program. This study identified ways that the program can both find potential participants and find some ways to best message to them that will help bridge the chasm from intent to do whole house upgrades to actually performing them. The figure below shows that limited intent customers are quite similar to the participant population in that both are far along in the knowledge and attitudinal constructs that lead to intent. The figure also shows that potential participants face several barriers to participation including structural constraints, financial constraints and low energy-related self-efficacy. The evaluation team recommends four things that PG&E can do to help bridge the gap for potential participants from "intent" to "action" (shown in block arrows in the Figure and further described below the Figure).

Figure 21. Summation of Behavior Change Model and Recommendations
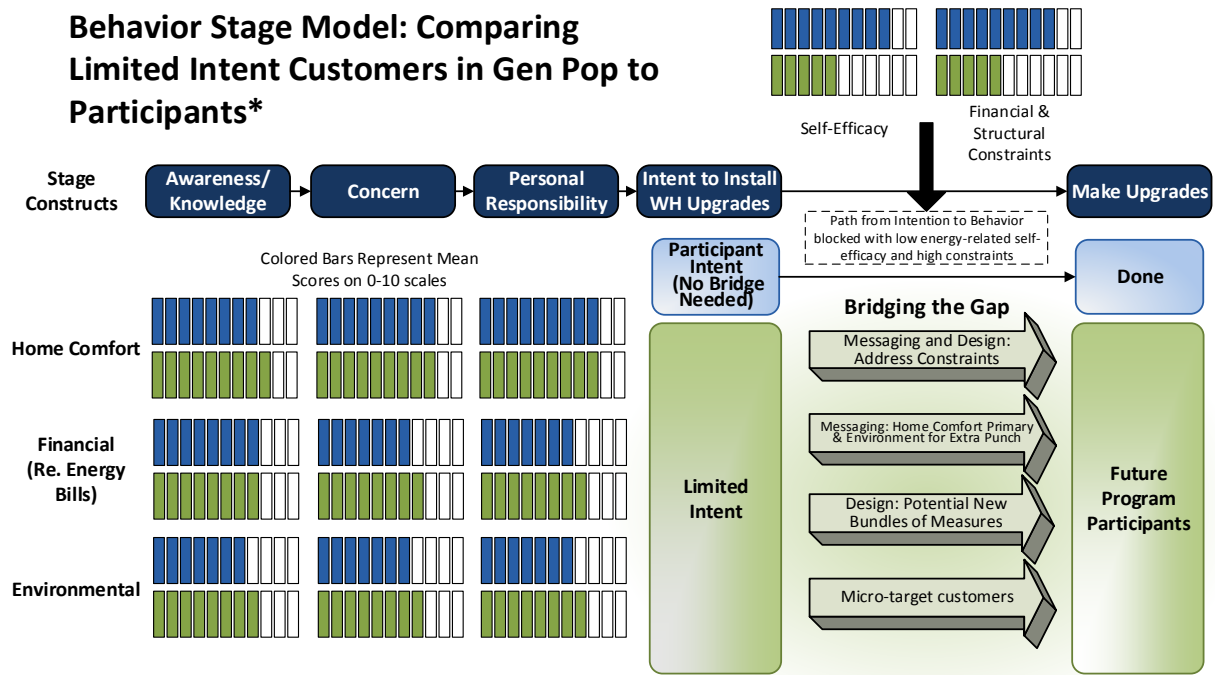
The evaluation team recommends the following to help PG&E target customers to both increase program savings potential and general participation in the program.

> **Recommendation #1: Address Constraints in Messaging and Design**

Financial constraints are the largest reason for not being able to take action. Key reasons for not participating in an audit or the program include the cost of the assessment and that the upfront costs of the upgrades are high.[22] The program can address financial constraints by making customers aware of that there is financial support available to help them make the upgrades they want. Financial support can come in the form of both incentives (currently offered) and increasing awareness of attractive financing options. Further, self-efficacy and perceived behavioral control related to saving energy are lower amongst intent customers indicating a need to help customers understand how they can save energy so they can see the path to doing it. Therefore, the program should communicate that participating in the program is easy and anyone can do it, as well as some instructions or testimonials about how participating customers accomplished it.

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[22] Note that the findings from the process evaluation indicate that financing would have helped many drop-outs.

➢ Recommendation #2: Lead with Home Comfort Message But Add Environment Message

Overall, the data we collected from research with the general population of homeowners showed that comfort is the dominant motivator and resonates with customers in each of the general population groups, particularly those with limited and full intent. In addition to comfort, finances (energy bills) and the environment both resonate with some customers. However, neither is as unifying as comfort as a potential platform for program messaging. While the environment may serve as an initial motivator for some customers, it alone is not enough to overcome barriers to participation such as financial constraints. However, before dismissing the environmental motivation, we note that the combination of comfort and environmental concerns was a combination that predicted a great deal: level of intent, program engagement (at least registering on the website), and program completion. No other combinations of domains predicted these steps beyond what each individual domain of concern predicted by itself. As such, environmental messaging, when combined with comfort messages, may be the most powerful of all messaging.

➢ Recommendation #3: Consider New Potential Measure Bundles

We explored what specific actions customers intend to take and found that approximately one fifth plan to install insulation, upgrade their windows, or upgrade their HVAC equipment to ENERGY STAR models. These measures represent a combination of items from the current Basic and Advanced program packages.

