



# **Berkshire Gas Home Energy Report Program Evaluation**

**Final Report in the Cross-Cutting Research Areas of  
Behavior and Education**

**Prepared for:  
Massachusetts Program Administrators and the Energy  
Efficiency Advisory Council**

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Navigant Consulting, Inc.  
1375 Walnut Street  
Suite 200  
Boulder, CO 80302

303.728.2479  
navigant.com

ILLUME Advising, LLC.  
440 Science Drive  
Suite 202  
Madison, WI 53711

608.807.2061  
illumeadvising.com

NAVIGANT

ILLUME



**Prepared by:**

**Navigant Consulting, Inc.**

Ken Seiden

Debbie Brannan

Carly McClure

Will Sierzchula

**Illume Advising, LLC**

Anne Dougherty

Eileen Hannigan

Mallika Jayaraman

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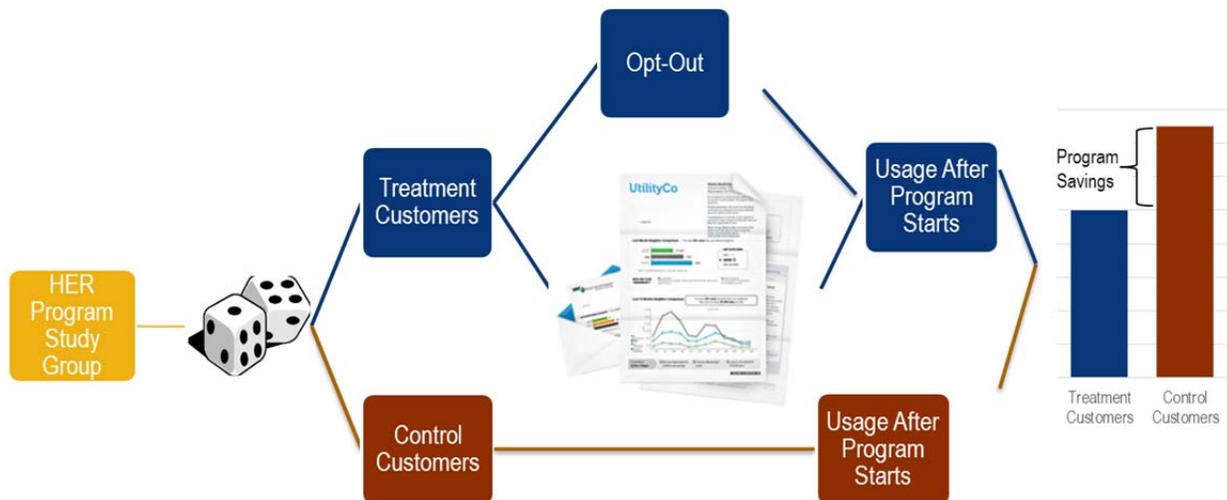
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**Executive Summary**

Navigant Consulting, Inc. (Navigant) and Illume Advising (the evaluation team) present the results of the first-year process and impact evaluation of Berkshire Gas’ Home Energy Report (HER) program. The primary objective of the program is to provide residential households with information on their gas consumption and tips on how to save energy to prompt them to take action to reduce their natural gas usage. The HER program, implemented by Opower, was launched in October 2014, and has delivered reports to nearly 12,000 customers during its first program year.

The HER program is implemented as a randomized controlled trial (RCT) in which customers are randomly assigned into treatment and control groups. As an opt-out implementation model, customers do not choose to participate; however, if they do not wish to receive the reports they can request removal from the program. Figure 1 illustrates the program design.

**Figure 1. HER Program Design**



*Source: Evaluation team analysis*

Treatment customers received printed reports by mail throughout the heating season (October 2014 through April 2015). The majority of customers received their first report between mid-October and mid-November. However, due to issues with the billing data generated by Berkshire Gas’ IT team, some customers did not receive their first report until later in the heating season. This resulted in many participants receiving fewer printed reports during the heating season than originally planned.

In addition to the printed reports, treatment customers also have access to a web portal that provides additional tips and information on household energy usage, and receive the home energy report by email if Berkshire had an email address on file. Email coverage for the Berkshire service territory is lower than for other program administrators (PAs) in the state of Massachusetts; approximately 3% to 4% of

customers received electronic reports via email compared to 21% to 53% for other PAs. Table 1 provides a synopsis of the Berkshire program.

**Table 1. HER Program Participants and Controls**

Month of First Report*	Evaluation Period	Actual Number of Participants	Actual Number of Controls
October 2014	October 1, 2014 – September 30, 2015	11,999	9,997

\*This is the month of the “RCT start date” in the Opower dataset when a wave is initiated. Participants likely received their first report approximately one month later than this date.

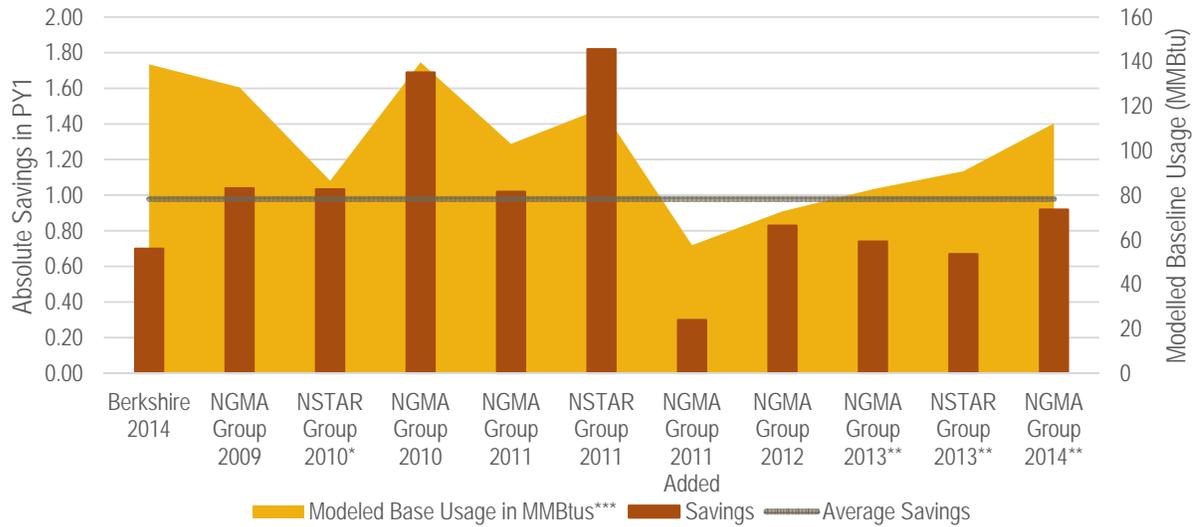
Source: Berkshire billing data, Opower implementation data, and evaluation team analysis

Key findings include:

- Overall, participants are satisfied with the HER reports. Over half of participants (59%) classify the reports as useful, similar to surveys of other Massachusetts gas HER programs.<sup>1</sup> Participants are most satisfied with the personal usage comparison.
- Total program savings (after the channeling savings adjustment) were 7,603 million British thermal units (MMBtu), which is 0.7 MMBtu annually per person or 0.49%. This absolute savings value is relatively low given the high baseline usage compared to the first-year evaluated savings of other gas cohorts in Massachusetts (Figure 2). In percentage terms, savings are the lowest among the MA cohorts. The lower than expected evaluated savings are supported by Opower’s reported savings, and the customer surveys we conducted reveal that fewer Berkshire participants report that the reports led to energy-saving behaviors (Figure 3).

<sup>1</sup> See Figure 5 in “Massachusetts Behavioral Process Evaluation,” July 2015, Navigant Consulting, Inc.

**Figure 2. First-Year Savings Comparison, Gas-Only Cohorts**



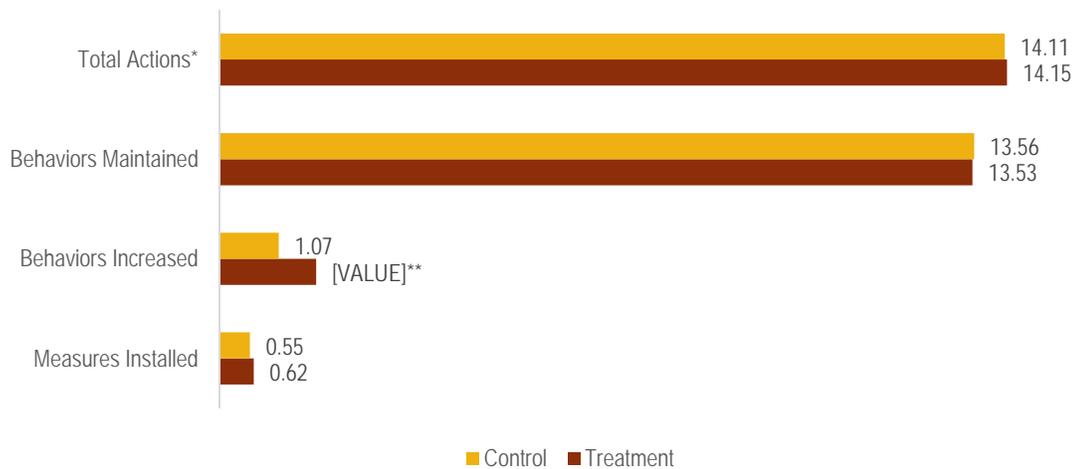
\*NSTAR Group 2010 is a weighted average of two analyses covering August 2010–April 2011 and May 2011–December 2011.

\*\*These cohorts were examined for the first time in 2014 in lieu of a true first-year evaluation.

\*\*\*Modeled baseline usage is not weather normalized.

Source: Evaluation team analysis, the 2013 Evaluation Report<sup>2</sup>, and the 2014 HER analysis<sup>3</sup>

**Figure 3. Energy-Saving Actions and Behaviors Taken by Treatment and Control Customers**



\*Includes all actions—measures installed/purchased, behaviors changed, and behaviors maintained.

\*\*Significantly higher than control group at p<0.05.

Source: Evaluation team analysis

<sup>2</sup> Opinion Dynamics, Navigant Consulting, Inc., and Evergreen Economics. 2013. *Massachusetts Cross-Cutting Behavioral Program Evaluation Integrated Report*.

<sup>3</sup> The results of the 2014 HER analysis were presented to the PAs in a memo titled “Massachusetts Cross-Cutting Behavioral Program Evaluation Opower Results” on June 25, 2015.

- Several factors may have contributed to lower than expected absolute and percentage savings during the first program year:
  - Data issues led to half of the customers receiving fewer reports than originally planned.
  - Relatively low email coverage prevented the implementer from reaching customers through a second channel that promotes savings.
  - Berkshire has a higher population of seasonal homes than the other PAs, which may cause participants to be less able to save because they are not occupying the home during the winter.
  - It is possible that households in urban areas with more exposure to the statewide Mass Save campaigns are primed and, thus are more responsive to HERs relative to rural areas.
  - The 2014/15 winter was colder than previous years which may have made participants less apt to save compared to other PA cohorts in previous years.
- The Berkshire HER program has resulted in an uplift in participation in the Home Energy Services program even though program-specific modules were not included in the home energy reports.

### *Recommendations for Berkshire's Consideration*

The evaluation team offers the following recommendations to Berkshire as potential HER program enhancements:

- **Recommendation 1:** Continue efforts to ensure that the program implementer receives complete billing data going forward. Berkshire has made changes to operations to ensure that the program vendor receives complete data moving forward. Berkshire should monitor these efforts to ensure they are successfully transmitting complete data.
- **Recommendation 2:** When possible, collect email addresses from customers. Customers with email addresses on file can receive electronic reports, which may help the program reach customers who prefer electronic communication and can reinforce messaging for customers who will read both paper and electronic reports.
- **Recommendation 3:** Continue to monitor participant feedback and savings. Since the program had a delayed start and difficulties with data, the evaluation team recommends monitoring the program for another year before considering additional program process changes.
- **Recommendation 4:** Berkshire should adopt a savings estimate ratio<sup>4</sup> of 100% in future years when third-party impact evaluations are not completed. This conservative estimate takes into account the fact that the savings estimate ratio typically falls after the first year of the program.

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<sup>4</sup> The saving estimate ratio is the calculated by dividing the modeled savings estimated by the evaluation team by the savings estimated by Opower.

## 1. Introduction

This report provides the findings from the process and impact evaluation of the first year of Berkshire Gas' Home Energy Report (HER) program. Navigant Consulting, Inc. (Navigant) and Illume Advising (the evaluation team) were contracted to conduct this evaluation, representing the first evaluation of the Berkshire program.

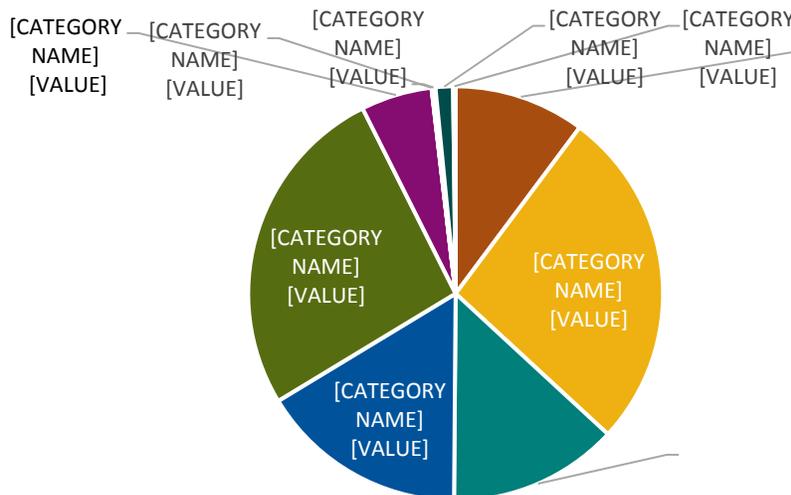
### 1.1 Program Description

The primary objective of the HER program is to provide residential households with information on their gas consumption and tips on how to save energy, prompting them to take action to reduce their natural gas usage. The HER program, implemented by Opower, was launched in October 2014, and has delivered reports to nearly 12,000 customers during its first program year.

The HER program is implemented as a randomized controlled trial (RCT) in which customers are randomly assigned into treatment and control groups. As an opt-out implementation model, customers do not choose to participate; however, if they do not wish to receive the reports they can request removal from the program.

Treatment customers received printed reports by mail throughout the heating season (October 2014 through April 2015). Customers received their first report between mid-October and mid-November. However, due to issues with the billing data generated by Berkshire Gas' IT team, some participants received fewer printed reports during the heating season than originally planned. Figure 1-1 shows the percentage breakdown of how many reports each customer received. Half received three or fewer reports in the period from October 2014 to September 2015 when typically customers would have received four or five reports during this period.

**Figure 1-1. Percentage Breakdown of Number of Reports Received**



Source: Evaluation team analysis

In addition to the printed reports, treatment customers also received the reports by email if Berkshire had an email address on file. Email coverage for the Berkshire service territory is lower than for other program administrators (PAs) in the state of Massachusetts; approximately 3% to 4% of customers received electronic reports via email compared to 21% to 53% for other PAs. Treatment customers also have access to a web portal that provides additional tips and information on household energy usage.

Table 1-1 provides a synopsis of the Berkshire program.

**Table 1-1. HER Program Participants and Controls**

Month of First Report*	Evaluation Period	Actual Number of Participants	Actual Number of Controls
October 2014	October 1, 2014 – September 30, 2015	11,999	9,997

\*This is the month of the “RCT start date” in the Opower dataset when a wave is initiated. Participants likely received their first report approximately one month later than this date.

Source: Berkshire billing data, Opower implementation data, and evaluation team analysis

## 1.2 Research Questions

This evaluation includes both a process and impact evaluation.

### 1.2.1 Process Evaluation

The process evaluation explored customers’ use and satisfaction with the home energy reports as well as how the reports have affected participant energy-saving actions and behaviors. The primary research questions investigated include the following:

1. How satisfied are customers with Berkshire’s energy efficiency services?
2. How do customers interact with the reports? How many of the reports do customers read?
3. How do customers view the usefulness of the different report modules and the reports overall?
4. What actions or behaviors have customers taken as a result of the reports?

### 1.2.2 Impact Evaluation

The primary research questions investigated as a part of the impact evaluation are listed below.

1. What are the total and per-customer savings from the Berkshire HER program?
2. Does the HER program channel participants into other Berkshire energy efficiency programs? What are HER savings after removing channeled savings to avoid double counting?
3. What is the savings estimate ratio that should be used by Berkshire in future years when third-party impact evaluations are not completed?

### *1.3 Structure of the Report*

The remainder of this report is presented as follows:

- Section 2. describes the methodology used in this evaluation, with Section 2.1 focused on the process evaluation and Section 2.1 focused on the impact evaluation
- Section 3. reports on participant satisfaction and perspectives on the home energy reports
- Section 4. presents the savings estimate and findings related to energy-saving actions taken as a result of the home energy reports
- Section 5. concludes and offers recommendations for the program going forward

## 2. Methodology

In this section, the evaluation team presents the methodology used for the process and impact evaluation.

### 2.1 Process Evaluation

As part of the evaluation, the evaluation team conducted telephone surveys in November 2015 with program participants (treatment group) and non-participants (control group). The survey instrument is provided in Appendix A. The main goal of the survey was to understand how the reports have affected participant energy-saving actions. The evaluation team designed the survey to make comparisons between treatment and control customers to determine which actions are contributing to program savings.

The evaluation team explored measure-based and behavior-based energy-saving actions, as shown in Figure 2-1.

