A Deeper Look into Participant Saving Patterns and Underlying Reasons to Enhance Targeting and Messaging

Kessie Avseikova, Megan Campbell, Jennifer Mitchell-Jackson,
Katherine Randazzo and Seth Wayland, Opinion Dynamics
Andy Fessel, Pacific Gas & Electric

ABSTRACT

Program administrators across the country strive to achieve deeper savings through their energy efficiency programs. However, despite versatile marketing approaches and sophisticated engineering modeling methods, participants often do not achieve the savings expected, and some even increase energy usage post-participation. Traditional impact evaluation results show how much energy program participants saved overall, but generally provide limited insight into reasons for saving or not saving energy, or which participant groups save more or less.

This paper draws on the results from several research studies conducted in 2013 for PG&E's Whole House program to demonstrate how analysis of energy savings patterns and reasons underlying those patterns can help unlock higher energy savings through informing the future focus of the program design and implementation, including marketing and messaging strategies.

Through leveraging survey efforts, secondary data sources, and multiple analytical techniques this paper explores energy saving patterns and identifies factors for predicting those patterns. The analysis classifies participants into "positive," "negative," and "neutral" saver groups and explores demographic, geographic, building, household, psychographic, project-specific, and behavioral characteristics most predictive of each group.

Understanding the mix of factors that drive energy savings allows for a more strategic selection of the program design elements and customer engagement tactics and can lead to the achievement of higher savings. The value of this study spans beyond the Whole House program – the results are useful to energy efficiency program implementation and marketing teams across the country, as they plan customer engagement strategies for their energy efficiency programs.

Introduction

Energy Upgrade California™ is a statewide program in California that offers incentives for completing energy saving improvements in a home. This program takes a whole house approach to a home's energy efficiency needs, as opposed to a measure-by-measure approach. As part of the program, customers receive an energy assessment and can take advantage of basic upgrades, such as duct replacement and sealing, air sealing, and attic insulation, as well as advanced upgrades (e.g heating, cooling, and water heating equipment, window and ductwork replacement, etc.) The program relies on a workforce of independent contractors trained to deliver the program and uses whole house modeling software to estimate energy savings. The expected reduction in savings as a result of the program is at least 10% in energy units (not money saved).

Pacific Gas & Electric (PG&E) is one of the California Investor-Owned Utilities (IOUs) that administers the Whole House program. This paper focuses on the program design and implementation within PG&E's service territory during the period between 2010 and 2012.[1]

The Whole House program was launched in PG&E's service territory as a pilot in August 2010. Following the first ten pilot months, the program was launched full-scale and has been ongoing since. Program marketing included fact sheets, community events and workshops, contractor marketing, and a website. From the start of the program through the second quarter of 2013 over 6,000 projects were initiated, and close to 5,000 projects were approved.[2]

This paper draws on a variety of research efforts completed over the course of 2012 and 2013 to understand Whole House program participants thus far, what is driving the difference in savings, and provide insights into possible programmatic changes and course corrections that could drive higher savings.

Overview of Research Efforts

This paper builds upon the following research efforts:

- A process evaluation conducted in 2012 and 2013 that explored attitudes, motivations, and household occupancy and behavior changes. 160 interviews completed with participants and 150 with drop-outs, customers who initiated a project but did not complete.
- A marketing, billing, and targeting analysis study completed in 2013 to determine the how many participants were saving energy and how much and to explore the drivers of savings:
    - Billing analysis of 912 households (individual regressions of each home)[3]
    - Classification and regression tree (CART) analysis using participant data, customer data, and Targetbase data[4]
- A behavioral change study completed in 2013 that explored intent to participate and attitudes.
    - Interviews with 2011 and 2012 participants (n=237)
    - Survey of non-participating homeowners (including those who started the participation process but did not complete it) in PG&E's service territory (n=264)

Detailed Findings

This paper focuses on some of the core factors that we attempted to understand to help PG&E formulate a strategy for increasing energy savings achieved through their Whole House program. They include:

- Understanding participant population, barriers and motivators to participation

[1] Note that for some of the research efforts, participants from early 2013 were included.
[2] The number of customers who actually received rebates is lower.
[3] Note that this analysis only focused on households where PG&E provides both electric and gas services.
[4] 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 and can be matched to each individual customer.