Table 20. Measures of Interest within the General Population of Homeowners (non-participants)

Measures	Current Package	Have Intention	Already Did It	No Intention
Attic, wall, or floor insulation	Basic/Advanced	21%	37%	43%
Upgrade windows, doors or skylights	Advanced	20%	36%	44%
Upgrade to ES heating or cooling equipment	Advanced	20%	32%	48%
Air sealing	Basic/Advanced	13%	25%	62%
Duct sealing and insulation	Basic/Advanced	12%	36%	52%

Based upon customers' intent to install multiple measures in the near future, we present two potential bundles for the basic path below.

Table 21. Potential Measure Bundles

Potential Bundle	Measures
Bundle #1	• Attic, wall or floor insulation • Duct sealing and insulation[a] • HVAC system upgrades
Bundle #2	• Attic, wall or floor insulation[b] • Windows, doors or skylights • ENERGY STAR appliances

[a] Correlation with insulation (r=0.51, n=264, p<.01, two tails) and HVAC upgrades (r=0.41, n=264, p<.01, two tails)

[b] Correlation with windows/doors (r=0.41, n=264, p<.01, two tails) and appliances (r=0.43, n=264, p<.01, two tails)

Additionally, if the program is interested in encouraging the uptake of air sealing as a measure (which is not a measure that many customers "intend" to take), staff could consider including it in one of the bundles presented above.

> ➤ **Recommendation #4: Score and Micro-target Customers**

The overall savings from this program are lower than expected (as shown in the KEMA impact analysis[23]). Targeting high savers would help to increase savings (and average savings per home) in the future. Our team used a classification and regression-tree analysis to investigate which variables are related to savings, while only including data available <u>on all residential customers</u> (i.e., not using participation data since that is only available for participants). We, again, developed three models: (1) households saving >30% combined energy savings, (2) households in the top quartile % and absolute for combined energy savings, and (3) households with >30% gas savings.[24]

Specifically, as we look across the three CART models, we found 13 important indicators that exist within available databases:
- Climate zone
- Home age
- Home size
- Program participation count
- Gas bill category
- Electric bill amount
- Electric opportunities (as identified by Targetbase)
- Electronic bill payment
- Length of residence
- Number of people in the home
- Ethnicity
- Longitude
- CARE scoring

Based on our analysis of **<u>household-level savings</u>**, using a minimum of these 13 key variables, PG&E can score all customers (where the scores would indicate likelihood to save on either a percentage or absolute value) so that it can target marketing efforts to those most likely to save the most and thereby help increase future savings from the program. I.e., the scoring would produce "likelihood to save more scores.[25]"

In the future, PG&E may also choose to augment the findings through a classification and regression-tree analysis of **<u>survey</u>** respondents. This additional effort could help to: (1) better understand which types of households have more intent to take action (and are therefore more likely to participate), i.e., it will produce a "likelihood to take action score"; and (2) better understand if there are any patterns in the types of customers for whom specific messaging will resonate based on the customer groups identified in this study as having different levels of intent and different concerns that messaging could build upon. In other words, based on the general population survey, we were able to identify groups of customers by their attitudes/motivations and by their intent to do a major energy upgrade to their

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[23] "DRAFT CPUC WO46 Residential Whole Building Retrofit" Memo, October 23, 2013. From DNV KEMA Energy & Sustainability to Energy Division, Whole House PCG.

[24] See Appendix G for details of each model.

[25] Note that the models may have to be adjusted once the data is available for all customers if the model does not show enough variability across the customer base.

home. If we can distinguish those groups from less promising ones, using variables available on everyone, the groups that are similar to the original surveyed groups can be targeted for marketing based on their likelihood to have pro-upgrade attitudes and their intent to do an upgrade.

Using both scores (i.e., "likelihood to save more" along with "likelihood to take action") would help the program both increase uptake and better target customers to ensure higher savings. Based on both classification efforts, each PG&E residential customer would have at least two scores, and the combinations of the two could be used to find the highest potential customers, both in terms of likelihood to participate, and likelihood to save energy.

A. APPENDIX A: RELIABILITY AND VALIDITY

Survey item reliability and validity were assessed by analysis in the following three areas:

1. **Distribution of Responses**: When item responses are heavily skewed they cannot distinguish between groups of customers. For an item to be predictive or to be predicted by other items, there must be a reasonable, if not normal, distribution of responses to the item. The biggest challenge with items for this model in California, is that so many residents are highly aware of energy and environment issues and feel concern about them. This makes it a challenge to find items that have adequate distributions.
2. **Scalability:** Another measure of item usefulness is a measure of the internal consistency of multiple items meant to be part of a scale. We analyzed the consistency of multiple combinations of items by examining measures of Cronbach's Alpha.
3. **Construct Validity:** This criterion assesses the extent to which the construct maps to the concept it is supposed to be measuring. There are several ways to acquire evidence in support or construct validity. In this study, the main ways construct validity was assessed was through:
    o *Predictive Validity*: the extent to which a construct is related to observed behavior
    o *Face Validity:* the extent to which survey items appear to inquire about the particular concept
    o *Internal Consistency of Similar Items:* the extent to which multiple items supposed to relate to each other because they map to the same underlying construct actually do

The following table lists the final constructs as well as the items that compose each one. In cases where multiple items converged to compose a construct, we used the average of the items' scores.