**Figure 2-1. HER Energy-Saving Actions**



Source: Evaluation team analysis

The surveys also assessed the following areas:

- Customer satisfaction with their utility's energy efficiency services
- Questions exploring how participants interact with the reports, such as readership levels
- The usefulness of the different report modules and the reports overall
- How participants thought the reports might be improved

The evaluation team completed surveys with 150 treatment group customers and 150 control group customers. The team applied sampling weights to account for differences in respondents' ages between the treatment and control groups. For age post-stratification weights, the team used the control group as a benchmark and weighted the treatment group to match the control to adjust for any response bias.

The survey of Berkshire participating and non-participating customers follows on a survey of participating and non-participating customers in other PA (National Grid and Eversource) service territories conducted in March and April 2015.<sup>5</sup> Where appropriate and informative, the evaluation team includes comparisons of Berkshire responses to the responses of the gas cohorts included in the earlier survey. Note, however, that this survey targeted cohorts of varying maturity and contained a mix of rural and urban participants. The Berkshire participants had been receiving reports for about one year at the time of the Berkshire survey, and the Berkshire service territory is more rural than the National Grid and Eversource territories.

## 2.2 *Impact Evaluation*

This section presents the methodology used for the validation of the randomization, the savings estimate, the channeling analysis, and the savings estimate ratio.

### 2.2.1 **Validation of Randomization**

The majority of the study group for the HER program was selected randomly from Berkshire's residential customer base. The only exception was a small low-income segment (identified via rate code) from which customers with the highest gas usage were selected. This segment made up only about 2,300 of the 22,000 customers included in the program. The customers in this segment were also randomly assigned to the treatment (participant) and control (non-participant) groups. If the allocation of the households across the treatment and control groups is truly random, the two groups should have the same distribution of gas usage during the pre-program period. Billing data were only available beginning in January 2014. As a result, the evaluation team conducted a validation of the randomization by conducting the following statistical analyses using data from the nine months before the start of the program (January 2014–September 2014):

1. A plot of monthly mean energy use for treatment and control households before the start of the program to examine differences between the two groups visually
2. Statistical t-tests on the difference in monthly mean energy use between the treatment and control groups in each of the nine months. If statistically significant differences are not

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<sup>5</sup> "Massachusetts Behavioral Process Evaluation," July 2015, Navigant Consulting, Inc.

- identified, the evaluation team can have confidence that the allocation of households was truly random.<sup>6</sup>
3. A regression analysis regressing customer average daily usage in the pre-program period on a binary treatment variable and a set of nine monthly fixed effects, with the standard error clustered at the household level, as shown in Equation 2-1.

**Equation 2-1. RCT Validation Model**

$$ADC_{kt} = \beta_1 Participant_k + \sum_j \beta_{2j} Month_{jt} + \varepsilon_{kt}$$

Where,

- $ADC_{kt}$  = The average daily consumption in therms for customer  $k$  during billing cycle  $t$ . This is the dependent variable in the model.
- $Month_{jt}$  = A binary variable taking a value of 1 when  $j=t$  and 0 otherwise.<sup>7</sup>
- $\varepsilon_{kt}$  = The cluster-robust error term for customer  $k$  during billing cycle  $t$ . Cluster-robust errors account for heteroscedasticity and autocorrelation at the customer level.<sup>8</sup>

If the coefficient  $\beta_1$  is statistically significant it would indicate that there is a non-random difference in usage between the treatment and control households.

**2.2.2 Savings Estimate**

The evaluation team conducts multiple analyses to determine savings, including analyses using the post-program regression (PPR) and linear fixed effects regression (LFER) models. Figure 2-2 illustrates the difference between these two models.

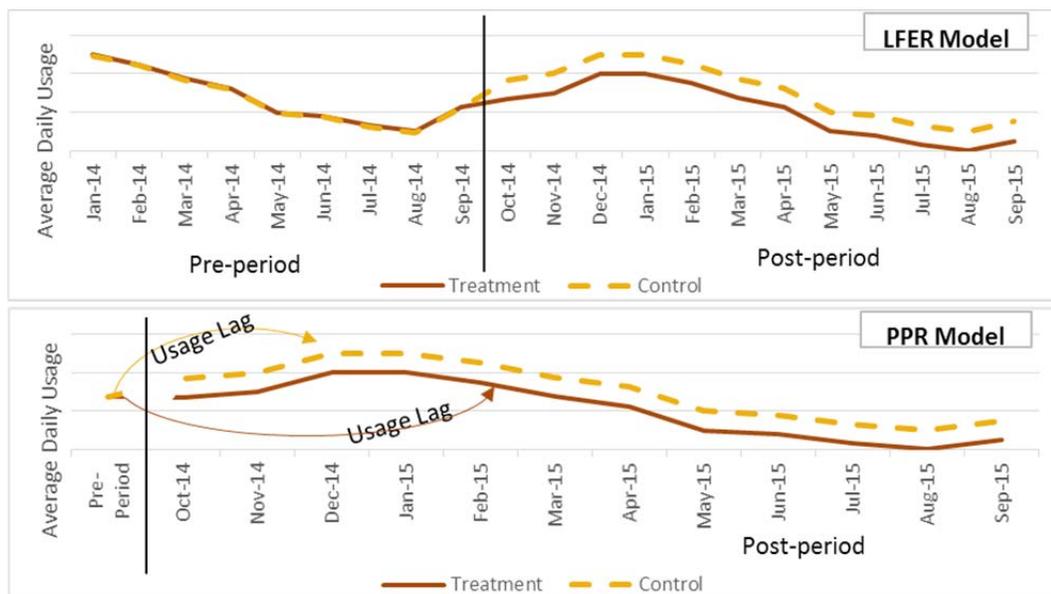
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<sup>6</sup> At a 90% confidence level, one month in 10 can be expected to show a statistically significant difference by random chance. Thus, if one month were statistically significant in the nine examined the evaluation team could still conclude that the allocation of households is consistent with random assignment.

<sup>7</sup> If there are  $T$  post-program months, there are  $T$  monthly dummy variables in the model, with the dummy variable  $Month_{jt}$  the only one to take a value of 1 at time  $t$ . These are, in other words, monthly fixed effects.

<sup>8</sup> A random variable is heteroscedastic when the variance is not constant. A random variable is autocorrelated when the error term in one period is correlated with the error terms in at least some of the previous periods.

Figure 2-2. Illustration of LFER versus PPR Model



Source: Evaluation team analysis

The PPR model uses only the post-program data, with lagged gas usage for the same calendar month of the pre-program period acting as a control for any small systematic differences between the participant and control customers. In particular, gas usage in calendar month  $t$  of the post-program period is framed as a function of both the participant variable and gas usage in the pre-program period. The underlying logic is that the systematic differences between participants and controls will be reflected in differences in their past energy use, which is highly correlated with their current gas usage. The version the evaluation team estimates includes monthly fixed effects and a single usage lag, which is the average usage in the pre-program period. Because only nine months of pre-program data were available, the version the evaluation team estimates does not interact the monthly fixed effects with the pre-program gas usage variable.<sup>9</sup> Formally, the model is shown in Equation 2-2.

<sup>9</sup> With one year of post-program data and only nine months of pre-program data it is not possible to interact the calendar month fixed effect with the pre-usage lag because not every month has pre-usage. Specifically, the months of September through December do not have pre-program lagged usage to be put into the model.

**Equation 2-2. PPR Model**

$$ADC_{kt} = \sum_j \beta_{1j} Month_{jt} + \beta_2 ADClag_k + \beta_3 Participant_k + \varepsilon_{kt}$$

Where,

$ADClag_k$  = Customer  $k$ 's average energy use in the pre-program period.

$Participant_k$  = A binary variable indicating whether customer  $k$  is in the participant group (taking a value of 1) or in the control group (taking a value of 0).

and all other variables are as defined in Equation 2-1.

In this model,  $\beta_3$  is the estimate of average daily energy savings due to the program. Total program savings are the product of the average daily savings estimate and the total number of participant days in the analysis.

To test the robustness of the savings estimate to model specification, the evaluation team also estimated savings using the standard regression approach for estimating savings for an RCT, an LFER model. Until the most recent advances in this field using the PPR approach, the LFER approach was viewed as the most appropriate regression approach for RCT programs. According to both Lawrence Berkley National Laboratory (LBNL) (2012) and a measurement and verification (M&V) white paper produced by the Brattle Group (2011), this approach was the preferred method for the evaluation of the energy use impacts of behavioral programs.<sup>10</sup> Moreover, the LFER model has been used in academic literature to evaluate other HER programs and has been used in all evaluations of HER programs done by the evaluation team as a robustness check on the newer PPR method.<sup>11</sup>

The simplest version of a LFER model, the One-Way LFER model, is one in which average daily consumption by customer  $k$  in bill  $t$ , denoted by  $ADC_{kt}$ , is a function of two variables: the binary variable  $Treatment_k$  (taking a value of 1 if household  $k$  is assigned to the treatment group and 0 otherwise) and the binary variable  $Post_t$  (taking a value of 0 if the observation  $t$  is before the *program start date* and 1 if the observation is after the program start date). Formally, Equation 2-3 shows the model.

<sup>10</sup> LBNL 2012: *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations*. Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory. 2012. <http://behavioranalytics.lbl.gov>.

Brattle Group 2011: *Measurement and Verification Principles for Behavior-Based Efficiency Programs*. Sanem Sergici and Ahmad Fauqui. 2011.

<sup>11</sup> For examples of academic applications of the approach to energy behavioral programs see:

Alcott, Hunt. "Social Norms and Energy Conservation," Working paper, Massachusetts Institute of Technology (MIT), Cambridge, MA, 2009.

[Ayres, I.](#), [S. Raseman](#) and [A. Shih](#). "Evidence from Two Large Field Experiments that Peer Comparison Feedback Can Reduce Residential Energy Usage," NBER working paper no. 15386, September 2009.

Costa, D.L. and M.E. Kahn. "Energy Conservation "Nudges" and Environmentalist Ideology: Evidence from a Randomized Residential Electricity Field Experiment," NBER working paper no. 15939, April 2010.

**Equation 2-3. One-Way LFER Model**

$$ADC_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Treatment_k \cdot Post_t + \epsilon_{kt}$$

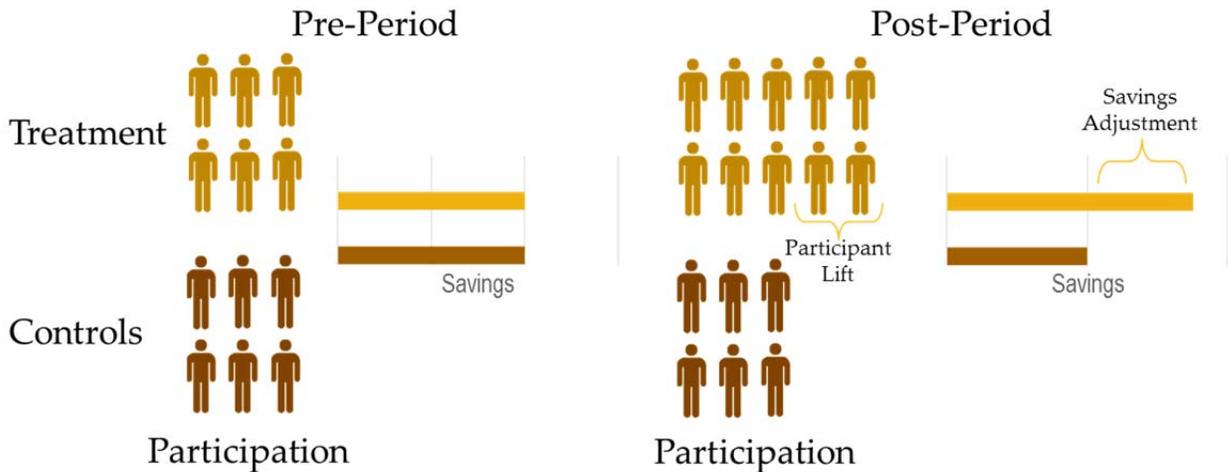
Three observations about this specification deserve comment. First, the coefficient  $\alpha_{0k}$  captures all customer-specific effects on gas usage that do not change over time, including those that are unobservable. Second,  $\alpha_1$  captures the average effect among control customers of being in the post-treatment period. In other words, it captures the effects of exogenous factors, such as an economic recession, that affect control customers in the post-treatment period but not in the pre-treatment period. Third,  $\alpha_1 + \alpha_2$  captures the average effect among treatment customers of being in the post-treatment period, and so for these households the effect directly attributable to the program is captured by the coefficient  $\alpha_2$ .

Both the PPR and LFER models produce unbiased estimates of the program effect. The evaluation team recommends reporting out results from the PPR model as this model has been shown in past studies to have slightly smaller standard errors, on average.

**2.2.3 Channeling Analysis**

There are two goals to the cross-program participation channeling analysis (shown in Figure 2-3): to document the lift in other program participation due to the behavioral program treatment (participant lift) and to remove the savings co-generated by behavioral and standard programs in order to avoid double-counting savings across the portfolio at the program and measure level (savings adjustment).

**Figure 2-3. Illustration of Channeling Analysis**



Source: Evaluation team analysis

The home energy reports include energy-saving tips, some of which encourage participants to enroll in other Berkshire energy efficiency programs. Channeling occurs when the HER program causes participants to enroll in energy efficiency programs at a higher rate than they otherwise would have. If participation rates in other energy efficiency programs are the same for HER participants and controls, the savings estimates from the regression analysis are not attributable to other programs and there is no channeling, as this indicates the HER program had no effect on participation in the other energy efficiency programs. Channeling does occur if the HER program affects participation rates in other energy efficiency programs. Thus, savings across all programs are lower than indicated by the simple summation of savings in the HER and energy efficiency programs. For instance, if the HER program increases participation in other energy efficiency programs, the increase in savings may be allocated to either the HER program or the other energy efficiency program but cannot be allocated to both programs simultaneously.

The evaluation team uses a difference-in-difference (DID) statistic to estimate channeling in other energy efficiency programs. For the Berkshire program, only nine months of pre-program data were available. As a result, the evaluation team subtracted the change in participation rate in another energy efficiency program between the nine months of the pre-program year (January 2014–September 2014) and the corresponding nine months of the program year (January 2015–September 2015) for the control group from the same change for the treatment group. Formally, the calculation is shown in Equation 2-4.

**Equation 2-4. DID Calculation**

$$DID\ Statistic = (Program\ year\ treatment\ group\ participation - pre\ year\ treatment\ group\ participation) - (program\ year\ control\ group\ participation - pre\ year\ control\ group\ participation)$$

As an example, if the rate of participation in an energy efficiency program during the nine-month period of the program year is 5% for the treatment group and 3% for the control group and the rate of participation during the nine months of the pre-program year is 2% for the treatment group and 1% for the control group, then the rate of uplift due to the HER program is 1%, which is reflected in the calculation:  $(5\% - 2\%) - (3\% - 1\%) = 1\%$ . The DID statistic generates an unbiased estimate of channeling when the baseline average rate of participation is the same for the treatment and control groups or when they are different due only to differences between the two groups in time-invariant factors, such as the square footage of the residence.

Multiplying the DID statistic by the number of program households produces the participant lift in the energy efficiency program generated by the HER program. Multiplying this participant lift by deemed net savings for the energy efficiency program generates the savings adjustment, which must be subtracted from either the HER program or the energy efficiency program to avoid double-counting savings. In line with industry standard practice, this evaluation subtracts the double-counted savings from the HER program rather than from the other energy efficiency programs. To get annual estimates of the participant lift and the savings adjustment, the evaluation team increased the estimate based on nine months by 25%. This assumes that participation in other energy efficiency programs is uniform throughout the year.

The evaluation team examined the uplift associated with the following Berkshire Gas residential energy efficiency programs: the Residential New Construction (NC) program, the Multifamily (MF) program,

the Home Energy Services (HES) program, the Boiler Furnace Replacement (BFR) program, and the Efficient Heat (EH) program.

#### 2.2.4 Savings Estimate Ratio

The evaluation team calculated a savings estimate ratio for use in future years when a third-party impact evaluation is not completed. The savings estimate ratio examines the differences in savings as measured by Opower, the program implementer, and the savings verified by this evaluation. The savings estimate ratio is the ratio of estimated savings to the implementer-reported estimates, as shown in Equation 2-5.