- Understanding energy savings, factors/drivers behind energy savings

Understanding Participant Population

Our analysis of the PG&E's Whole House program participants revealed that, not surprisingly, they are quite different from non-participants and the general PG&E customer base. Geographically, program participation was focused in the Sacramento, Alameda, and Santa Clara counties.

Table 1. Participation and population by county

	% of Approved Projects	% of Single Family Household Population[5]
Sacramento	26%	10%
Alameda	12%	9%
Santa Clara	10%	10%
Contra Costa	8%	8%
San Francisco	7%	2%
San Mateo	6%	5%
San Joaquin	5%	5%
Fresno	4%	6%
Place	3%	3%
Sonoma	3%	4%
All other counties	16%	37%

Furthermore, as demonstrated in the Table 2, below, we found that program participants and also drop-out customers are much more likely to have higher incomes and education levels than non-participants.

Table 2. Comparison of participant characteristics to non-participants and drop-outs

Characteristic	Participants (n=240)	Non-Participants (n=264)	Drop-Outs* (n=111)
	(C)	(A)	(B)
Income			
$75k or more	70%	46% BC	69%
Less than $75k	30%	54% BC	31%
Education			
College or more	78%	47% BC	80%
Less than college	22%	53% BC	20%

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. For example, 46% of non-participants make 75K or more and that is significantly lower than the 70% of participants and 69% of drop-outs.
* Customers who started but did not complete the participation process.

[5] Source: 2010 Census Data of 1-unit housing types in PG&E territory counties.

Because participants are so different from non-participants, it is possible that they have different motivators and more importantly barriers to participation. We describe them below. However, simply knowing how participants are different from non-participants offered an insight to the PG&E program team in terms of who self-selects to participate in the Whole House program, whether that is the desirable audience for the program, and whether any modifications to program design and implementation are needed.

Understanding Barriers and Motivators to Participation

Program participants are less likely to face structural or financial constraints than non-participants. On a scale of 1 to 10, where 1 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 homes does not pose problems in completing those actions (a financial and structural combined average score of 9.1 out of 10). Among non-participants (including drop-outs – customers who started but did not complete the process), the average score ranged between 4.0 and 4.7, which is considerably different from participants' score. Such difference can be attributed, at least partially, to the differing levels of incomes and education of participants as compared to non-participants.

In addition to understanding possible barriers to participation, the research also sought to understand the perceived benefits of the program. The findings show that participants place significant value on improving home comfort (average rating of 4.6 on a 5-point scale where 1 means "not at all important and 5 means "very important"). Reducing energy usage and saving money on energy bills are also among the main program benefits (average ratings of 4.5 for both on the same scale), whereas environmental concerns were trailing behind (average rating of 4).

As shown in the Figure 1,below, when asked about the main program benefits after completing the project, participants were consistent with what motivated them, with top benefits being home comfort, followed closely by saving money and energy.

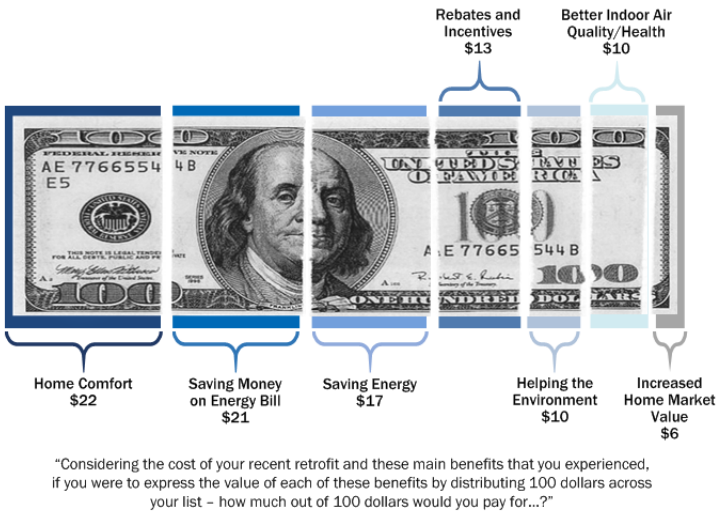

Figure 1. Main program benefits rating.