Table 22. Final Constructs

| Model Stage | General | Program-Specific | Motivational Domain | | | Survey Items |
			Comfort	Environ-mental	Financial	
Awareness/Knowledge		X				Using a scale from 0 to 10 where 0 is 'None' and 10 is 'A lot', how many of the following types of ads have you've seen or heard in the past year: • Ads about major home energy improvements or upgrades. • Ads that say making home energy improvements decreases a home's impact on the environment. • Ads that say home energy improvements lower utility bills. *Cronbach's alpha=0.84*
	X		X			I am going to ask you some questions about improvements that homeowners might make to increase the comfort of their homes. Please answer using a scale from 0 to 10 where 0 is "would not increase comfort at all" and 10 is "would increase comfort a lot". • How much do you think weather stripping and caulking would increase the comfort of a home that doesn't have it already? • How much do you think adding 8 inches of insulation to the attic or walls would increase the comfort of a home in your area that doesn't have it already *Cronbach's alpha=0.73*
	X			X		Using a scale from 0 to 10 where 0 is 'Not at all knowledgeable' and 10 is 'Very knowledgeable', how knowledgeable do you feel you are about… • home energy improvements that would decrease the impact of your home's energy use on the environment the most? • things you could do to make your home warmer in the winter and cooler in the summer without increasing your natural gas or electricity use? Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following statements: • Conserving electricity will help reduce global warming. *Cronbach's alpha= 0.60*

Model Stage	General	Program-Specific	Motivational Domain			Survey Items
			Comfort	Environ-mental	Financial	
	X				X	Using a scale from 0 to 10 where 0 is 'Not at all knowledgeable' and 10 is 'Very knowledgeable', how knowledgeable do you feel you are about home improvements that would significantly decrease your PG&E bill? *Cronbach's alpha= n/a*
Concern	X		X			Using a scale where 0 is 'Not at all concerned'' and 10 is 'Very concerned', how concerned are you with each of the following... Keeping your home free from drafts and hot and uneven temperatures Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following... I would be very uncomfortable living in a house with very bad drafts and uneven temperatures *Cronbach's alpha= 0.57*
	X			X		Using a scale where 0 is 'Not at all concerned'' and 10 is 'Very concerned', how concerned are you with each of the following... Global warming Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following statements: • I am very concerned about how energy use affects the environment. • I am very concerned about the environmental impacts of power plants *Cronbach's alpha= 0.84*
	X				X	Using a scale where 0 is 'Not at all concerned'' and 10 is 'Very concerned', how concerned are you with each of the following... • The cost of heating or cooling your home • Finding ways to control your home energy costs Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following... I sometimes worry whether there is enough money to pay my energy bill. *Cronbach's alpha= 0.67*

Model Stage	General	Program-Specific	Motivational Domain			Survey Items
			Comfort	Environ-mental	Financial	
Personal Responsibility	X		X			Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following… In my household, I am the person most responsible for making my home comfortable by doing things like keeping it free from drafts. *Cronbach's alpha= n/a*
	X			X		Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following… • If I didn't try to make my home energy efficient, I would feel a little guilty about harming the environment. • I feel it is my job to find ways to reduce my home's impact on the environment. • I feel guilty if I use too much energy *Cronbach's alpha= 0.76*
	X				X	Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following… • I feel a personal responsibility to help lower my household's utility bills. • If my utility bills go up, I feel like I must do something to lower them. • If others in my household can't or won't change their behavior to lower our utility bills, I feel I should personally do even more to control these energy costs *Cronbach's alpha= 0.66*
Intent	X					Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following… • This summer, I intend to try harder to save electricity than last summer • I intend to look for new ways to save energy this year *Cronbach's alpha= 0.55*
		X				Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with… I intend to invest in a major home energy upgrade within the next two years (General Population/Non-Participant Survey) *Cronbach's alpha= n/a*
	X					An intention index was created by totaling the number of positive responses to six items. Do you intend to complete any of the following in the next two years? • Perform air sealing

Model Stage	General	Program-Specific	Motivational Domain			Survey Items
			Comfort	Environ-mental	Financial	
						• Perform duct sealing or duct insulation • Install attic, wall, or floor insulation • Upgrade windows, doors or skylights • Upgrade to ENERGY STAR appliances • Upgrade to ENERGY STAR heating or cooling equipment (General Population/Non-Participant Survey, Web and BIG dropout Surveys) *Cronbach's alpha= n/a*
Behavior Change	X					An intention index was created by totaling the number of positive responses to six items. Have you completed any of the following? • Perform air sealing • Perform duct sealing or duct insulation • Install attic, wall, or floor insulation • Upgrade windows, doors or skylights • Upgrade to ENERGY STAR appliances • Upgrade to ENERGY STAR heating or cooling equipment (General Population/Non-Participant Survey, Web and BIG dropout Surveys) *Cronbach's alpha= n/a*
		X				Have you decided whether you will conduct work on your home through the Whole House program? Response choices include: • Yes, I have decided to conduct work on my home that may be eligible for an incentive through the program • I am considering whether to conduct the work through the program, but I have not decided yet • I have decided NOT to conduct work through the program • Completed work already (Web and BIG dropout Surveys) *Cronbach's alpha= n/a*