#### Equation 2-5. Savings Estimate Ratio by Cohort

$$SER = \frac{\text{Evaluation Team Estimated Savings}}{\text{OPOWER Reported Savings}}$$

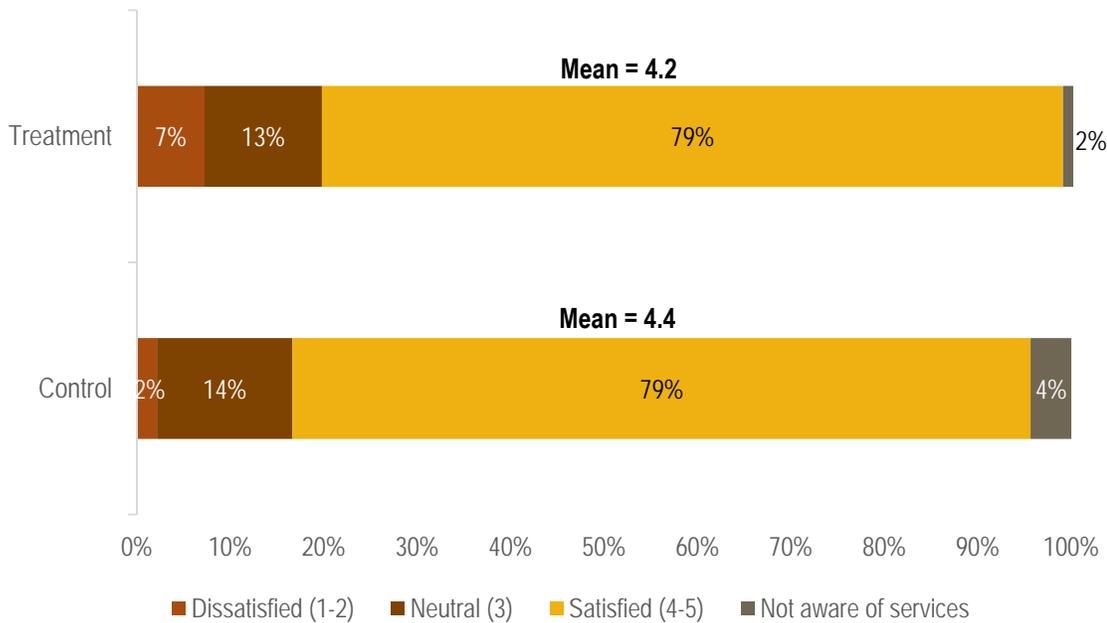
**3. Participant Satisfaction and Perspectives on Home Energy Reports**

In this section of the report, the evaluation team reports on participant satisfaction and perspectives on the home energy reports based on surveys with both treatment and control customers.

**3.1 Are Participants Satisfied with the Energy Efficiency Services Offered by Berkshire Gas?**

Survey responses show that both treatment and control customers experience high satisfaction levels with the energy efficiency services offered by Berkshire Gas. Nearly 80% of both groups reported that they are satisfied (rating services a four or five on a five-point scale) with the energy efficiency services that Berkshire Gas offers to help customers save natural gas (Figure 3-1). Furthermore, slight differences in customers rating their satisfaction with services as neutral, dissatisfied, or unaware of services are not statistically significant.

**Figure 3-1. Satisfaction with Berkshire Gas Energy Efficiency Services Received**



Note: Satisfaction rated on a scale of 1 to 5, with 5 being very satisfied. Treatment n=140, Control n=138.

Source: Evaluation team analysis

The evaluation team also compared satisfaction scores to the total number of equipment and behavior actions<sup>12</sup> taken in the past year to determine whether there is any correlation between these two metrics.

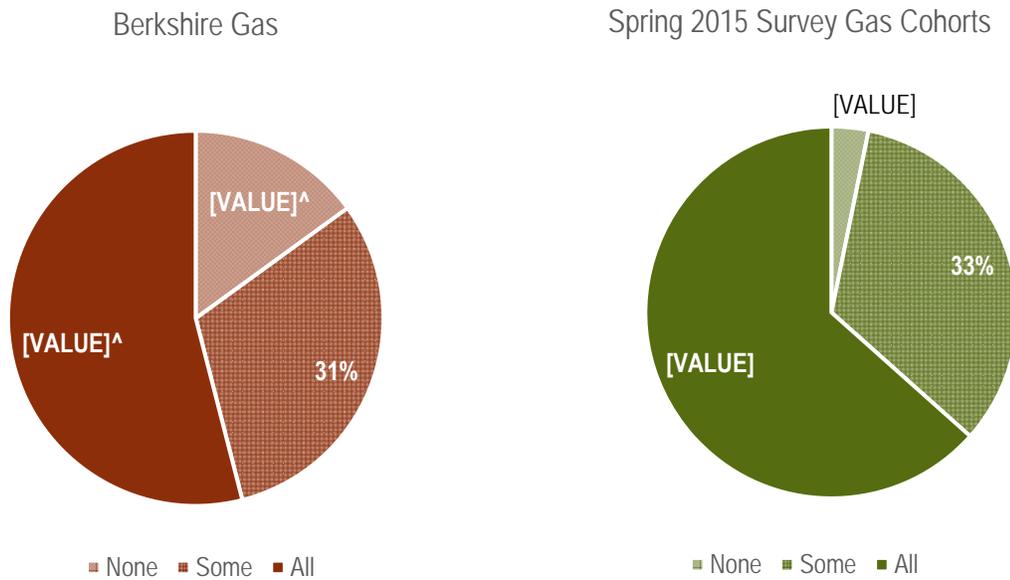
<sup>12</sup> In this case, defined as the number of equipment actions and regular behavior actions taken in the past year (including those maintained from previous years).

No correlation was found ( $\rho = 0.08, p = 0.17$ ), indicating that taking a larger number of energy-saving actions does not seem to impact satisfaction with the efficiency services received (and vice versa).

### 3.2 How Often Are Customers Reading the Reports?

A majority of participating customers are reading the reports. At least 54% of customers reported reading the report each time it arrived, and an additional 31% reported reading some of the reports, as shown in Figure 3-2. Fewer Berkshire participants are reading every report compared to other Massachusetts gas cohorts included in spring 2015 survey, where 63% of participants reported reading every report. Furthermore, more Berkshire Gas participants (15%) report that they do not read any of the reports compared to other PA gas participants (3%). The differences are statistically significant ( $p < 0.10$ ). These differences may be attributed to recall bias— the spring 2015 survey was launched shortly following the 2014–2015 heating season whereas the Berkshire Gas survey was not launched until November 2015.

**Figure 3-2. How many of the home energy reports did you read in the past year? (n=147)**



^ Significantly different from spring 2015 survey at  $p < 0.10$ .  
 Source: Evaluation team analysis

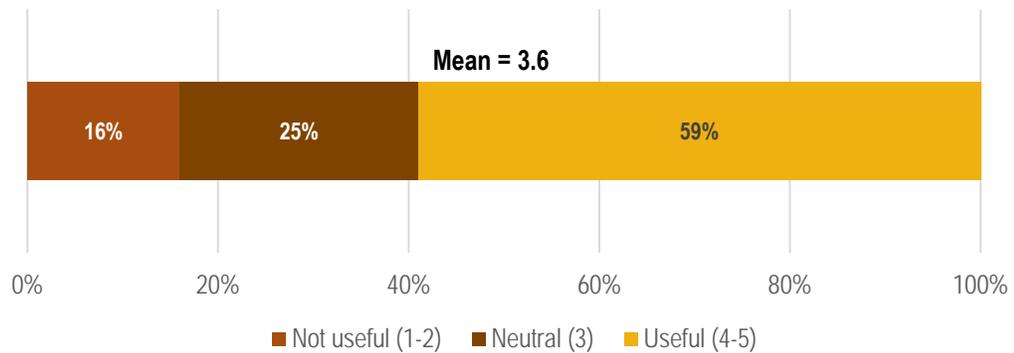
The majority (80%) of participants want to maintain the level of frequency with which they receive reports. Those participants reported that they would like to receive the reports at “about the same” level of frequency as they do now.

### 3.3 Do Customers Find the Reports Useful?

The majority of participants found the home energy reports useful overall, with 59% of participants rating the reports a four or five on a five-point scale, with five being very useful (Figure 3-3). The survey asked participants about the usefulness of specific sections of the report, including the personal usage comparison, the similar homes comparison, and the energy-saving tips section. When asked about

specific sections of the report, the personal usage comparison had a significantly higher average rating than the other sections of the report. In addition, the energy-saving tips section had a significantly higher rating than the similar homes section (Figure 3-4). The overall and individual section ratings are similar to the responses of the gas cohorts in the spring 2015 survey.<sup>13</sup>

**Figure 3-3. How useful do participants find the reports overall? (n=120)**

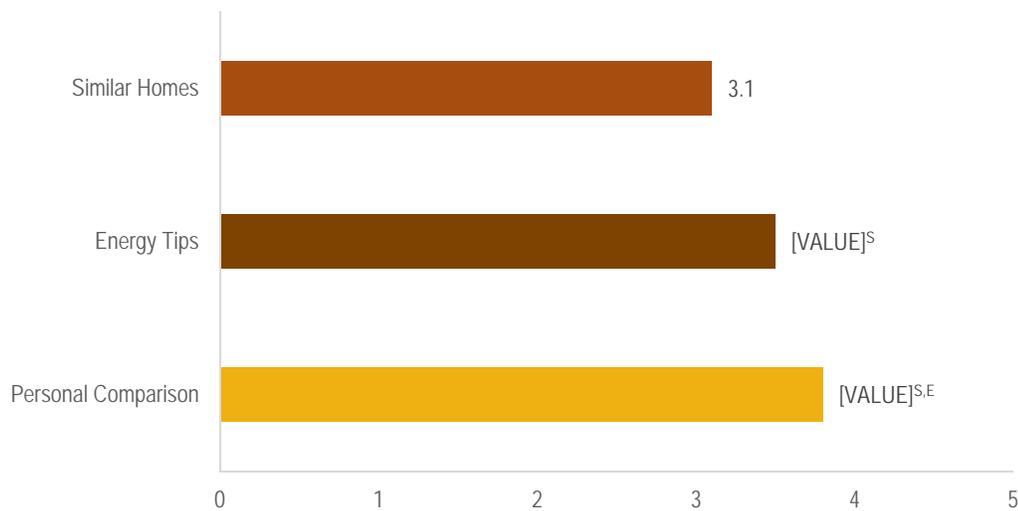


Note: Usefulness was rated on a scale of 1 to 5. Scores of 1 and 2 are not useful, 3 is neutral, and 4 and 5 are useful.

Source: Evaluation team analysis

<sup>13</sup> In the spring 2015 survey, the gas cohorts also rated the personal comparison section as most useful, with a mean score of 3.9. The energy-saving tips section received scores of 3.3, and the similar homes comparison received a score of 3.2.

**Figure 3-4. How useful do participants find the individual report sections?**



<sup>S, E, P</sup> Denote a significantly higher mean score than another report section at the  $p < 0.05$  level; S: similar homes, E: energy tips, P: personal comparison  
 Note: Usefulness was rated on a scale of 1 to 5. Scores of 1 and 2 are not useful, 3 is neutral, and 4 and 5 are useful  
 Source: Evaluation team analysis

While fewer participants rate the similar homes section as useful (give a rating of four or five on the five-point scale), those who do feel the section is useful report taking a greater total number of equipment and behavior actions<sup>14</sup> in the past year as compared to participants who do not rate the section as useful (15.1 compared to 13.7 actions). The difference is statistically significant,  $p < 0.05$ . This difference does not exist for the other sections of the report or the overall ratings: participants who give higher ratings do not take more actions than those giving lower ratings. This suggests that the similar homes section may be more effective at stimulating action among a subset of the population. Participants who rated the similar homes section as useful were more likely than participants who did not find that section useful to install low-cost measures; to increase behaviors that reduce hot water, lighting, and personal electronics energy use; and to engage in more heating, ventilation, and air conditioning (HVAC) maintenance behaviors. These difference are statistically significant,  $p < 0.05$ .

### 3.4 How Might the Home Energy Reports Be Improved?

As a part of the survey efforts, the evaluation team also asked participants how Berkshire could improve the home energy reports. Most participants did not have any suggestions for improvement, with 73% suggesting no changes. The most common theme among respondents who did suggest improvements was additional customization in the reports. Nine respondents requested tips or a similar homes comparison more specific to the customer’s home or situation. Six participants requested more information in general or more tips.

<sup>14</sup> In this case, defined as the number of equipment actions and regular behavior actions taken in the past year (including those maintained from previous years).

## 4. Savings Estimate

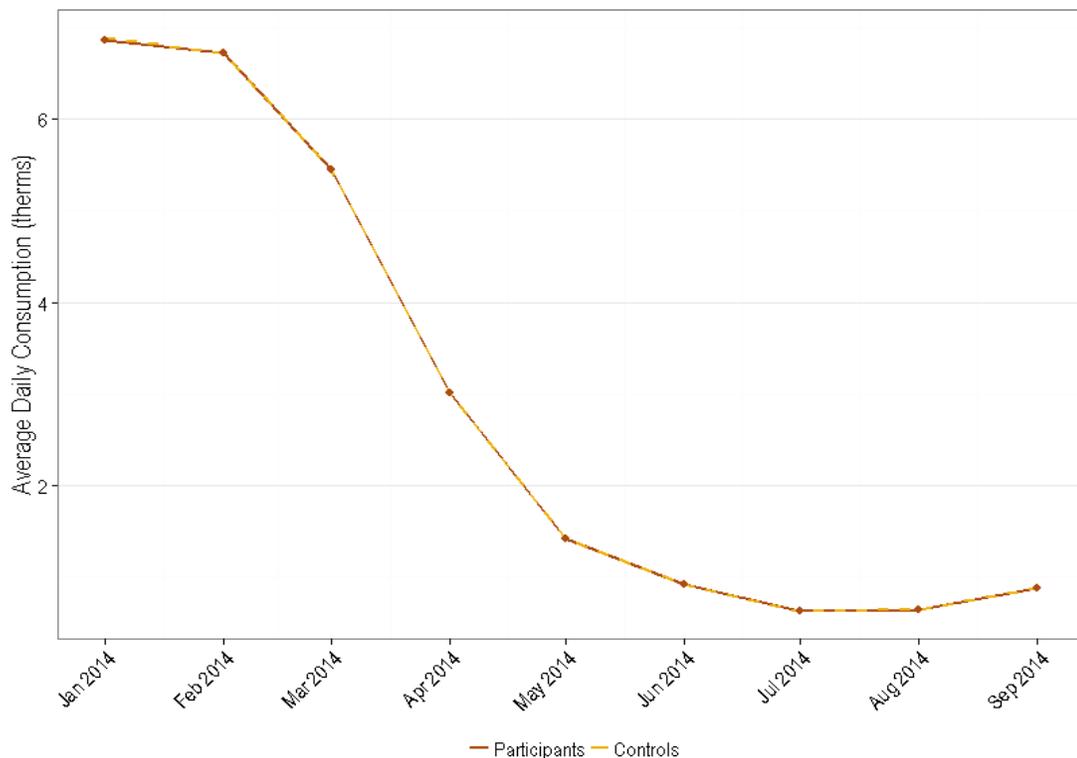
In this section of the report, the evaluation team reports on the evaluated savings informed by both the process and impact evaluations, including

1. Validation of Randomization
2. Savings Estimate
3. Channeling Analysis
4. Savings Estimate Ratio

### 4.1 Validation of Randomization

The results of this analysis validate that program households were randomly allocated across the treatment and control groups. Figure 4-1 depicts the average gas usage for treatment and control households for the nine months available prior to the start of the HER program. The orange line indicates the average gas usage for the control group and the yellow dashed line indicates the average gas usage for the treatment group. The two lines are essentially identical, indicating no difference in average usage patterns for the treatment and control groups. The evaluation team conducted a statistical t-test on the difference in the mean gas usage for the two groups in each of the nine months and found the difference to be statistically insignificant at the 90% confidence level in every month.

**Figure 4-1. Pre-Period Treatment and Control Usage in Therms**



Source: Evaluation team analysis

As a final check, the evaluation team estimated a model to test whether there is a statistically significant difference in usage for treatment and control households. The team’s analysis found no statistically significant differences in usage between treatment and control households as shown in Table 4-1, further confirming that the allocation of treatment and control households is consistent with random assignment.

**Table 4-1. RCT Validation Model Results**

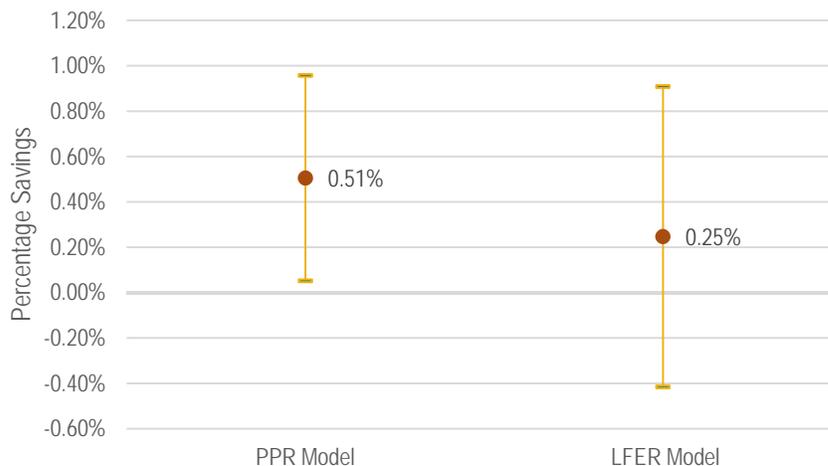
Point Estimate of Treatment Effect	90% Confidence Interval
0.00142	[-0.032, 0.034]

Source: Evaluation team analysis

## 4.2 Savings Estimate

The evaluation team estimated total savings for the Berkshire program to be 7,873 MMBtu prior to the channeling adjustment. This works out to per-customer savings of 0.51% or -0.019 therms per day. As discussed in Section 2.2.2 the evaluation team estimated savings from two models and is reporting out savings from the PPR model.<sup>15</sup> Figure 4-2 shows the point estimate and 90% confidence interval from the two models. Although the point estimates are different, the confidence bounds from the two models mostly overlap indicating that the two estimates are not statistically different.<sup>16</sup>

**Figure 4-2. PPR and LFER Model Savings Estimates**



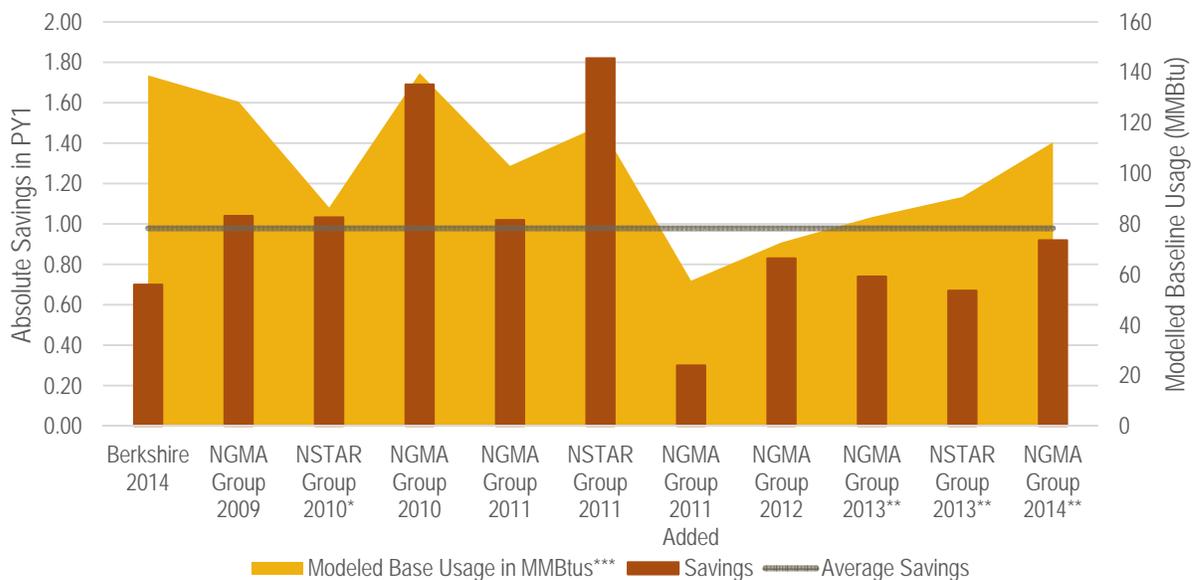
<sup>15</sup> The evaluation team prefers the PPR model because it has been found to have slightly lower standard errors in practical application.