Understanding Energy Savings

Not every participant saved the same amount of energy. Regression analysis of participant billing data revealed that customers are saving energy at different rates post-participation[6]. In fact, despite projected energy savings of at least 10%, some participants ended up increasing their energy usage post-participation. We conducted a regression analysis that included 912 homes where PG&E provides gas and electric services that had sufficient amount of pre- and post-participation billing data. We ran the analysis as a series of individual regressions, which allowed us to review changes in energy usage home-by-home, instead of at the aggregate level. As part of the analysis, we developed absolute and relative changes in energy usage by fuel and combined, at the site level. There was variation in the project size and predicted savings for each participant, however in order to qualify for the program, a project needed to have predicted savings of at least 10%.

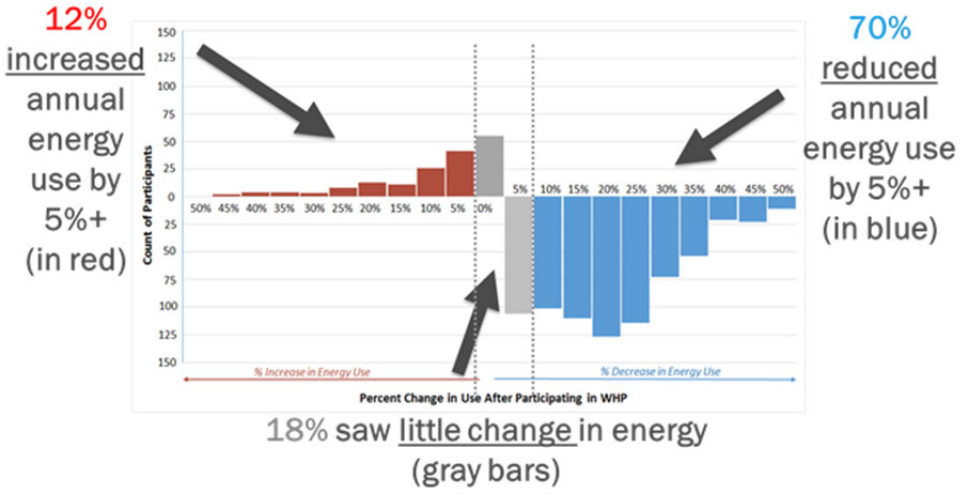

Figure 2. Percent energy savings achieved by program participants.

When looking at the absolute savings, 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.

Analysis of energy savings by fuel revealed that a lot more participants increased electric consumption post-participation, as compared to gas consumption. As can be seen in Figure 3, a large majority of participants (74%) saw gas savings of 6% or more, as compared to 43% of participants who saw similar electric savings. Furthermore, 43% saw gas savings of over 21%, whereas only 15% saw electric savings of similar magnitude. Examining the individual households, there was no consistent pattern in the relationship between gas savings and electric savings. Some households were able to save on both fuels; others saved much more on one than the other, and often savings on one was counter-balanced by increased usage in the other fuel type. It is possible that many participants saved on gas for heating purposes but this also speaks to the diverse nature of the PG&E customer base in terms of what fuel is used for what purpose.

[6] Pre and post periods were at least 9 months in length depending on project dates and billing data availability.

Note that we also explored behavior changes that explain the increase in energy use which is described later in this report.