Model Stage	General	Program-Specific	Motivational Domain			Survey Items
			Comfort	Environ-mental	Financial	
Self-Efficacy/Perceived Behavioral Control	X	X				Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following... • If I wanted to complete a full set of energy efficiency upgrades to my home, I don't think anything would keep me from doing it. • I know I could significantly decrease my electricity bill if I wanted to. • I know I could significantly decrease my natural gas bill if I wanted to. • I know how to participate in the Energy Upgrade California Whole House Program. • I'm sure I could find a contractor who can help me participate in the Energy Upgrade California Whole House Program. • I'm certain I could find information on the Energy Upgrade California Whole House Program *Cronbach's alpha= 0.75*
Constraints (Self Efficacy/Perceived Behavioral Control	X					Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following... • I really don't think I could afford to complete a full set of energy upgrades to my home, even with rebates. • My home's structure or age makes it hard to complete a full set of energy upgrades. *Cronbach's alpha= 0.76*
Family, Friends, Colleagues	X					Using a scale where 0 is 'Not at all agree and 10 is 'Completely agree', how much do you agree with the following... • I know people who talk about their homes being drafty and having uneven temperatures. • I know people who worry about the impact of their home's energy use on the environment. *Cronbach's alpha= 0.55*

B. APPENDIX B: BILLING DATA CLEANING

The Evaluation Team cleaned both program tracking and billing data to prepare it for analysis. From the period of March 1, 2009 to April 1, 2013, the program tracking data contained a total of 6,249 jobs. 4,242 were completed projects. Of those, 4,144 were completed in homes where PG&E provides at least one type of fuel. As seen in the Table 23 below, 2,745 projects were completed in homes where PG&E is both electric and gas provider, 194 in PG&E electric only homes, and 1,205 in PG&E gas only homes.

Table 23. Participant Breakdown

IOU Combination	Total Completed Projects
PG&E Gas and Electric	2,745
PG&E Gas Only	1,205
PG&E Electric Only	194
Subtotal PG&E	*4,144*
PG&E does not provide service	98
TOTAL	4,242

Out of these 4,144 completed projects, we requested detailed participant data and billing data for 2,602 completed projects. These projects started no later than the first half of 2012. Thus, projects started after June 2012 were not included. For these projects we identified for the billing analysis, we requested billing data from January 1, 2009 to the latest billing period available, which corresponded to roughly April 2013. Of the 2,602 projects we identified for the analysis, PG&E was able to obtain billing data for 2,505 projects which consisted of 1,578 electric accounts and 2,409 gas accounts. PG&E was unable to find billing data for some projects because the account numbers for these projects were either missing, erroneous, or the service provider determined to not be PG&E for either gas or electric. Since we received sufficient data for both gas and electric accounts, we decided to conduct the analysis with only those customers that have both gas and electric service from PG&E. In addition, these the customer must also have enough data for both gas and electric for analysis. This limitation ensures that the combined savings are representative of each individual household

For the billing data, we took the following steps to clean the data:

➢ Combining billing data from all calendar years 2009-2013.

➢ Checking billing periods for duplicate observations and overlaps and taking appropriate actions to resolve the issues in order to arrive at an accurate daily consumption value.

➢ Audit date and test-out date are used as treatment begin and treatment end dates. These dates are verified using the Green Energy Compass documentations to make sure our pre-post and dead-band periods are an accurate reflection of the Whole House audits and installations that took place.

➢ Obtaining heating and cooling degree days from the nearest weather stations and merging them with the billing data.

➢ Electric and Gas customer data are combined together in order to determine which customers have both electric and gas service from PG&E.

> ➢ Kept only customers with sufficient data for both gas and electric. Thus, dropping accounts where pre-post period is less than 9 months for either gas or electric billing data. Summary of drops below.

> ➢ Dropped net metered electric accounts.

The billing data we received from PG&E contained the following information:

From the customer list:

- ➢ Sa ID
- ➢ Person ID
- ➢ Premise ID
- ➢ Account ID
- ➢ Customer name (Including name of another in household, in most cases a spouse)
- ➢ Customer phone number
- ➢ Customer service address - including street number, street name, unit, city,and zip code
- ➢ Rate Schedule (Gas and Electric)
- ➢ Gas and electric service start and stop dates
- ➢ Flag indicating if service is active
- ➢ NOA weather station and PG&E assigned weather station

From the billing Data

- ➢ Current billing period end date
- ➢ Previous billing Period end date
- ➢ Billing period duration
- ➢ Energy usage data (therms, kWh)
- ➢ Rate Schedule (Gas or Electric)
- ➢ Estimate Read Indicator (0 for actual, 1 for estimate)
- ➢ Care flag for whether this customer participated in this low income program

A full list of the billing data we received from PG&E is located in Appendix E. The outcome of the data cleaning steps are described below. After all data cleaning, we ended up with 920 households for the billing analysis with complete data for the analysis.