<sup>16</sup> The standard error and confidence bounds on this estimate are larger than the evaluation team usually sees, which could be due to a couple of things. With 22,000 customers, Berkshire is small relative to the other Massachusetts cohorts, which increases the standard error. Additionally, due to the data issues previously mentioned, there was more variability in the number of reports customers received; this could have caused more variability in savings across customers, leading to larger standard errors.

Source: Evaluation team analysis

The evaluated savings estimate is lower than expected. As a point of reference, the evaluation team compared the first-year savings estimate for the Berkshire HER program against the first-year savings estimate for other Massachusetts PAs' gas-only cohorts.<sup>17</sup> In Figure 4-3, the vertical bars show MMBtu savings across different PA program cohorts, and the yellow background shows the baseline usage in MMBtu. Figure 4-4 shows the same comparison in percentage terms. . Despite having nearly the highest baseline usage, the Berkshire HER program has low per-customer absolute savings and the lowest per-customer percentage savings. This is unexpected as higher baseline usage generally leads to higher percentage savings.

**Figure 4-3. First-Year Absolute Savings Comparison, Gas-Only Cohorts**



\*NSTAR Group 2010 is a weighted average of two analyses covering August 2010–April 2011 and May 2011–December 2011.

\*\*These cohorts were examined for the first time in 2014 in lieu of a true first-year evaluation.

\*\*\*Modeled baseline usage is not weather normalized.

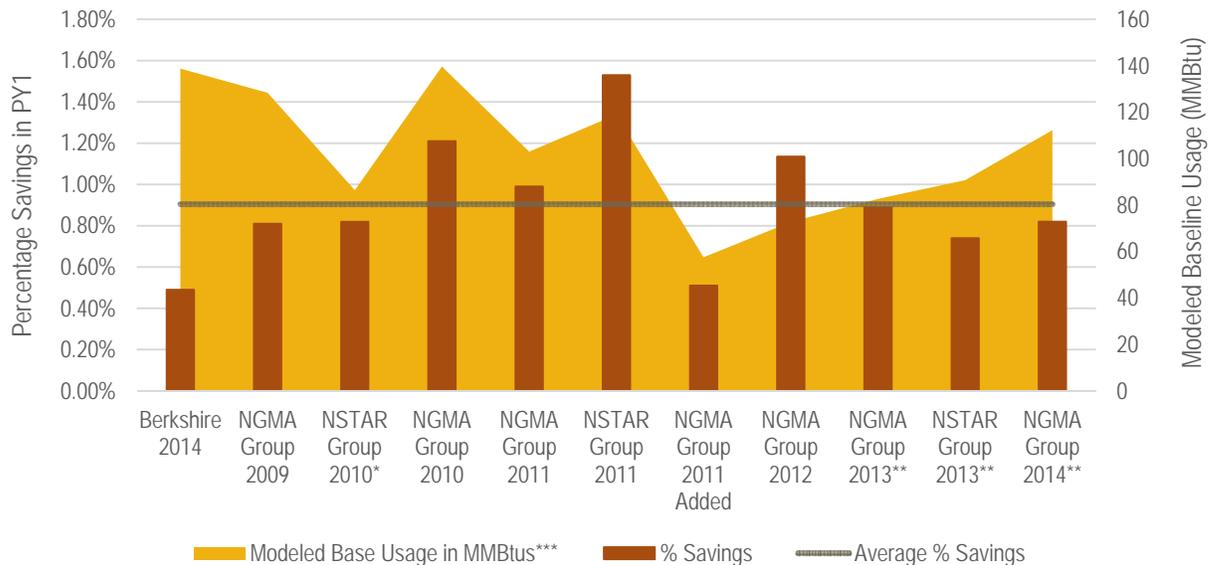
Source: Evaluation team analysis, the 2013 Evaluation Report<sup>18</sup>, and the 2014 HER analysis<sup>19</sup>

<sup>17</sup> National Grid and NSTAR (currently Eversource Energy) have implemented gas-only cohorts dating back to 2009.

<sup>18</sup> Opinion Dynamics, Navigant Consulting, Inc., and Evergreen Economics. 2013. *Massachusetts Cross-Cutting Behavioral Program Evaluation Integrated Report*.

<sup>19</sup> The results of the 2014 HER analysis were presented to the PAs in a memo titled “Massachusetts Cross-Cutting Behavioral Program Evaluation Opower Results” on June 25, 2015.

Figure 4-4. First-Year Percentage Savings Comparison, Gas-Only Cohorts



\*NSTAR Group 2010 is a weighted average of two analyses covering August 2010–April 2011 and May 2011–December 2011.

\*\*These cohorts were examined for the first time in 2014 in lieu of a true first-year evaluation.

\*\*\*Modeled baseline usage is not weather normalized.

Source: Evaluation team analysis, the 2013 Evaluation Report<sup>20</sup>, and the 2014 HER analysis<sup>21</sup>

There are several factors which may have contributed to the relatively low savings, including: data issues impacting implementation, low email coverage, seasonal occupants, extreme winter conditions in 2014/2015, and differences in an urban versus rural setting. Each of these is discussed below.

- As mentioned in Section 1.1 data issues resulted in half of the participants receiving only three reports compared to the four or five they would have typically received.
- Low email coverage resulted in relatively few customers receiving email reports in addition to the printed reports (3% to 4% compared to one-quarter to half of participants in other MA PA cohorts).
- According to a recent survey, approximately five percent of homes in the Berkshire territory are seasonal residences and 100% of those surveyed were occupied only in the spring or summer.<sup>22</sup> Due to the HER program’s RCT design the same percentage of participant and control households should be seasonally occupied. However, seasonal occupation may cause participants to be less able to save because they are not occupying the home during the winter.
- The 2014/2015 winter was relatively extreme compared to previous winters. **Error! Reference source not found.** shows the average winter temperatures in Pittsfield, MA from September to

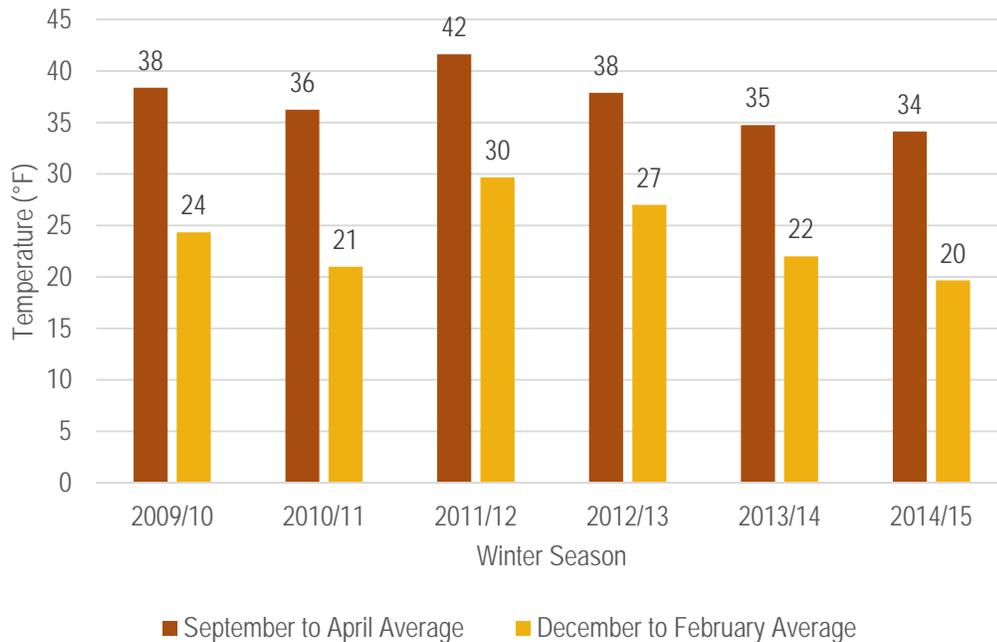
<sup>20</sup> Opinion Dynamics, Navigant Consulting, Inc., and Evergreen Economics. 2013. *Massachusetts Cross-Cutting Behavioral Program Evaluation Integrated Report*.

<sup>21</sup> The results of the 2014 HER analysis were presented to the PAs in a memo titled “Massachusetts Cross-Cutting Behavioral Program Evaluation Opower Results” on June 25, 2015.

<sup>22</sup> GDS Associates, Inc. 2015. *Berkshire Gas - Remaining Potential Study Final Report*.

April and December to February for each winter season since 2009.<sup>23</sup> The 2014/2015 winter was the coldest over this time period. The colder temperatures may have both resulted in the high baseline usage for Berkshire and made customers less apt to save.

**Figure 4-5. Average Winter Temperatures**

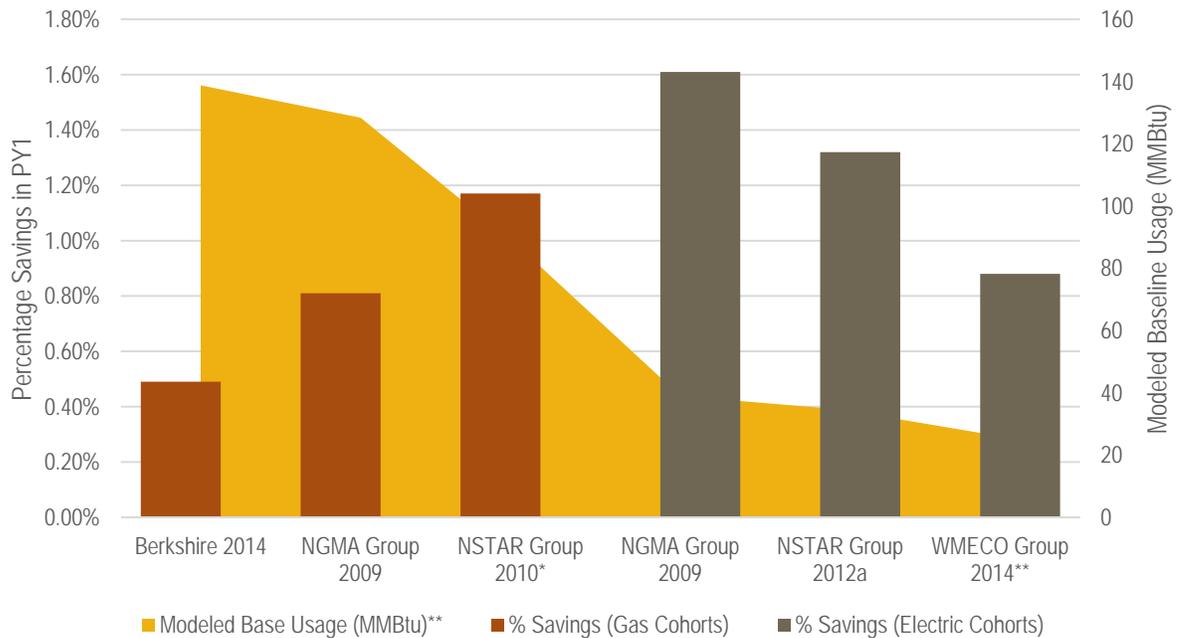


Source: Evaluation team analysis of data from Weather Underground

- The evaluation team also compared the Berkshire HER first-year savings against the first-year savings of the first gas-only and electric-only cohort for each of the other PAs. The gray vertical bars in Figure 4-6 represent first-year percentage savings for electric cohorts. Berkshire Gas’ service territory is more rural than National Grid or Eversource Energy (East, formerly NSTAR). It is possible that households in urban areas with more exposure to the statewide Mass Save campaigns are primed, and thus more responsive to home energy reports. This hypothesis may be supported by the relatively low evaluated savings rate for Western Massachusetts Electric Cooperative, another utility with a more rural service territory and who recently implemented an HER program.

<sup>23</sup> Temperatures are from Pittsfield Municipal Airport.

**Figure 4-6. First-Year Percentage Savings Comparison, Early Gas and Electric Cohorts**



\*NSTAR Group 2010 is a weighted average of two analyses covering August 2010–April 2011 and May 2011–December 2011.

\*\*This cohort was examined for the first time in 2014 in lieu of a true first-year evaluation.

\*\*\*Modeled baseline usage is not weather normalized.

Source: Evaluation team analysis and the 2013 Evaluation Report<sup>24</sup>

The evaluation team surveyed treatment and control customers to understand what energy-saving actions contributed to program savings in the past year. Actions explored included both energy-saving behaviors (e.g., wash clothes in cold water, etc.) taken in the past year and measures (e.g., an ENERGY STAR furnace, etc.) installed or purchased in the past year. For energy-saving behaviors taken in the past year, the evaluation team analyzed both behaviors that started or increased in frequency (i.e., behaviors changed) and behaviors maintained from previous years.

#### 4.2.1 How Many Actions Are Participants Taking?

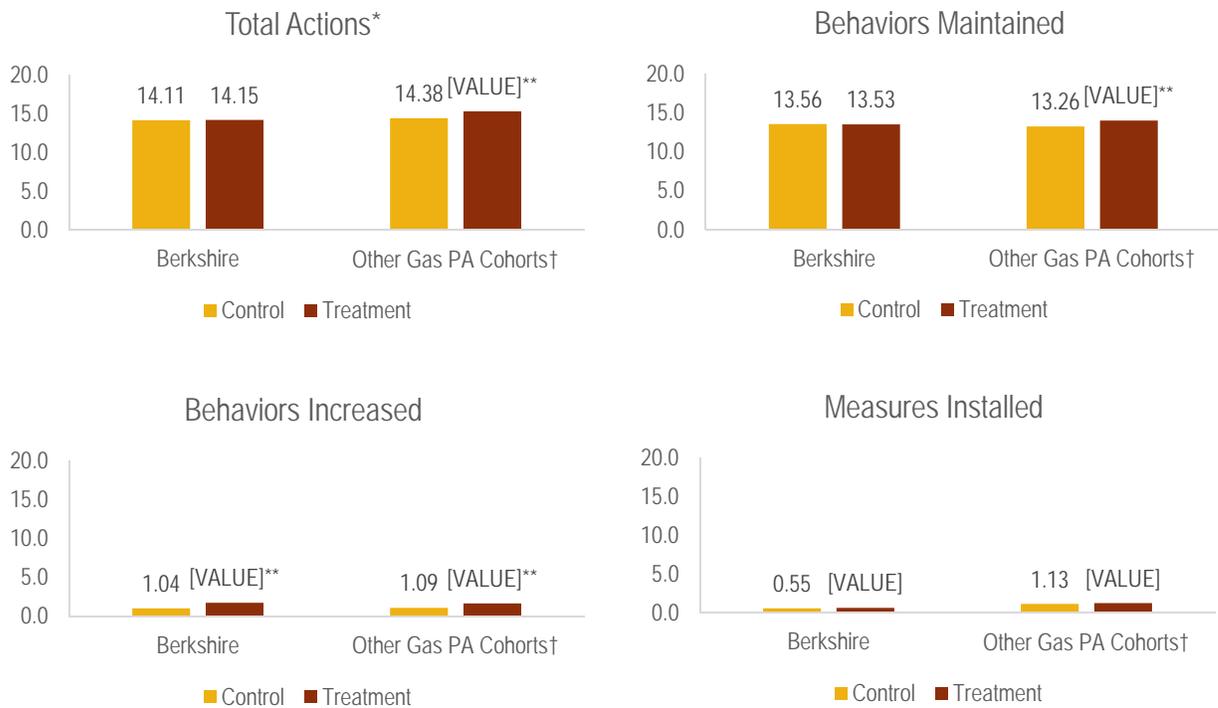
The reports have led to modest changes in participant energy-saving actions and behaviors. As shown in Figure 4-7, treatment and control customers report the same total number of actions and behaviors. They also report *maintaining* similar numbers of behaviors from previous years.<sup>25</sup> However, treatment customers do report more behaviors (statistically significant) that started or increased in the past year than control customers. The spring 2015 survey found that in other gas PA cohorts, participants reported

<sup>24</sup> Opinion Dynamics, Navigant Consulting, Inc., and Evergreen Economics. 2013. *Massachusetts Cross-Cutting Behavioral Program Evaluation Integrated Report*.