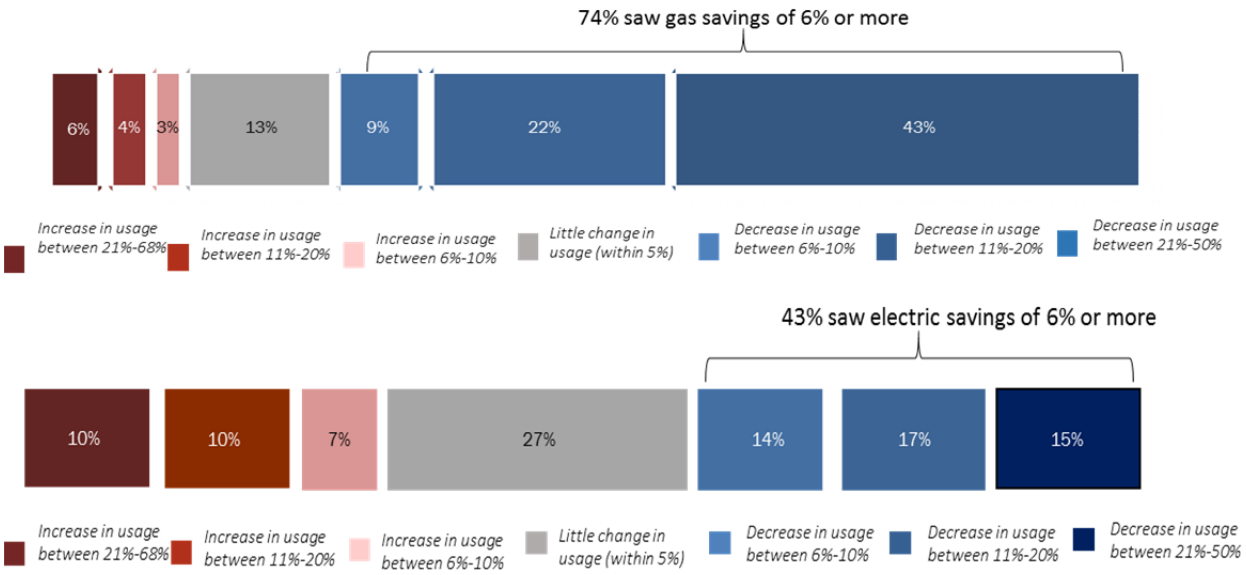

Figure 3. Comparison in percentage of energy savings by fuel type.

Understanding Drivers behind Energy Savings

We completed additional primary research and conducted additional modeling efforts. We used over 200 variables provided by PG&E to facilitate the additional analysis. These variables consisted of project-related data, housing data (e.g., housing structure, home ownership, etc.), climate data (e.g., climate bands), and customer data (e.g., age, education, income, household size, and psychographic characteristics). We utilized Targetbase as the source for many of these variables.

We first looked at direct comparisons between savers and non-savers.[7] We found five key areas where there were significant differences between those two segments. 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.)

[7]We excluded participants with negligible energy savings – those whose energy consumption either reduced or increased by up to 5%. Savers are defined as participants who saved 5% or more. Non-savers were defined as customers who increased their energy consumption by 5% or more.

In addition to drawing direct comparisons, we also used the available psychographic, demographic, customer and participant data to statistically model the factors most predictive of energy 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.

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 as well as at the combined (gas and electric) level. We ran multiple models across a variety of savings categories and selected the best fitting models for the following groups of savers: (1) households saving of more than 30% savings at the combined level, (2) households in the top quartile in terms of both relative and absolute energy savings at the combined level, and (3) households with more than 30% gas savings. Note that all energy savings in this paper refers to energy units saved, not dollars saved.

- ***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: After controlling for weather in the analysis,** 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 (i.e. we see most of the saving coming from gas and heating usage is more prevalent in cooler climate zones) 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: Small, Medium, Large). This could be due to the fact that those customers might have electric heat, which costs a lot more and where energy savings are easily generated.
- ***Model 2: households in the top quartile for both percent 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.

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, 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 (i.e., homes with lower gas usage)
    - Electric opportunities in the household (homes with the opportunities to save in the top two quartiles)[8]
    - Engagement with utility through number of rates and non-energy efficiency programs

Note that our initial 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. We surmised that there may be other factors (such as changes in the household) that were not included in this initial analysis that could explain savings or the levels of savings. Such factors could include customers making family or lifestyle changes (e.g., retirement, birth of a baby, etc.), changes to the energy consumption due to added cooling or heating load, and behavior changes that result in takeback/snapback (e.g., changing thermostat setting to more comfortable temperatures). To deal with this, we conducted additional primary research to explore the above-listed factors. We conducted interviews with 119 customers that included both high positive savers, savers, neutral savers and non-savers.

Table **3** 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.

[8] This variable was a part of Targetbase and was developed using a modeling effort, specifics of which are not completely known to us.

Table 3. 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%

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 **3**), 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 **3** and

Table **4**). 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 (as measured by the size of the rebate)
- Negative savers were very concerned about comfort, and more so than other groups

Table 4. 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.

Conclusions and Reflections

The findings from this research allow PG&E to make informed decisions about program design, implementation, and marketing and messaging strategies. This study identified ways that PG&E can both target customers with the highest savings and participation potential and some ways to best message to them that will help bridge the chasm from intent to action. Figure 4 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 recommended four things that PG&E can do to help bridge the gap for potential participants from “intent” to “action” (shown in block arrows in Figure 4 and further described below the figure).