Table 24. Billing Data Cleaning Steps and Counts

	Total Customer Counts
Electric Customers	1,583
Gas Customers	2,414
Total Customer Records Received	2,505
Gas Customer but Not Electric	922
Electric Customer but Not Gas	91

	Total Customer Counts
No Electric or Gas Billing Data Received	5
Total Possible Accounts For Analysis	1,487
Both Gas and Electric Have 0 Post Periods	230
Either Gas or Electric Have Insufficient Pre-Post Data	337
Total Accounts (For Billing Analysis)	920
Gas or Electric Savings Over 100% of Baseline Usage	8
Total Accounts (For Targeting/CART Analysis)	912

Table 25. Billing Analysis Detailed Drop Accounts

Detailed Drops Table	Electric	Gas
Data Availability		
9 months	25	23
10 months	23	34
11 months	43	81
12 or more months	966	1,788
Total	1,057	1,926
Total Customers	1,578	2,409
< 9 months of Data	521	483
Low ADC (<2 kWh/<0.07 Thm)	17	13
Net Meter	65	0
Total	975	1,913
Do not have both gas and electric data	55	993
Total	920	920

C. APPENDIX C: PROGRAM TRACKING DATA

Program Tracking Data Variables
Job ID
Confirmation Code
Contractor Company
Homeowner Name
Address
City
State
ZIP Code
Year Built
Gross sq. ft.
Conditioned sq. ft.
Electric Utility
PG&E Electric SA_ID
Possible Electric SA_ID
Natural Gas Utility
PG&E Gas SA_ID
Possible Gas SA_ID
Date Building Record Created
Initial Heating Fuel
Post-Upgrade Heating Fuel
Initial Cooling Type
Initial Hot Water Fuel
Initial Hot Water Type
Post-Upgrade Hot Water Type
Initial Thermostat Type
Audit Date
Test-Out Date
Completed Cost
Job Disposition
Check Amt.
Check Date

Program Tracking Data Variables
Check #
Total Kbtu Savings
Electricity Savings
Natural Gas Savings
Type
Total kBtu Savings
Electricity Savings (kBtu)
Natural Gas Savings (kBtu)

D. APPENDIX D: GEOGRAPHIC DISTRIBUTION OF WEATHER STATIONS AND WHOLE HOUSE PROJECTS
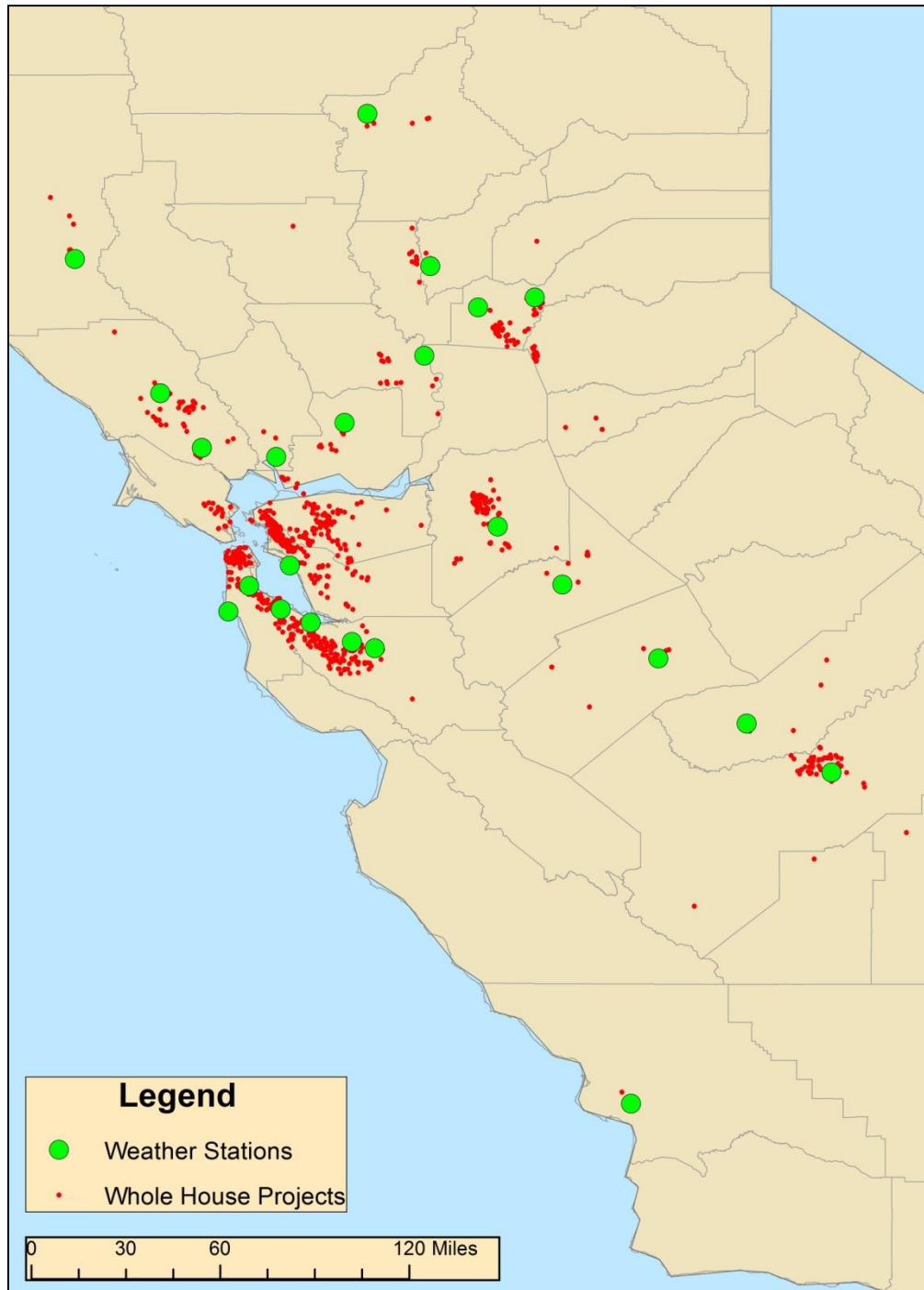
E. APPENDIX E: BILLING DATA RECEIVED