<sup>25</sup> In the survey the evaluation team asked both treatment and control customers whether they took specific energy-saving behaviors. If a behavior did not start or increase in frequency in the past year (behavior change), it was started in previous years and is now being *maintained*.

more behaviors that increased, more behaviors that were maintained, and more actions overall. However, as noted, the gas cohorts in the spring 2015 survey includes cohorts of varying maturity. The spring 2015 survey report notes that while treatment customers in more mature cohorts changed and maintained significantly more behaviors than the control customers, treatment customers in younger cohorts changed and maintained similar numbers of behaviors as their control groups.<sup>26</sup>

**Figure 4-7. Average Number of Actions Taken in Past Year per Household**



\*Includes all actions—measures installed/purchased, behaviors changed, and behaviors maintained  
 ^In order to shorten and simplify the survey, the Berkshire survey asked fewer questions about installation of lighting measures than the other gas PA surveys. Some of the difference between Berkshire and other PA gas cohorts in measures installed is likely attributable to the difference in survey questions. Gas treatment cohorts in other gas PA surveys installed 0.79 lighting measures, on average.  
 \*\*Significantly higher than the control group at p<0.05.  
 †Source: Table 5 in “Massachusetts Behavioral Process Evaluation,” July 2015, Navigant Consulting, Inc.  
 Source: Evaluation team analysis

**4.2.2 What Specific Energy-Saving Actions Have Participants Taken in the Past Year?**

In Figure 4-8, the evaluation team presents results for several composite end-use categories.<sup>27</sup> Treatment and control customers reported similar levels of installation of high-efficiency measures. About 10% of

<sup>26</sup> See Section 4.1 in “Massachusetts Behavioral Process Evaluation,” July 2015, Navigant Consulting, Inc.  
<sup>27</sup> For example, households that purchased a high-efficiency furnace in the past year are included in the “Heating/Cooling” category and households that reported reducing their water heater temperature are included under “Hot Water Usage” category. More detailed tables by measure can be found in Appendix B.

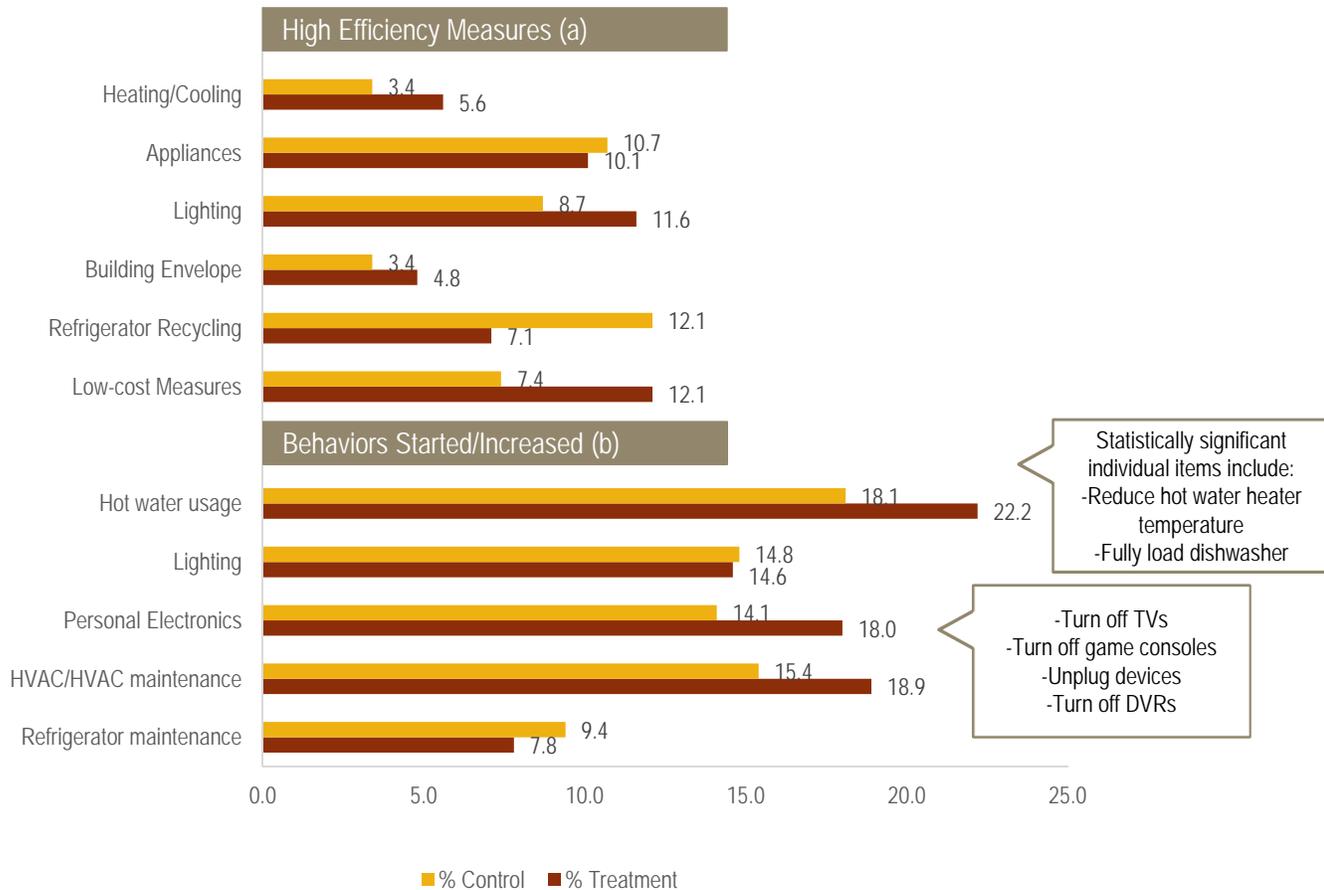
both groups reported installing efficient appliances. Fewer treatment than control customers (7.1% vs. 12.1%) reported participating in refrigerator recycling, while more treatment than control customers reported installing low-cost measures (12.1% vs. 7.4%). However, none of the differences are statistically significant.

There were also no statistically significant differences among the percentage of households engaging in various categories of behavior changes. While the differences were not statistically significant, treatment customers more often reported changes in hot water usage, personal electronics, and HVAC/HVAC maintenance composite categories, indicating there may be a trend that cannot be confirmed by the data.

While the composite categories do not show statistically significant differences, some of the individual measures do show differences across the treatment and control groups. In particular, treatment customers more often reported turning off or unplugging electronic devices and reducing hot water heater temperatures. These statistically significant differences at the individual behavior level are shown in Appendix B.

In the spring 2015 survey, there were statistically significant differences in only three categories: heating/cooling, appliances, and, similar to the Berkshire survey, HVAC/HVAC maintenance.

**Figure 4-8. Percentage of Households Taking Energy-Saving Actions in Past Year by Composite Category**



**(a) High-Efficiency Measures Metric:** Purchased or installed at least one energy-efficient item in the group in the past year. Includes: (1) Heating/Cooling: ENERGY STAR (ES) central air conditioning (CAC) or ES air source heat pump (ASHP), ES room or wall air conditioning (AC), ES ductless mini-split heat pump, ES boiler, and ES furnace. (2) Appliances: ES or front-load clothes washer, heat pump water heater (ES), tank-less water heater, and ES dehumidifier. (3) Lighting: Indoor light fixture (LED or CFL) and outdoor light fixture (LED or CFL). (4) Building Envelope: ES double-paned or triple-paned windows, attic/ceiling/wall insulation, and storm windows. (5) Refrigerator Recycling: Recycled second refrigerator. (6) Low-Cost Measures: Weather-stripping, low-flow faucet aerators, low-flow showerheads, water heater tank wrap or pipe wrap, motion sensors (e.g., lighting), programmable or Wi-Fi thermostat, advanced power strips, and duct sealing or insulation.

**(b) Behaviors Metric:** Started or increased at least one of items in the behavior group in the past year. Includes: (1) Hot Water Usage: Wash laundry in cold water, fully load washing machine, fully load dishwasher, take short showers, and reduce water heater temperature. (2) Lighting: Turn off lights in unoccupied rooms and turn off outside lights by day. (3) Personal Electronics: Turn off computers at night/when not in use, put computer(s) to sleep, turn off TV(s) when no one is watching, turn off video game console(s) when not in use, switch off power strips, unplug devices when not in use, and turn off DVR and/or cable box when not watching TV. (4) HVAC: Use a portable window or ceiling fan, set thermostat at or below 70 degrees for heating, set thermostat at or above 78 degrees for cooling, clear area around vents, maintained heating and cooling system, and changed furnace filter. (5) Refrigerator maintenance: Make sure refrigerator seals are tight, clean refrigerator coils, check refrigerator temperature, and unplugged a second refrigerator for weeks to months.

Source: Evaluation team analysis

### 4.2.3 What Energy-Saving Behaviors Did Participants Maintain from Previous Years?

In addition to encouraging the adoption of new energy-saving behaviors, the home energy reports may help encourage participants to maintain behaviors that they started before receiving the reports. In the survey, the evaluation team asked both treatment and control customers whether they engaged in specific energy-saving behaviors. If a behavior did not start or increase in frequency in the past year (behavior change), it was started in previous years and is now being maintained. Maintained behaviors can contribute to program savings. Both treatment and control Berkshire customers are maintaining specific energy-saving behaviors that were started in previous years. Table 4-2 shows these results by composite behavior category.

While a high percentage of respondents in both the treatment and control groups reported maintaining at least one energy-saving behavior in each composite category, treatment group customers reported maintaining behaviors that reduce lighting usage more than control customers (2.7% lift) primarily through manually turning off lights in unoccupied rooms.

The spring 2015 survey found a small lift in hot water usage behaviors among treatment customers in the gas cohorts but did not find lift in other behaviors.

**Table 4-2. Percentage of Households Maintaining Energy-Saving Behaviors in Past Year by Composite Category**

	Berkshire		Other Gas PA Cohorts†	
	% Control	% Treatment	% Control	% Treatment
<b>Behaviors Maintained</b>				
 Hot Water Usage	98.7	99.1	95.8	99.8**
 Lighting	97.3	100.0**	98.8	98.6
 Personal Electronics	99.3	99.0	99.3	98.7
 HVAC and HVAC Maintenance	99.3	99.5	99.9	98.6^
 Refrigerator Maintenance	74.5	77.6	70.3	84.3

See Appendix B. for behavior metric categories.

\*\* Significantly higher than control group at  $p < 0.05$ .

^ Significantly higher than control group at  $p < 0.10$ .

†Source: Table 7 in “Massachusetts Behavioral Process Evaluation,” July 2015, Navigant Consulting, Inc.

Source: Evaluation team analysis

#### 4.2.4 Are the Reports Producing Cross-Fuel Effects?

While the Berkshire HER program specifically targets natural gas usage, customers may be motivated by the reports to save electricity. The evaluation team investigated this cross-fuel effect for Berkshire customers and compared this finding to the cross-fuel effects identified as a result of the 2015 survey.<sup>28</sup>

While some actions save only one fuel (for example, turning off the lights in unoccupied rooms), other actions may save two fuels (installing attic insulation, which reduces both heating and cooling loads). For the purpose of this analysis, the evaluation team assigned one fuel to each measure based on the primary fuel being saved. This primarily affects building envelope measures, such as windows and insulation. For these measures, the evaluation team assigned the primary fuel as non-electric (natural gas, propane, or oil) due to the higher number of heating days in Massachusetts compared to cooling days.

The evaluation team did not find any differences between Berkshire treatment and control customers in the composite categories, as shown in Table 4-3, suggesting there are no cross-fuel effects. However, as noted above, there are statistically significant differences in some of the individual electricity-saving behaviors including turning off and unplugging electronics and lighting.<sup>29</sup> See Appendix B. for details. The spring 2015 survey found lift among the gas cohorts in lighting and advanced power strip measures as well as in cooling behaviors. As noted, the spring 2015 survey included more mature cohorts. Berkshire may see more cross-fuel effects after the program has been implemented for a longer period of time.

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<sup>28</sup> The PAs are currently conducting a separate study to quantify cross-fuel effects based on energy usage data.

<sup>29</sup> It is possible that some Berkshire Gas HER program participants are also receiving an electric home energy report from another PA—i.e., the increase in electricity-saving behaviors may be cross-fuel effects or due to overlap in program implementation. The ongoing cross-fuel effects study may provide additional insight.

**Table 4-3. Gas Customers: Electricity-Saving Actions Taken in 2014 by Composite Category**

	Measure Category	% Control (n=149)	% Treatment (n=148)
<b>Electric-Saving Measures (a)</b>			
	Cooling (includes low-cost measures and thermostats)	3.4	1.7
	Lighting and Advanced Power Strips	12.1	15.3
	Refrigerator Recycling	12.1	7.1
<b>Electric-Saving Behaviors (b)</b>			
	Cooling	4.7	9.2
	Lighting, Advanced Power Strips & Electronic Devices	12.8	16.8
	Refrigeration	8.1	6.1

**(a) Electric Measures Metric:** Purchased or installed at least one energy-efficient item in the measure group in the past year. Includes: (1) Cooling: ES CAC or ASHP, ES room or wall AC, ES ductless mini-split heat pump, and ES dehumidifier. (2) Lighting and Power Strips: Indoor LED or CFL light fixtures, outdoor LED or CFL light fixtures, motion sensors, and advanced power strips. (3) Refrigerator Recycling: Recycled second refrigerator.

**(b) Electric Behaviors Metric:** Started or increased at least one of the items in the behavior group in the past year. Includes: (1) Cooling: Use portable window or ceiling fan and set thermostat at or above 78 degrees for cooling. (2) Lighting, Power Strips, and Electronic Devices: Turn off lights in unoccupied rooms, turn off outside lights by day, turn off computers at night/when not in use, put computer(s) to sleep, turn off TV(s) when no one is watching, turn off video game console(s) when not in use, switch off power strips, unplug devices when not in use, and turn off DVR and/or cable box when not watching TV. (3) Refrigeration: Made sure refrigerator seals are tight, cleaned refrigerator coils, increased refrigerator temperature, and unplugged a second refrigerator for weeks to months.

Source: Evaluation team analysis

### 4.3 Channeling Analysis

Home energy reports often include information regarding available incentives or rebates as well as how to access them, which can drive participation in other energy efficiency programs. While the Berkshire reports did not include these energy efficiency program modules, the evaluation team still investigated if reports affected program participation.

Table 4-4 presents program savings due to participation uplift in each of five energy efficiency programs for which estimates of deemed savings are available. The row labeled “Change in program participation due to HER program” shows the participant uplift, and the row labeled “Savings attributable to other programs (MMBtu)” shows the savings adjustment. In total, the participant uplift in other energy efficiency programs for the first year of the program was approximately 77 customers. The majority of the uplift occurred in the HES program, where the effect was statistically significant at the 90% confidence level. The other statistically significant effect was in the BFR program, which had a decrease of five customers. The final savings adjustment was approximately 269 MMBtu, a small proportion of the total savings (3.4%).

**Table 4-4. Channeling Estimates**

	Program				
	New Construction	Multi-Family	Home Energy Services	Boiler Furnace Replacement	Efficient Heat
Median program savings (annual MMBtu per participant)	50	12	0.3	7	45
No. of HER treatment households	11,999	11,999	11,999	11,999	11,999
Rate of participation, program year (%)	0.00%	0.00%	2.33%	0.09%	0.82%
Change in rate of participation from pre-program year (%)	-0.03%	-0.18%	-0.52%	-0.01%	-0.84%
No. of HER control households	9,997	9,997	9,997	9,997	9,997
Rate of participation, program year (%)	0.01%	0.02%	2.00%	0.06%	0.93%
Change in rate of participation from pre-program year (%)	-0.03%	-0.16%	-0.94%	-0.08%	-0.74%
DID statistic	0.00%	-0.02%	0.42%	0.07%	-0.10%
Change in program participation due to HER program	15	-22	90	-5	-1
Statistically significant at the 90% confidence level?	No	No	Yes	Yes	No
Savings attributable to other programs (MMBtu)	433	-141	16	-21	-18

Source: Evaluation team analysis

Table 4-5 presents detailed savings estimates after the adjustment from the channeling analysis.<sup>30</sup> Total savings prior to the savings adjustment were 7,873 MMBtu. Subtracting the savings adjustment results in the final verified savings estimate of 7,603 MMBtu. To put this in perspective, the average percentage savings were 0.51% before the savings adjustment and 0.49% following the adjustment.<sup>31</sup>

**Table 4-5. Savings Estimates after Channeling Adjustment**

Total Number of Participants	Modeled Baseline Usage (MMBtu)	Average Annual Savings per Customer (MMBtu)	Percentage Savings	Total Savings (MMBtu)
11,999	138	0.70	0.49%	7,603

Source: Evaluation team analysis

#### 4.3.1 How Are the Reports Influencing Measure Installations Compared to Financial Incentives?

To further explore if the home energy reports are driving participation in other programs, the evaluation team asked both treatment and control customers whether any of the measures they purchased or installed in the past year received financial incentives, special pricing, or free offerings such as direct installation of low-cost measures during a home energy audit. The team’s research found no difference between the Berkshire Gas treatment and control groups in the percentage of customers purchasing rebate-eligible items or in the percentage of customers receiving rebates. As shown in Table 4-6, only four treatment customers (2.6% of the respondent group) and only seven control customers (4.7% of the respondent group) reported purchasing a rebate-eligible item. This difference is not statistically significant. All customers in both groups who purchased a rebate-eligible item received a rebate. This indicates that the program is not yet influencing customers to purchase (and be aware of) rebate-eligible energy efficiency items either through an energy efficiency program or on their own.