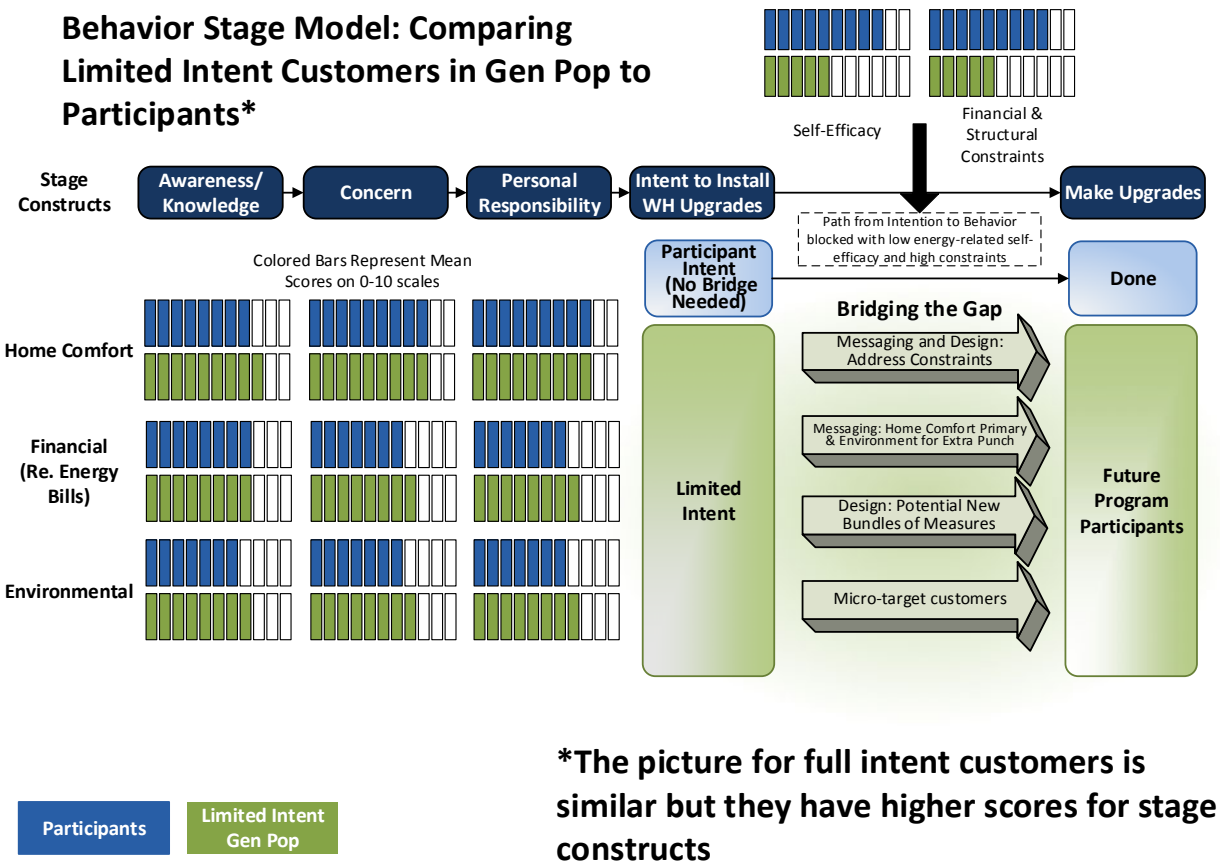

Figure 4. Summation of behavior change model and recommendations.

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 (perceived or real depending on whether the customer received an assessment).[9] 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.

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

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

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. Therefore new potential bundles of measures were presented to PG&E for consideration in future program design.

Recommendation #4: Score and Micro-target Customers: Targeting high savers would help to increase savings (and average savings per home) in the future. As we look across the three CART models, we found 13 important indicators that exist within available databases. Based on our analysis of **household-level savings**, 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.[10] In the future, PG&E may also choose to score customers based on their likelihood to participate. 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 home. 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.

While these conclusions are specific to PG&E's Whole House program, the underlying principles presented in this paper can be used in successful targeting and achievement of high savings by other programs. Those principles include understanding participants, reasons, barriers, and motivators to participation, energy savings that participation results in and if/how those are different by customer segments. Research methods described in this paper can comprise a toolkit of approaches for efficiency program managers to use to improve their programs and reach higher savings.

[10] 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.