File Name	Variable List	Variable Description
2009 Gas Billing Data	SA_ID	Service Agreement ID
2010 Gas Billing Data	ACCT_ID	Person ID
2011 Gas Billing Data	PREM_ID	Premise ID
2012 Gas Billing Data	YEAR	Year
2009 Electric Billing Data	CDT__1-CDT__12	Current Billing Date
2010 Electric Billing Data	KWH__1-KWH__12 (Electric)	Monthly Billed kWh Usage
2011 Electric Billing Data	THM__1-THM__12 (Gas)	Monthly Billed Therm Usage
2012 Electric Billing Data	PDT__1-PDT__12	Previous Billing Date
(..for Cleansed EUC Population)	RSCH__1-RSCH__12	Rate Schedule
	DAY__1-DAY__12	Number of Days in Billing Cycle
	CARE__1-CARE__12	CARE Flag (1 = Enrolled in CARE)
	EST__1-EST__12	Estimated Flag (1 = Usage is Estimated)
Electric EUC Population	SA_ID	Service Agreement ID
Gas EUC Population	PER_ID	Person ID
(..Based on Cleansed Electric SA_Ids)	PREM_ID	Premise ID
	ACCT_ID	Account ID
	NAME	Name
	NAME2	Alternate Name (Usually Spouse)
	SERADDR	Service Street Address
	SERADDR2	Address Line 2, Units
	SERCITY	City
	SERZIP	Zip Code
	RSCHED	Rate Schedule
	CUSPHONE	Customer Phone Number
	STATUS	Account Active Status (1 = Active)
	STOPDATE	Service Stop Date
	SASTART	Service Start Date
	NETMETER (Electric Only)	Flag for Whether the Site is Net Metered
	NOAWSTN	NOA Weather Station Assignment
	PGEWSTN	PG&E Weather Station Assignment
PGE weather station data	DATE	Date
	CITY	Weather Station City
	TEMP1 - TEMP48	Temperate in Half Hour Intervals
	RH1 - RH48	Relative Humidity in Half Hour Intervals

F. APPENDIX F: COMPARISON OF SAVINGS ESTIMATION TO ENERGY PRO

This task involves comparing savings estimation methods by examining how the changes in usage derived through the regression model compare to the changes estimated through the EnergyPro modeling software. To approach this task, the Evaluation Team compared the results of the regression analysis to the energy savings modeled through the EnergyPro software to understand how the participants did or did not save energy after the program intervention compare to the modeled savings estimates. We examined the differences at the site level, gas savings and then electric savings. We conducted this analysis with the early billing analysis participants (mainly 2011 participants), including 464 total households.

As compared to the billing analysis results, EnergyPro overestimates savings considerably, especially on the electric side (See Figure 22). Results show that EnergyPro savings estimates are higher than billing analysis savings estimates for a large number of participants:

- At the site level, EnergyPro overestimated savings by more than 100% for 50% of projects

- On the gas side, EnergyPro overestimated savings by more than 100% for 45% of projects

- On the electric side, EnergyPro overestimated savings by more than 100% for 66% of projects

Conversely, data show that EnergyPro can also underestimate savings. At the site level, EnergyPro underestimated savings for 23% of the projects (underestimating by as low as 31% to up to 100%). The underestimates do appear to be as extreme as the overestimates and EnergyPro is overestimating more often than underestimating.

Figure 22. EnergyPro Savings Comparison to Billing Analysis
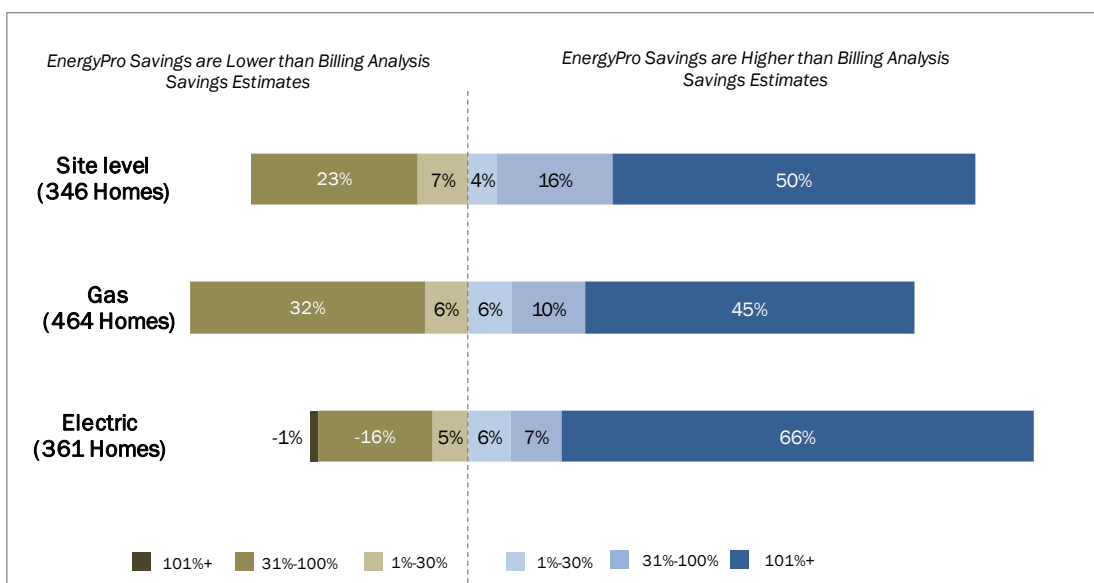
Note that site level analysis comparison only included accounts for which both electric and gas data were included in the pre-post regression analysis, i.e. customers with dual fuel service from PG&E