<sup>30</sup> Baseline usage is presented as the modeled value as a technical reference manual (TRM) baseline is not available for this program because this is its first year. (Massachusetts Technical Reference Manual. 2013-2015 Program Years.)

<sup>31</sup> Multiplying 0.51% (the percentage of total energy use saved) by 3.40% (the percentage of total savings uplift in other energy efficiency programs) generates the value 0.02%. Formally shown in the following calculation:  $0.0051 \times 0.034 = 0.00017$ . Subtracting this value from 0.0051 gives 0.0049, or 0.49%.

**Table 4-6. Respondents Purchasing Rebate-Eligible Items and Receiving Rebates or Special Offers**

Purchase Category	Berkshire		Other Gas PA Cohorts†	
	% Control (n=150)	% Treatment (n=150)	% Control (n=306)	% Treatment (n=359)
Purchased any rebate-eligible item (as % of total n)	4.7	2.6	25.4	29.6
Reported receiving a rebate (as % of total n)	4.7	2.6	9.8	17.4**
Reported receiving a rebate (as % of people with an eligible purchase)	100.0	100.0	38.5	58.7**

Note: See Appendix A. question PE9 for a list of rebate-eligible items.

\*\*Significantly higher than control group at p<0.05.

†Source: Table 10 in “Massachusetts Behavioral Process Evaluation,” July 2015, Navigant Consulting, Inc.

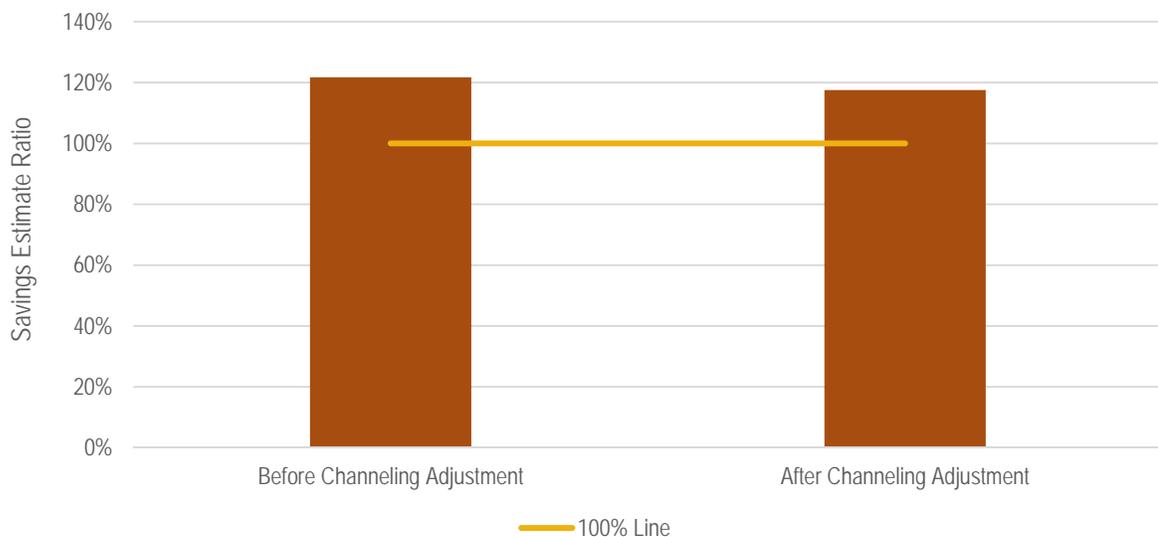
Source: Evaluation team analysis

By comparison, the spring 2015 survey revealed that treatment customers (17.4%) were more likely than control customers (9.8%) to take advantage of energy efficiency program financial incentives, suggesting the home energy reports influenced participation in rebate programs. The difference is statistically significant, p<0.05.

#### 4.4 Savings Estimate Ratio

The evaluation team calculated the savings estimate ratio comparing the evaluated savings to those reported by Opower. Figure 4-9 shows the savings estimate ratio both before and after the channeling adjustment. The evaluation team’s savings estimate is higher than Opower’s, resulting in a savings estimate ratio of 118% after adjusting for channeling.

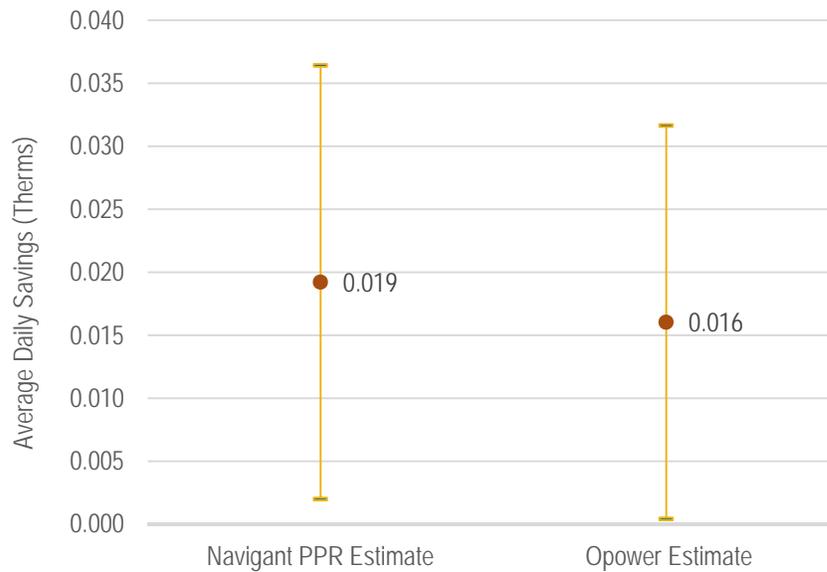
**Figure 4-9. Savings Estimate Ratio Before and After Channeling Adjustment**



Source: Evaluation team analysis

The relatively large difference in total savings driving the realization rate is caused by slight differences in the model specifications used by the evaluation team and Opower.<sup>32</sup> The estimates of average daily savings are quite similar, as shown in Figure 4-10, and Opower’s estimate is well within the 90% confidence interval of the evaluation team’s estimate.

**Figure 4-10. Evaluation Team and Opower Daily Savings Estimates**



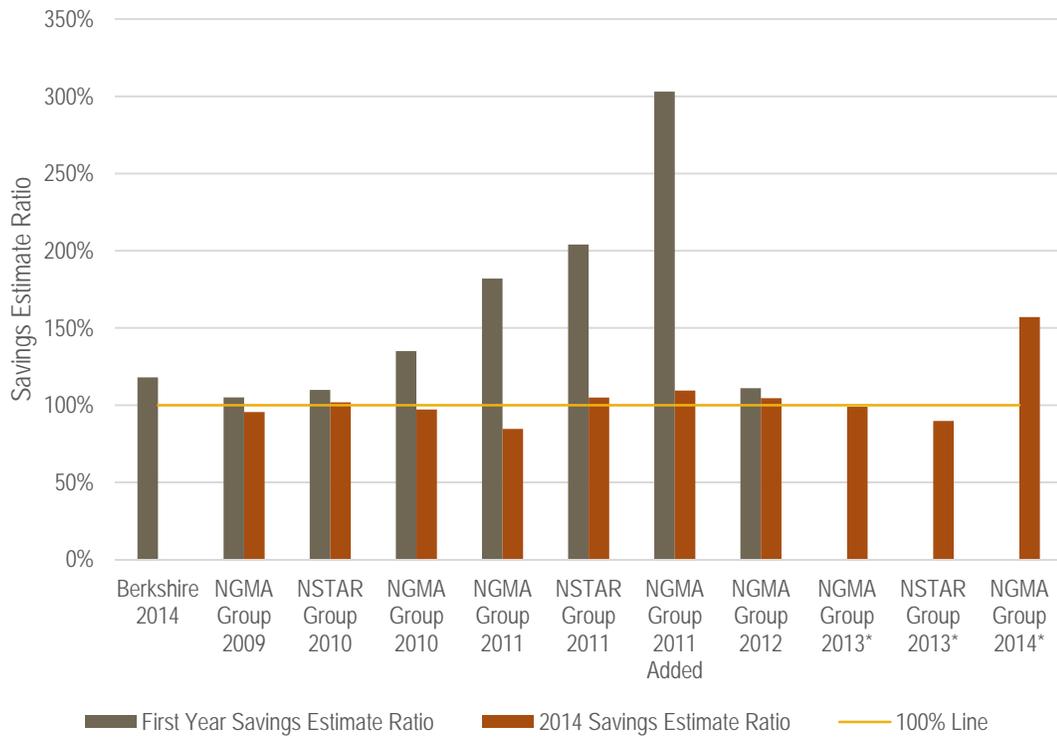
Source: Evaluation team analysis and Opower

The evaluation team compared the savings estimate ratio with the first-year and aggregate savings estimate ratios for gas-only cohorts implemented by other PAs (Figure 4-11).<sup>33</sup> The Berkshire savings estimate ratio is well within the range of first-year savings estimate ratios for other gas-only cohorts. Given that the savings estimate ratio tends to fall sharply in later years the evaluation team recommends Berkshire adopt a conservative savings estimate ratio of 100%.

<sup>32</sup> The Opower savings estimates are based on a variation of the PPR model. Rather than include a single average estimate of pre-program usage the Opower model also includes estimates of pre-usage in the cooling and heating seasons.

<sup>33</sup> The results of the 2014 evaluation were presented to the PAs in a memo titled “Massachusetts Cross-Cutting Behavioral Program Evaluation Opower Results” on June 25, 2015.

**Figure 4-11. Gas Savings Estimate Ratios after Channeling Adjustment across Massachusetts PAs**



\*These cohorts were examined for the first time in 2014 in lieu of a true first-year evaluation.  
 Source: Evaluation team analysis

## 5. Discussion and Recommendations

In October 2015, Berkshire Gas completed the first year of implementing an HER program. The goal of this evaluation was to assess participant satisfaction, identify energy-saving actions taken by participants, and estimate energy savings.

- Overall, participants are satisfied with the home energy reports. Over half of participants (59%) classify the reports as useful, similar to surveys of other Massachusetts gas HER programs.<sup>34</sup> Participants are most satisfied with the personal usage comparison.
- Total program savings after the channeling savings adjustment were 7,603 MMBtu or 0.49%. This savings rate is lower than the first-year evaluated savings of other gas cohorts in Massachusetts despite having high baseline usage. The lower than expected evaluated savings are supported by Opower's reported savings, as well as the customer surveys, which had fewer participants reporting that the home energy report led to energy-saving behaviors. Several factors may have contributed to lower than expected savings during the first program year:
  - Data issues led to half of the customers receiving fewer reports than originally planned.
  - Relatively low email coverage prevented the implementer from reaching customers through a second channel that promotes savings.
  - Berkshire has a higher population of seasonal homes than the other PAs, which may cause participants to be less able to save because they are not occupying the home during the winter.
  - It is possible that households in urban areas with more exposure to the statewide Mass Save campaigns are primed and, thus are more responsive to HERs relative to rural areas.
  - The 2014/15 winter was colder than previous years which may have made participants less apt to save compared to other PA cohorts in previous years.
- The Berkshire HER program has resulted in an uplift in participation in the HES program even though program-specific modules were not included in the home energy reports.

### 5.1 Recommendations

The evaluation team offers the following recommendations to Berkshire as potential HER program enhancements:

- **Recommendation #1:** Continue efforts to ensure that the program implementer receives complete billing data going forward. Berkshire has made changes to operations to ensure that the program vendor receives complete data moving forward. Berkshire should monitor these efforts to ensure they are successfully transmitting complete data.
- **Recommendation #2:** When possible, collect email addresses from customers. Customers with email addresses on file can receive electronic reports, which may help the program reach

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<sup>34</sup> "Massachusetts Behavioral Process Evaluation," July 2015, Navigant Consulting, Inc.

customers who prefer electronic communication and can reinforce messaging for customers who will read both paper and electronic reports.

- **Recommendation #3:** Continue to monitor participant feedback and savings. Since the program had a delayed start and difficulties with data, the evaluation team recommends monitoring the program for another year before considering additional program process changes.
- **Recommendation #4:** Berkshire should adopt a savings estimate ratio<sup>35</sup> of 100% in future years when third-party impact evaluations are not completed. This is a conservative estimate takes into account the fact that the savings estimate ratio typically falls after the first year of the program.

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<sup>35</sup> The saving estimate ratio is the calculated by dividing the modeled savings estimated by the evaluation team by the savings estimated by Opower.

## Appendix A. Participant and Non-Participant Survey

**To:** Massachusetts Program Administrators

**From:** Illume Advising, LLC and Navigant Consulting

**Date:** October 5, 2015

**Re:** Final Behavioral Programs Process Survey to Treatment and Control Customers – Draft for Berkshire Gas

### *A.1 Behavioral Programs Survey Objectives and Sample Plan*

As part of the evaluation of Massachusetts behavioral programs, the evaluation team will conduct a phone survey of program participants (treatment group) and control group customers to understand how home energy reports have affected participant energy-saving actions (both conservation and measure-based actions), how these actions have changed over time, participant satisfaction with their utility, along with questions exploring how participants interact with the reports, the usefulness of the different report modules and the reports overall, and where improvements might be made. Demographic and fuel source questions will also be asked.

For this effort the evaluation team will aim to complete a total of 300 interviews with program participants (n=150) and control customers (n=150) of Berkshire Gas.

### **Survey Introduction**

#### INTRO:

Hello, my name is [YOUR NAME] with Bellomy Research. I am calling on behalf of Berkshire Gas. This is not a sales call; our questions are for research purposes only.

May I speak with **[INSERT CONTACT NAME]**? (IF NOT AVAILABLE, SAY: May I please speak to one of the people in your household that is most knowledgeable about your household's energy usage?) (IF NO ONE AVAILABLE, SCHEDULE A CALL BACK.) We are conducting a study to understand your home energy use to help improve Berkshire Gas's energy efficiency program offerings.

Before we begin the survey, I need to ask a few questions to see if your household qualifies. (INTERVIEWER: READ ONLY IF ASKED: The survey will take about 15 minutes to complete.)

### **Screener Questions**

#### **[INCLUDE S2-S7 IN DAILY DISPO REPORT]**

- S1. Are you, or is anyone in your household, an employee of an electric or gas utility?
1. Yes **[THANK AND TERMINATE]**
  2. No
  98. Don't know **[THANK AND TERMINATE]**

99. Refused [THANK AND TERMINATE]  
[IF S1 = 1 OR 98 OR 99, THANK AND TERMINATE.]

[IF SAMPLE\_PARTICIPANT = 1, CONTINUE. OTHERWISE SKIP TO S4 S6.]

S2. (INTERVIEWER: RE-INTRODUCE YOURSELF IF NECESSARY.)

Do you recall receiving a home energy report from Berkshire Gas? This is a mailer sent to your home that provides a description of your household's gas usage in comparison to similar homes, with tips on how to save energy in your home.

1. Yes [ASK S6]
2. No
98. Don't know
99. Refused

[REMOVED S2G]

[ASK IF S2 = 2, OR 98, OR 99]

S3. Is there someone else in your household I could speak with who may be aware of the home energy report?

1. Yes [ASK S3A]
  2. No [THANK AND TERMINATE]
  98. Don't know [THANK AND TERMINATE]
  99. Refused [THANK AND TERMINATE]
- [IF S3 = 2 OR 98 OR 99, THANK AND TERMINATE.]

S3a. May I please speak to that person? (IF NOT AVAILABLE, SCHEDULE A CALLBACK. REMEMBER TO RECORD NAME OF PERSON TO ASK FOR.)

1. Yes, available [RETURN TO S2]
  98. Don't know [THANK AND TERMINATE]
  99. Refused [THANK AND TERMINATE]
- [IF S3A = 98 OR 99, THANK AND TERMINATE.]

[MOVED DE2, DE3; REMOVED AGE QUOTA CHECK, S4, AND S5]

S6. Are you responsible for paying your natural gas utility bill?

1. Yes
  2. No [THANK AND TERMINATE]
  98. Don't know [THANK AND TERMINATE]
  99. Refused [THANK AND TERMINATE]
- [IF S6 = 2 OR 98 OR 99, THANK AND TERMINATE.]

[REMOVED S4A AND S4B]

S7. According to our records, your address is [INSERT SAMPLE\_SITE\_ADDRESS]. Is this still your primary address?

(INTERVIEWER: READ ONLY THE STREET NUMBER AND STREET NAME WHEN READING THE ADDRESS TO THE RESPONDENT. IT IS NOT NECESSARY TO READ THE CITY, STATE AND ZIP CODE.)

- 1. Yes
- 2. No [THANK AND TERMINATE]
- 98. Don't know [THANK AND TERMINATE]
- 99. Refused [THANK AND TERMINATE]
- [IF S7 = 2 OR 98 OR 99, THANK AND TERMINATE.]

**Demographics**

[INCLUDE DE1-DE3 IN DAILY DISPO REPORT]

DE1. Do you own or rent your home?

- 1. Own
- 2. Rent
- 3. Other (Please specify)
- 98. Don't know
- 99. Refused

DE2. Please stop me when I read your correct age range? (READ LIST.)

- 1. 24 years or younger
- 2. 25 to 34 years
- 3. 35 to 44 years
- 4. 45 to 54 years
- 5. 55 to 64 years
- 6. 65 years and over
- 98. (DO NOT READ) Don't know
- 99. (DO NOT READ) Refused

DE3. Record gender. (SILENT CAPTURE.)

- 1. Male
- 2. Female

**Satisfaction with Utility Services Received to Help Save Energy**

NS1. Thank you. The goal of this study is to learn about energy use in selected homes in Berkshire Gas' service territory.

Many energy service providers in Massachusetts offer energy efficiency programs, rebates, and tips to help customers save energy and money.

[REMOVED NA1]

NA2. On a scale of 1 to 5 where 1 is "very dissatisfied" and 5 is "very satisfied", how satisfied are you with the services that Berkshire Gas offers to help you save natural gas?

Very Dissatisfied				Very Satisfied	Not Aware of these Services	Don't know	Refused
1	2	3	4	5	96	98	99

### Energy-Efficient Equipment

Now I am going to read a list of equipment or appliances that might be in your home. Please tell me “yes” or “no” as I read each one.

PE1. Does your home have a... (READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Yes (1)	No (2)	Don't know (98)
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**[ROTATE.]**

a. CAC unit or ASHP (IF NEEDED SAY: This does not include ductless heat pumps or “mini-splits.”)

b. Room or wall air conditioning unit

c. Clothes washing machine

d. Clothes dryer

e. Dishwasher

f. Television

g. Computer

h. Video game console

i. Ductless Mini-split Heat pump (IF NEEDED SAY: these are usually mounted to your ceiling or wall and connect to an outdoor unit. There are no ducts.)

j. Boiler (IF NEEDED SAY: Do you have radiators in your home?)(IF YES TO RADIATOR, RECORD YES TO BOILER. IF NO TO RADIATOR, RECORD NO TO BOILER)

k. Furnace (IF NEEDED SAY: Do you have vents or baseboards?) (IF YES TO VENTS, RECORD YES TO FURNACE. IF NO TO VENTS, RECORD NO TO FURNACE.)

l. Refrigerator

m. Attic, ceiling or wall insulation

n. Heat pump water heater (IF NEEDED SAY: These use electricity and take the heat from surrounding air and transfer it to an enclosed storage tank.)

o. Tank-less water heater (IF NEEDED SAY: Also known as an on-demand water heater; it does not have a large storage tank to hold heated water, which saves energy.)

p. Double-paned or triple-paned windows (IF NEEDED SAY: These windows have energy-efficient features, like glazing and are much thicker than older windows.)

	Yes (1)	No (2)	Don't know (98)
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q. Dehumidifier

**[IF PE1\_C = 1, CONTINUE. OTHERWISE SKIP TO PE3.]**

PE2. Is your clothes washing machine front-load or top-load?

- 1. Front-load
- 2. Top-load
- 98. Don't know
- 99. Refused

**[IF PE1\_A – Q = 1, CONTINUE. OTHERWISE SKIP TO PE5.]**

PE3. Did you purchase or install any of the equipment or appliances we just discussed in the last year?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

**[IF PE3 = 1, CONTINUE. OTHERWISE SKIP TO PE5.]**

PE4. In the past year, did your household purchase or install a...(READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Yes (1)	No (2)	Don't know (98)	Refused (99)
--	---------	--------	-----------------	--------------

**[ONLY INCLUDE EQUIPMENT/APPLIANCES PE1\_A-Q =1.]**

a. CAC unit or ASHP (IF NEEDED SAY: This does not include ductless heat pumps or "mini-splits.")

b. Room or wall air conditioning unit

c. Clothes washing machine

d. Clothes dryer

e. Dishwasher

f. Television

g. Computer

h. Video game console

i. Ductless Mini-split Heat pump (IF NEEDED SAY: These are usually mounted to your ceiling or wall and connect to an outdoor unit. There are no ducts.)

j. Boiler (IF NEEDED SAY: Do you have radiators in your home?)(IF YES TO RADIATOR, RECORD YES TO BOILER)

k. Furnace (IF NEEDED SAY: Do you have baseboards or vents?) (IF YES TO VENTS, RECORD YES TO FURNACE)

l. Refrigerator

m. Attic, ceiling or wall insulation

n. Heat pump water heater (IF NEEDED SAY: These use electricity and take the heat from surrounding air and transfer it to an enclosed storage tank.)

	Yes (1)	No (2)	Don't know (98)	Refused (99)
o. Tank-less water heater (IF NEEDED SAY: Also known as an on-demand water heater; it does not have a large storage tank to hold heated water, which saves energy.)				
p. Double-paned or triple-paned windows (IF NEEDED SAY: These windows have energy-efficient features, like glazing and are much thicker than older windows)				
q. Dehumidifier				

PE5. Has your household recycled a second refrigerator or freezer within the last year?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

**[IF PE5 = 1 OR 2, CONTINUE. OTHERWISE SKIP TO PE6.]**

PE5a. Do you currently have a second refrigerator or freezer?

- 1. Yes
- 2. No, our household does not have a second refrigerator or freezer
- 98. Don't know
- 99. Refused

*(CLIENT NOTE ONLY: Excludes items that are (a) energy-efficient by definition: heat pumps and HPWH; insulation; on-demand and tank-less water heaters, or (b) where market share is predominately ES already: dishwashers, computers, refrigerators, or televisions, or (c) where there is no ES certification (clothes dryers, video game consoles).*

**[IF PE4A-Q = 1, CONTINUE. OTHERWISE SKIP LI1.]**

PE6. As I read some of the equipment or appliances you told me you purchased in the past year, please tell me, to the best of your knowledge, if any of them are ES qualified. (READ LIST AND RECORD ONE ANSWER FOR EACH.)

	Yes (1)	No (2)	Don't know (98)	Refused (99)
<b>[ONLY INCLUDE EQUIPMENT/APPLIANCES PE4_A-Q =1.]</b>				
a. CAC unit or ASHP				
b. Room or wall air conditioning unit				
c. Clothes washing machine				
d. Clothes dryer <b>[DO NOT DISPLAY]</b>				
e. Dishwasher <b>[DO NOT DISPLAY]</b>				
f. Television <b>[DO NOT DISPLAY]</b>				
g. Computer <b>[DO NOT DISPLAY]</b>				
h. Video game console <b>[DO NOT DISPLAY]</b>				

	Yes (1)	No (2)	Don't know (98)	Refused (99)
i. Ductless Mini-split Heat pump (IF NEEDED SAY: These are usually mounted to your ceiling or wall and connect to an outdoor unit. There are no ducts.)				
j. Boiler				
k. Furnace				
l. Refrigerator <b>[DO NOT DISPLAY]</b>				
m. Attic, ceiling or wall insulation <b>[DO NOT DISPLAY]</b>				
n. Heat pump water heater (IF NEEDED SAY: These use electricity and take the heat from surrounding air and transfer it to an enclosed storage tank.) <b>[DO NOT DISPLAY]</b>				
o. Tank-less water heater (IF NEEDED SAY: Also known as an on-demand water heater; it does not have a large storage tank to hold heated water, which saves energy.) <b>[DO NOT DISPLAY]</b>				
p. Double-paned or triple-paned windows (IF NEEDED SAY: These windows have energy-efficient features, like glazing and are much thicker than older windows)				
q. Dehumidifier				

### Lighting

LI1. Now I want to ask about the type of lighting that you have in your home. Does your home have any of the following types of light bulbs? (READ LIST AND RECORD ONE ANSWER FOR EACH.)

	Yes (1)	No (2)	Don't know (98)	Refused (99)
<b>[ROTATE:]</b>				
a. Halogen (IF NEEDED, SAY: Halogen and incandescent bulbs look very similar — they are both globe shaped.)				
b. Incandescent or Halogen (IF NEEDED SAY: These are traditional, globe-shaped light bulbs that can be used throughout your home. Halogen and Incandescent bulbs look very similar.)				
c. Compact Fluorescent Light bulbs, also known as CFLs (IF NEEDED SAY: The most common type of compact fluorescent bulb is made with a glass tube bent into a spiral, resembling a soft-serve ice cream, and fits in a regular light bulb socket.)				
d. LEDs, other than holiday bulbs (IF NEEDED SAY: LED bulbs have only been widely available for the past few years. They can be used in the same type of fixtures as incandescents or CFLs, but may be shaped differently and produce light with semiconductor chips. We are NOT referring to holiday lights or night lights.)				

	Yes (1)	No (2)	Don't know (98)	Refused (99)
--	---------	--------	-----------------	--------------

e. Fluorescent bulbs other than CFLs that are not compact (IF NEEDED SAY: For example, these can be long linear bulbs in garages or basements, or U-shaped or circular bulbs used for specialty applications. They may be linear or tube shaped and are typically installed as overhead lighting.)

**[PROGRAMMER: DISPLAY IMMEDIATELY AFTER c. Compact Fluorescent Light bulbs...]**

**[IF LI1\_A-E = 1, CONTINUE. OTHERWISE SKIP TO LI4.]**

LI2. Did you purchase or install any of these light bulbs in the past year? (IF NEEDED SAY: Installing could include replacing bulbs in your home with bulbs you purchased in previous year. (ALSO, IF NEEDED SAY: This could include bulbs installed during a home energy audit/assessment.)

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

**[REMOVED LI3]**

LI4. Does your home have outdoor light fixtures?

- 1. Yes
- 2. No
- 98. Don't Know
- 99. Refused

**[IF LI4 = 1, LI5\_INSERT = "indoor or outdoor"**

**IF LI4 ≠ 1, LI5\_INSERT = "indoor"]**

LI5. Did you purchase or install any **[INSERT LI5\_INSERT]** light fixtures in the past year? (IF NEEDED SAY: Here I'm asking about the fixture itself rather than the bulb or lamp that goes in the fixture.) (RECORD ONE ANSWER ONLY.)

- 1. Indoor
- 2. Outdoor **[DO NOT DISPLAY IF LI4 ≠ 1]**
- 3. Both **[DO NOT DISPLAY IF LI4 ≠ 1]**
- 4. No light fixtures purchased in the past year
- 98. Don't know
- 99. Refused

**[IF LI5 = 1 OR 3, CONTINUE. OTHERWISE SKIP TO PA1.]**

LI6. What type of bulbs are your new indoor fixtures designed for? (READ LIST IF NECESSARY. RECORD ALL MENTIONS.)

- 1. ~~Halogen (IF NEEDED, SAY: Halogen and incandescent bulbs look very similar — they are both globe shaped.)~~
- 2. Incandescent or Halogen (IF NEEDED SAY: These are traditional, globe-shaped light bulbs that can be used throughout your home. Halogen and Incandescent bulbs look very similar.)

3. Compact Fluorescent Light bulbs, also known as CFLs (IF NEEDED SAY: The most common type of compact fluorescent bulb is made with a glass tube bent into a spiral, resembling a soft-serve ice cream, and fits in a regular light bulb socket.)
4. LEDs, other than holiday bulbs (IF NEEDED SAY: LED bulbs have only been widely available for the past few years. They can be used in the same type of fixtures as incandescents or CFLs, but may be shaped differently and produce light with semiconductor chips. We are NOT referring to holiday lights or night lights.)
5. Fluorescent bulbs other than CFLs that are not compact (IF NEEDED SAY: For example, these can be long linear bulbs in garages or basements, or U-shaped or circular bulbs used for specialty applications. They may be linear or tube shaped and are typically installed as overhead lighting.) **[PROGRAMMER: DISPLAY IMMEDIATELY AFTER c. Compact Fluorescent Light bulbs...]**
98. Don't know
99. Refused

**[REMOVED LI7]**

**Other energy-saving equipment**

PA1. Does your home have...(READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Yes (1)	No (2)	Don't know (98)	Refused (99)
<b>[ROTATE.]</b>				
a. Weather-stripping or caulking around windows and/or doors				
b. Low-flow shower heads (IF NEEDED SAY: Uses water more <b>efficiently</b> so less is used)				
c. Low-flow faucet aerators (IF NEEDED SAY: Uses water more <b>efficiently</b> so less is used)				
d. Water heater tank wrap or pipe wrap				
e. <del>Insulated outlets and/or light switches</del>				
f. Motion sensors (e.g., for lighting)				
g. Storm windows				
h. <del>Window shades, window insulation or window quilts</del>				
i. Programmable thermostat (IF NEEDED SAY: This could include a WiFi thermostat, like Nest, Honeywell Lyric or Ecobee)				
j. Energy-saving or advanced power strips				
k. Duct sealing or duct insulation				
l. <b>[INCLUDE IF PE1-j = 1]</b> Boiler reset controls (IF NEEDED, SAY: controls the temperature of a hot water boiler based on the outside temperature.)				

**[IF PA1\_A-L = 1, CONTINUE. OTHERWISE SKIP TO PA4.]**

PA2. Did you purchase or install any of the items we just discussed in the last year?

1. Yes

- 2. No
- 98. Don't know
- 99. Refused

**[IF PA2 = 1, CONTINUE. OTHERWISE SKIP TO PA4.]**

PA3. In the past year, did your household purchase or install any...(READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Yes (1)	No (2)	Don't know (98)	Refused (99)
<b>[ONLY INCLUDE PA1_A-L = 1 ANSWERS.]</b>				
a. Weather-stripping or caulking around windows and/or doors				
b. Low-flow shower heads (IF NEEDED SAY: Uses water more <b>efficiently</b> so less is used)				
c. Low-flow faucet aerators (IF NEEDED SAY: Uses water more <b>efficiently</b> so less is used)				
d. Water heater tank wrap or pipe wrap				
e. <del>Insulated outlets and/or light switches</del>				
f. Motion sensors (e.g., for lighting)				
g. Storm windows				
h. <del>Window shades, window insulation or window quilts</del>				
i. Programmable thermostat (IF NEEDED SAY: This could include a WiFi thermostat, like Nest, Honeywell Lyric or Ecobee)				
j. Energy-saving or advanced power strips				
k. Duct sealing or duct insulation				
l. <del>Boiler reset controls (IF NEEDED, SAY: controls the temperature of a hot water boiler based on the outside temperature.)</del>				

PA4. Have you ever had a home energy assessment or audit, where someone from MassSave or another organization came to your house and assessed your home's energy use? (IF YES, ASK: Was it within the past year OR more than 1 year ago?)

- 1. Yes, within the past year
- 2. Yes, more than 1 year ago
- 3. No
- 98. Don't know
- 99. Refused

**Financial assistance for measures installed in past year**

PE90. For the ~~equipment or~~ items that you installed in the past year, did you receive any special pricing or rebates, or receive an item for free?

- 1. Yes
- 2. No
- 98. Don't know

99. Refused

**[IF PE90 = 1, CONTINUE. OTHERWISE SKIP TO BA1.]**

PE9. For each item that I list, please let me know if you received a rebate, other special pricing or discounts, or if you received it for free... (IF NEEDED SAY: as part of a home energy audit or assessment).

**[ASK FOR EACH where PE4 = 1 or where PE5 = 1 or LI6 = 3, 4, 5, 98 or ~~LI7=3, 4, 5, 98~~ or where PA3 = 1]**

Did you receive a rebate or other special pricing for the...(READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Rebate (1)	Other special pricing (2)	Received for free (3)	None of these (4)	Don't Know (98)
PE9a. [ASK IF PE4a=1] CAC unit or ASHP					
PE9b. [ASK IF PE4b=1] Room or wall air conditioning unit					
PE9c. [ASK IF PE4c=1] Clothes washing machine					
PE9d. [ASK IF PE4d=1] Clothes dryer					
PE9i. [ASK IF PE4i=1] Ductless Mini-split Heat pump					
PE9j. [ASK IF PE4j=1] Boiler					
PE9k. [ASK IF PE4k=1] Furnace					
PE9l. [ASK IF PE4l=1] Refrigerator					
PE9m. [ASK IF PE4m=1] Attic, ceiling or wall insulation					
PE9n. [ASK IF PE4n=1] Heat pump water heater					
PE9o. [ASK IF PE4o=1] tank-less water heater					
PE9q. [ASK IF PE4q=1] Dehumidifier					
PE9t. [ASK IF PE5=1] Refrigerator or freezer you recycled					
<del>LI6c. [ASK IF LI3c=1] Compact Fluorescent Light bulbs</del>					
<del>LI6d. [ASK IF LI3d=1] LED bulbs</del>					
LI7a. [ASK IF LI6=3,4,5,98] Indoor Light Fixtures					
<del>LI7b. [ASK IF LI7=3,4,5,98] Outdoor Fixtures</del>					
PA4b. [ASK IF PA3b=1] Low-flow shower heads					
PA4c. [ASK IF PA3c=1] Low-flow faucet aerators					
PA4d. [ASK IF PA3d=1] Water heater tank wrap or pipe wrap					
PA4i. [ASK IF PA3i=1] Programmable thermostat					
PA4j. [ASK IF PA3j=1] Advanced power strips					
PA4k. [ASK IF PA3k=1] Duct sealing or duct insulation					

	Other special pricing (2)	Received for free (3)	None of these (4)	Don't Know (98)
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**Behavioral Actions Taken**

BA1. Next I'm going to ask a few questions regarding actions that you may take in your home. For each action that I read, please tell me if you regularly (IF NEEDED SAY: Most of the time) do them.