G. APPENDIX G: CART MODELS

The CART(classification and regression tree) models shown below indicate some subgroups of customers who are more likely than others to show good savings after a whole house retrofit. CART started with the whole group of participants, and then found all of the variables in our dataset that help to divide the groups into two subgroups. The two subgroups will have a higher (or lower) concentration of customers in one savings level category. CART finds the best variable, and the best cut-point of that variable's values that most efficiently divides the "parent" group into the two "child" groups. After each split of a parent node into two child nodes, each child node then becomes a potential parent node to another split. Groups continue to be split until it is no longer beneficial to do so. In the models below, the final subgroups of interest are circled for emphasis. Our emphasis in doing this is identifying subgroups of customers most likely to save.

It is possible to define potential subgroups of savers in various ways. We represent a few here. Model 1 is an analysis to identify those who saved at least 30% of energy, considering both fuel types. Model 2 also deals with combined electric and gas savings, but defines the target groups by both percentage and raw savings, requiring the customers to be in the top 25th percentile to qualify as a saver in this analysis. Model 3 considers super savers in gas only.

Model 1-Combined
Savings
Super Savers(>30%)

	Class = 0	
Class	Cases	%
0	800	87.7
1	112	12.3

CZ_AVG_ALL <= 14.53

	Class = 1	
Class	Cases	%
0	392	84.8
1	70	15.2

CZ_AVG_ALL > 14.53

	Class = 0	
Class	Cases	%
0	408	90.7
1	42	9.3

GBILL_CAT <= 1.50

Class	Cases	%
0	121	75.2
1	40	24.8

GBILL_CAT > 1.50

	Class = 0	
Class	Cases	%
0	271	90.0
1	30	10.0

EEOC_QTILE <= 2.50

	Class = 0	
Class	Cases	%
0	185	96.4
1	7	3.6

EEOC_QTILE > 2.50

	Class = 1	
Class	Cases	%
0	223	86.4
1	35	13.6

CONTR_AVGSAV <= 41.82

	Class = 0	
Class	Cases	%
0	179	93.7
1	12	6.3

CONTR_AVGSAV > 41.82

Class	Cases	%
0	92	83.6
1	18	16.4

X <= -121.88

	Class = 0	
Class	Cases	%
0	72	91.1
1	7	8.9

X > -121.88

Class	Cases	%
0	113	100.0
1	0	0.0

YR_BUILT <= 1975.50

Class	Cases	%
0	126	80.3
1	31	19.7

YR_BUILT > 1975.50

Class	Cases	%
0	97	96.0
1	4	4.0

HH_PEOPLE$ = (2 People,...)

Class	Cases	%
0	97	99.0
1	1	1.0

HH_PEOPLE$ = (1 Person,...)

Class	Cases	%
0	82	88.2
1	11	11.8

RES_LENGTH <= 7.50

Class	Cases	%
0	16	72.7
1	6	27.3

RES_LENGTH > 7.50

Class	Cases	%
0	56	98.2
1	1	1.8

Variable	Value	
CZ_AVG_ALL	100.0000	|||||||||||||||||||||||||||||||||||||||||||||||
GBILL_CAT	20.8294	||||||||||
EEOC_QTILE	7.3820	|||
YR_BUILT	1.0006	
CONTR_AVGSAV	0.9346	
HH_PEOPLE$	0.1177	
X	0.0636	
RES_LENGTH	0.0055	

Model 2-Combined Savings
Top 25 Percentile in
Percentage & Absolute
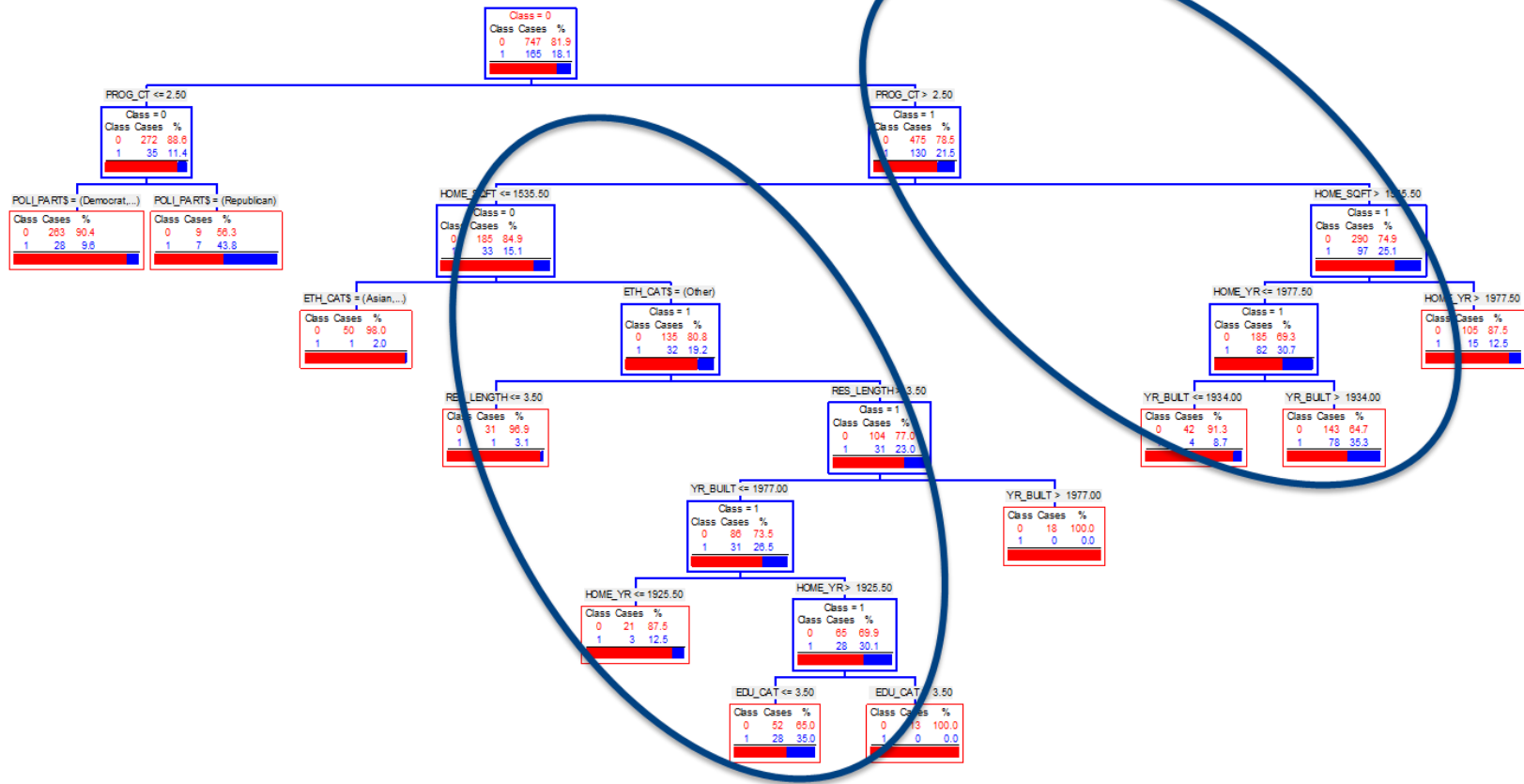
YR_BUILT	100.0000	|||||||||||||||||||||||||||||||||||||||||||
HOME_YR	88.3521	||||||||||||||||||||||||||||||||||||||
PROG_CT	74.3874	||||||||||||||||||||||||||||||
POLI_PART$	65.4064	||||||||||||||||||||||||||
ETH_CAT$	60.1218	||||||||||||||||||||||||
HOME_SQFT	59.0714	|||||||||||||||||||||||
EDU_CAT	58.8944	|||||||||||||||||||||||
RES_LENGTH	45.6602	||||||||||||||||||

Model 3 - Gas Savings
Super Savers (>30%)

Class = 0
Class	Cases	%
0	695	76.2
1	217	23.8

HOME_YR <= 1981.50

Class = 1
Class	Cases	%
0	550	72.8
1	206	27.2

HOME_YR > 1981.50

Class	Cases	%
0	145	92.9
1	11	7.1

GBILL_CAT <= 1.50

Class	Cases	%
0	140	56.9
1	106	43.1

GBILL_CAT > 1.50

Class = 0
Class	Cases	%
0	410	80.4
1	100	19.6

GBILL_CAT <= 2.50

Class = 0
Class	Cases	%
0	317	77.7
1	91	22.3

GBILL_CAT > 2.50

Class	Cases	%
0	93	91.2
1	9	8.8

EBILL_AMT <= 575.00

Class	Cases	%
0	73	90.1
1	8	9.9

EBILL_AMT > 575.00

Class = 1
Class	Cases	%
0	244	74.6
1	83	25.4

X <= -121.93

Class = 1
Class	Cases	%
0	162	69.2
1	72	30.8

X > -121.93

Class	Cases	%
0	82	88.2
1	11	11.8

INS_HVAC$ = (No)

Class = 0
Class	Cases	%
0	77	81.1
1	18	18.9

INS_HVAC$ = (Yes)

Class	Cases	%
0	85	61.2
1	54	38.8

HH_INCOME <= 7.50

Class	Cases	%
0	10	55.6
1	8	44.4

HH_INCOME > 7.50

Class	Cases	%
0	67	87.0
1	10	13.0

GBILL_CAT	100.0000																																																			
HOME_YR	52.6974																										
X	27.1651														
EBILL_AMT	24.6900													
INS_HVAC$	21.4566												
HH_INCOME	18.2480										