Do you regularly... (READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Yes (1)	No (2)	Not applicable (96)	Don't know (98)	Refused (99)
a. Hang laundry to dry					
b. Wash laundry in cold water					
c. [INCLUDE IF PE1_c = 1] Fully load clothes washing machine					
d. [INCLUDE IF PE1_e = 1] Fully load dishwasher					
e. Turn off lights in unoccupied rooms					
f. [INCLUDE IF LI4 = 1] Turn off outside lights by day					
g. [INCLUDE IF PE1_g = 1] Turn off computers at night/when not in use					
h. [INCLUDE IF PE1_g = 1] Put computer(s) to sleep					
i. [INCLUDE IF PE1_f = 1] Turn off TV(s) when no one is watching it					
j. [INCLUDE IF PE1_h = 1] Turn off video game console(s) when not in use					
k. Switch off power strips					
l. Unplug devices when not in use (phones, chargers, TVs, stereos, etc.)					
m. [INCLUDE IF PA1_h = 1] Lower window shades, insulation or quilts (IF NEEDED, SAY: During the day in the summer and/or at night in the winter)					
n. Take short showers					
o. Use a portable window fan or ceiling fan					
p. Clear the area around vents					
q. Set the thermostat at or below 70 degrees for heating					
r. [IF PE1_a = 1 OR PE1_b = 1 OR PE1_j = 1] Set the thermostat at or above 78 degrees for cooling					
s. [INCLUDE IF PE1_f = 1] Turn off DVR and/or cable box when not watching TV					

**[IF ANY BA1\_A-S = 1, CONTINUE. OTHERWISE SKIP TO BA4.]**

BA2. Did you start taking any of the actions we just discussed in the past year?

1. Yes

- 2. No
- 98. Don't know
- 99. Refused

**[IF BA2 = 1, CONTINUE. OTHERWISE SKIP TO BA4.]**

BA3. For the actions you told me you regularly do, please answer “yes” if you started taking that action within the past year or “no” if you have been taking that action for more than a year. Within the past year, did you start...(READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Yes (1)	No (2)	Don't know (98)	Refused (99)
<b>[ONLY INCLUDE BA1_A-S = 1 ANSWERS.]</b>				
a. <del>Hanging laundry to dry</del>				
b. Washing laundry in cold water				
c. Fully loading clothes washing machine				
d. Fully loading dishwasher				
e. Turning off lights in unoccupied rooms				
f. Turning off outside lights by day				
g. Turning off computers at night/when not in use				
h. Putting computer(s) to sleep				
i. Turning off TV(s) when no one is watching it				
j. Turning off video game console(s) when not in use				
k. Switching off power strips				
l. Unplugging devices when not in use (phones, chargers, TVs, stereos, etc.)				
m. <del>Lowering window shades, insulation or quilts</del>				
n. Taking short showers				
o. Using a portable window fan or ceiling fan				
p. Clearing the area around vents				
q. Setting the thermostat at or below 70 degrees for heating				
r. <b>[IF PE1_a = 1 OR PE1_b = 1 OR PE1_i = 1 AND BA1_r = 1]</b> Setting the thermostat at or above 78 degrees for cooling				
s. Turning off DVR/cable box when not watching TV				

**[BA8 MOVED AFTER BA3 LIKE IN WAVE 1]**

BA8. The next set of questions is about the actions you've been taking for more than a year.

In the past year compared to previous years, how frequently did you...(READ LIST)?  
 Would you say “more frequently”, “less frequently” or “no change in frequency”? (RECORD ONE ANSWER FOR EACH.)

	Increased Frequency (1)	Decreased Frequency (2)	No change in frequency (3)	Don't know (98)	Refused (99)
<b>[ONLY INCLUDE (BA1_A-S = 1 AND BA3_A-S ≠ 1) ANSWERS.]</b>					
a. <del>Hang laundry to dry</del>					
b. Wash laundry in cold water					
c. Fully load clothes washing machine					
d. Fully load dishwasher					
e. Turn off lights in unoccupied rooms					
f. Turn off outside lights by day					
g. Turn off computers at night/when not in use					
h. Put computer(s) to sleep					
i. Turn off TV(s) when no one is watching it					
j. Turn off video game console(s) when not in use					
k. Switch off power strips					
l. Unplug devices when not in use (phones, chargers, TVs, stereos, etc.)					
m. <del>Lower window shades, insulation or quilts</del>					
n. Take short showers					
o. Use a portable window fan or ceiling fan					
p. Clear the area around vents					
q. Set the thermostat at or below 70 degrees for heating					
r. <b>[IF PE1_a = 1 OR PE1_b = 1 OR PE1_j = 1]</b> Set the thermostat at or above 78 degrees for cooling					
s. Turn off DVR/cable box when not watching TV					

BA4. Within the past year, which of the following actions have you done? Have you...(READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Yes (1)	No (2)	Not applicable (96)	Don't know (98)	Refused (99)
<b>[ROTATE.]</b>					
a. Maintained your heating and cooling system					
b. <b>[INCLUDE IF PE1k = 1]</b> Changed the furnace filter					
c. <del><b>[INCLUDE IF PE1j = 1]</b> Cleaned the boiler water</del>					
d. Reduced the water heater temperature					
e. Made sure refrigerator seals are tight					
f. Cleaned refrigerator coils					
g. Increased refrigerator temperature					
h. <b>[INCLUDE IF PE5a = 1]</b> Unplugged a second refrigerator for weeks to months at a time					

**[IF ANY BA4\_A-H = 1, CONTINUE. OTHERWISE SKIP TO P1 BA7.]**

BA5. Did you start taking any of these actions we just discussed ~~for the first time~~ in the past year?

1. Yes
2. No
98. Don't know
99. Refused

**[IF BA5 = 1, CONTINUE. OTHERWISE SKIP TO P1 BA7.]**

BA6. As I read each action you told me you have taken in the past year, please answer "yes" if you started taking that action within the past year or "no" if you have been taking it for more than a year. Within the past year, did you start...(READ LIST AND RECORD ONE ANSWER FOR EACH)?

	Yes (1)	No (2)	Don't know (98)	Refused (99)
<b>[ONLY INCLUDE BA4_A-H = 1 ANSWERS.]</b>				
a. Maintaining your heating and cooling system				
b. Changing the furnace filter				
<del>c. Cleaning the boiler water</del>				
d. Reducing the water heater temperature				
e. Making sure refrigerator seals are tight				
f. Cleaning refrigerator coils				
g. Increasing refrigerator temperature				
h. Unplugging a second refrigerator for weeks to months at a time				

**Home Energy Report Questions**

**[IF SAMPLE\_PARTICIPANT = 1, CONTINUE. OTHERWISE SKIP TO DE0.]**

P1. The next set of questions is about the home energy report. This is a mailer sent to your home that provides a description of your household's energy usage in comparison to similar homes, with tips to save energy in your home.

About how many of the home energy reports have you read in the past year? Have you read...(READ LIST)?

1. None of them
2. Some
3. All of them
98. (DO NOT READ) Don't know
99. (DO NOT READ) Refused

P1a. How has this changed since you first received the reports? ~~If so, how?~~ Do you read them... (READ LIST)?

1. More
2. Less
3. About the same

- 98. (DO NOT READ) Don't know
- 99. (DO NOT READ) Refused

**[IF P1A = 1 OR 2, ASK P2.]**

P2. Why do you read the home energy reports **[INSERT P1A ANSWER]** since you first received them? What is the reason for this change? (RECORD VERBATIM.)

\_\_\_\_\_ **[CODING USE ONLY]**

**[IF P1 = 2 OR 3, ASK P2A.]**

P2a. After receiving the reports, which of the following best represents your response to the reports? (READ LIST.)

- 1. I immediately began taking action to reduce my energy use
- 2. I began taking action to reduce my energy use after reading a few reports
- 3. I began taking action to reduce my energy use, but it was long after I started receiving the reports
- 4. I have not taken any actions to reduce my energy use
- 98. (DO NOT READ) Don't know
- 99. (DO NOT READ) Refused

**[IF P1 = 2 OR 3, CONTINUE. OTHERWISE SKIP TO DE0.]**

P3. Would you like to receive the reports at more, less, or about the same frequency as you do now?

- 1. More
- 2. Less
- 3. About the same
- 98. Don't know
- 99. Refused

**[IF P1 = 2 OR 3, ASK P4-P8.]**

P4. The reports include a comparison of your natural gas usage from the previous month to similar homes in your area. On a scale of 1 to 5, where 1 is "not at all useful" and 5 is "very useful", how would you rate the usefulness of the comparison to similar homes?

Not at all useful				Very useful	Don't know	Refused
1	2	3	4	5	98	99

P5. The reports also include a weather-adjusted comparison of your household's current natural gas usage to your usage during the same time the previous year. On a scale of 1 to 5, where 1 is "not at all useful" and 5 is "very useful", how would you rate the usefulness of this personal comparison?

Not at all useful				Very useful	Don't know	Refused
1	2	3	4	5	98	99

P6. The home energy reports have tips on different ways to lower your natural gas usage in your home. Again on a scale of 1 to 5, where 1 is “not at all useful” and 5 is “very useful”, how would you rate the usefulness of the tips provided?

Not at all useful					Very useful	Don't know	Refused
1	2	3	4	5	98	99	

P7. On a scale of 1 to 5, where 1 is “not at all useful” and 5 is “very useful”, how would you rate the usefulness of the home energy reports overall?

Not at all useful					Very useful	Don't know	Refused
1	2	3	4	5	98	99	

P8. What, if anything, could make the home energy reports more useful? (INTERVIEWER: PROBE FOR THREE RESPONSES IF POSSIBLE.) PROBE: Is there anything else that could make the home energy reports more useful?  
(RECORD VERBATIM UP TO THREE RESPONSES.)

[CODING USE

ONLY]

FOR CODING PURPOSES ONLY

1. Receive more reports
2. Receive fewer reports
3. More tips
4. More detailed tips
5. More information about rebates/discounts
6. More information about how my home is being compared to similar homes
7. Provide tips that are more specific to my home/situation
8. Receive information on my monthly bill instead of a separate report
9. Receive information online instead of a paper report
10. Receive information by email instead of a paper report
11. Less detailed information in general
12. More detailed information in general
13. In general, more information on how to lower my energy bill
14. Provide similar homes comparisons that are more specific to my home/situation
96. Stop receiving reports
96. Nothing/No change needed
97. Other
98. Don't know
99. Refused

**Additional Demographics and Fuel Questions [ALL CUSTOMERS]**

DE0. We're almost done. We have just a few more questions about you and your household.

**[REMOVE DE4 AND DE5]**

DE6. Do you have any children in your household under the age of 18?

1. Yes
2. No
98. Don't know
99. Refused

DE7. Please stop me when I reach the highest level of education you have completed. (READ LIST.)

1. Less than high school
2. High school graduate or equivalent
3. Some college, no degree
4. Associate's degree
5. Bachelor's degree
6. Graduate or professional degree
98. (DO NOT READ) Don't know
99. (DO NOT READ) Refused

DE8. Please stop me when I read the range of your household's total annual income before taxes. Is it...(READ LIST)?

1. Less than \$25,000
2. \$25,000 to less than \$35,000
3. \$35,000 to less than \$50,000
4. \$50,000 to less than \$75,000
5. \$75,000 to less than \$100,000
6. \$100,000 to less than \$150,000
7. \$150,000 to less than \$200,000
8. \$200,000 or more
98. (DO NOT READ) Don't know
99. (DO NOT READ) Refused

DE9. What kind of home do you live in? Is it...(READ LIST)?

1. A single-family detached residence
2. A single-family attached residence (for example, a townhouse)
3. An apartment or condominium in a building with 2-4 units
4. An apartment or condominium in a building with 5 or more units
5. A mobile home
6. Other (Please specify)
98. (DO NOT READ) Don't know
99. (DO NOT READ) Refused



[REMOVE DE10, DE11, DE12, DE13]

That completes the Home Energy Use survey! Thank you for your participation. Berkshire Gas values your opinion. Your responses have been recorded and will be kept confidential. Thank you again for your time.

## Appendix B. Energy Savings Actions at the Measure Level

Table B-1 to Table B-3 show the detailed results for measure and behavior actions taken by treatment and control groups. In the first column, each heading displays the name of the composite category, with the measures or behaviors making up that category reported below. In the evaluation team’s composite tables, respondents who had taken at least one action in the composite category were counted toward the total percentage of respondents reporting having taken action in that category.

**Table B-1. Energy-Saving Actions Taken (Measures Installed or Purchased in Past Year)**

Measure	Berkshire Gas	
	% Control	% Treatment
<b>Heating and Cooling</b>		
CAC or ASHP (ES)	0.0	0.0
Room or Wall AC (ES)	1.3	0.9
Ductless Mini-Split Heat Pump (ES)	0.0	0.0
Boiler (ES)	0.7	2.6
Furnace (ES)	1.3	3.1
<b>Appliances</b>		
Clothes Washer (ES or front-load)	8.1	8.3
Heat Pump Water Heater (ES)	1.3	0.0
Tank-Less Water Heater	0.0	1.7
Dehumidifier (ES)	2.0	0.9
<b>Light Fixtures</b>		
Indoor light fixtures (LED or CFL)	8.7	11.6
<b>Building Envelope</b>		
Double-Paned or Triple-Paned Windows (ES)	2.7	0.9
Attic, Ceiling, or Wall Insulation	2.0	3.1
Storm windows	0.0	0.9
<b>Refrigerator Recycling</b>		
Recycled Second Refrigerator	12.1	7.1
<b>Low-Cost Measures</b>		
Weather-stripping	2.7	6.3
Low-flow faucet aerators	2.0	0.0 <sup>^</sup>
Low-flow showerheads	2.7	1.4
Water heater tank wrap or pipe wrap	0.7	1.4
Motion sensors (e.g., for lighting)	1.3	4.9 <sup>^</sup>
Programmable or W-Fi Thermostat	2.0	3.1
Advanced Power Strips	2.7	3.7

Measure	Berkshire Gas	
Duct sealing or insulation	0.7	0.5

^ Significantly higher than control group at p<0.10.

Source: Evaluation team analysis

**Table B-2. Energy-Saving Actions Taken  
(Behaviors Started or Increased in Frequency in the Past Year)**

Measure	Berkshire Gas	
	% Control	% Treatment
<b>Hot Water Usage</b>		
Wash laundry in cold water	9.4	13.1
Fully load clothes washer	6.0	9.6
Full load dishwasher	1.3	4.8^
Take shorter showers	6.7	11.4
Reduced the water heater temperature	1.3	5.6**
<b>Lighting</b>		
Turn off lights in unoccupied rooms	12.1	13.8
Turn off outside lights by day	6.0	7.0
<b>Personal Electronics</b>		
Turn off computers at night/when not in use	4.7	8.2
Put computer(s) to sleep	5.4	8.2
Turn off TV(s) when no one is watching	4.0	12.3**
Turn off video game console(s) when not in use	2.0	7.7**
Switch off power strips	2.7	4.9
Unplug devices when not in use (phones, chargers, TVs, stereos, etc.)	1.3	8.7**
Turn off DVR and/or cable box when not watching TV	3.4	9.7**
<b>HVAC</b>		
Use a portable window or ceiling fan	4.7	9.2
Set thermostat at or below 70 degrees for heating	7.4	9.2
Set thermostat at or above 78 degrees for cooling	0.0	1.7
Clear area around vents	3.4	8.2^
Maintained heating and cooling system	5.4	6.1
Changed furnace filter	2.7	2.2
<b>Refrigeration</b>		
Made sure refrigerator seals are tight	7.4	6.1
Cleaned refrigerator coils	4.0	3.6
Increased refrigerator temperature	1.3	2.6
Unplugged a second refrigerator for weeks to months at a time	1.3	0.0

\*\* Significantly higher than control group at p<0.05.

^ Significantly higher than control group at p<0.10.

Source: Evaluation team analysis

**Table B-3. Energy-Saving Actions Taken (Behaviors Maintained from Previous Years)**

Measure	Berkshire Gas	
	% Control	% Treatment
<b>Hot Water Usage</b>		
Wash laundry in cold water	67.8	70.9
Fully load clothes washer	80.5	80.2
Full load dishwasher	61.7	57.6
Take shorter showers	77.9	73.6
Reduced the water heater temperature	26.2	21.0
<b>Lighting</b>		
Turn off lights in unoccupied rooms	92.6	97.8**
Turn off outside lights by day	86.6	87.4
<b>Personal Electronics</b>		
Turn off computers at night/when not in use	65.1	65.2
Put computer(s) to sleep	54.4	57.0
Turn off TV(s) when no one is watching	89.3	88.6
Turn off video game console(s) when not in use	29.5	32.9
Switch off power strips	40.3	29.3**
Unplug devices when not in use (phones, chargers, TVs, stereos, etc.)	32.9	42.8^
Turn off DVR and/or cable box when not watching TV	59.7	55.2
<b>HVAC</b>		
Use a portable window or ceiling fan	78.5	79.4
Set thermostat at or below 70 degrees for heating	90.6	88.4
Set thermostat at or above 78 degrees for cooling	14.8	13.4
Clear area around vents	73.8	70.7
Maintained heating and cooling system	73.8	79.2
Changed furnace filter	32.9	29.9
<b>Refrigeration</b>		
Made sure refrigerator seals are tight	63.8	70.8
Cleaned refrigerator coils	40.3	43.0
Increased refrigerator temperature	11.4	9.6
Unplugged a second refrigerator for weeks to months at a time	11.4	9.1

\*\* Significantly higher than control group at p<0.05.

^ Significantly higher than control group at p<0.10.

Source: Evaluation team analysis