2017 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs

VOLUME II

APPENDICES C - G

AEP OHIO

An AEP Company

BOUNDLESS ENERGY

TABLE OF APPENDICES

APPENDIX C

NAVIGANT

Appliance Recycling Program

2017 Evaluation Report

Prepared for:

AEP Ohio

AEP OHIO ®

A unit of American Electric Power

April 9, 2018

NAVIGANT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This report presents the findings of the evaluation of the 2017 AEP Ohio Appliance Recycling Program. The Executive Summary provides a high-level description of the program, key impact findings, conclusions, and recommendations stemming from these findings. Detailed methodology and findings are contained in the body of the report following this Executive Summary.

ES.1 Program Summary

The objective of the AEP Ohio Appliance Recycling Program is to remove old, inefficient refrigerators and freezers from operation as secondary units in homes, and therefore reduce energy use and peak demand. The program also aims to prevent primary appliances from being sold into the secondary market or retained and used as secondary units after customers purchase new units.

A new program implementer, Recleim, began implementing the program in January 2017. Additionally, the incentive for recycling an appliance through the program was decreased from $50 to $35, although it increased to $50 during the months of October through December. In 2017, the program collected a total of 13,608 appliances (11,038 refrigerators and 2,570 freezers). While this number is higher than the program total in 2016, this number is lower than prior years, when the incentive was at least $50 throughout the program year.

ES.2 Key Impact Evaluation Findings

Table ES-1 shows the *ex-ante* savings claimed by the program, the *ex post* savings, and the 2017 realization rates. The realization rates for 2017 were 1.00 for both energy and demand savings. To estimate the *ex post* savings, the evaluation team applied the methods and assumptions outlined in the Draft 2010 Ohio Technical Reference Manual (Draft Ohio TRM). The program achieved 18,388 MWh and 2.94 MW in energy and demand savings, respectively.

Table ES-1. Program Savings and Realization Rate for Program Year 2017

	2017 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goals = (c) / (a)
Energy Savings (MWh)	11,833	18,388	18,388	1.00	155%
Demand Savings (MW)	1.806	2.94	2.94	1.00	163%

[1] AEP Ohio Volume 1: 2017 to 2019 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, September 2, 2016.

ES.3 Conclusions and Recommendations

The 2017 Appliance Recycling Program evaluation resulted in seven primary conclusions and four recommendations.

1. **The program surpassed the savings goals for 2017.** The program surpassed the energy savings goal of 11.8 GWh by 55 percent and the demand savings goal of 1.8 MW by 63 percent. This occurred under a new program implementer and despite a decreased incentive amount.

2. ***Ex post* savings were identical to the program *ex ante* values, resulting in realization rates of 1.00.** AEP Ohio appropriately calculated the Draft Ohio TRM annual energy (kWh) and summer peak demand (kW) impacts for the program.

3. **Program participation was reduced from previous years.** In program years 2014 and 2015, 17,734 and 14,641 appliances were collected, respectively (the program operated only part of the year in 2016, collecting 7,352 appliances). In 2017, when the program again operated for the full year, 13,608 appliances were collected. This year-over-year downward trend may be due in part to the incentive amount, which was reduced from $50 to $35 as of January 1, and may also be because marketing did not begin until April. Participation ramped up steadily over the first half of the year and then increased again toward the end of the year when the incentive was increased to $50. The volume during the second half of the year was fairly similar to the same period in previous years, with 9,771 appliances in the second half of 2014, 8,025 appliances in the second half of 2015, and 8,754 appliances in the second half of 2017).

    - **Recommendation 1: Begin marketing earlier in the year.** Marketing occurred later than normal this year, partly because of the selection of a new implementation contractor, which may have resulted in low participation rates at the beginning of the year. Once a marketing plan was in place and implemented, participation nearly doubled towards the second half of the year. To avoid these inconsistencies in program participation, the evaluation team recommends an adjusted marketing timeline that will ensure more consistent program participation throughout the next program year.

4. **Program participants were generally very satisfied with the program and with AEP Ohio.** Survey respondents rated their overall satisfaction with the program an average of 9.0 on a scale from 0 (Not at all satisfied) to 10 (Very satisfied). Program participants rated their average satisfaction with AEP Ohio as an electric company overall as an 8.6 on a 0-to-10 scale. When asked about specific program elements, participants ranked the following elements most highly: the collection team (9.5), their enrollment experience (9.2), and the type of the incentive received (9.0).

5. **Perceived delays in rebate payments resulted in lower satisfaction among some participants.** The 23 percent of participants who reported waiting four weeks or longer to receive a rebate, and the 5 percent of participants who believed they had not yet received their rebate at the time of the survey, reported lower levels of satisfaction. Although customers are informed that they should expect their incentive payment within 4 to 6 weeks, of those who reported they waited 4 weeks or longer for the rebate, 53 percent were very satisfied with the time it took to receive their incentive, compared with 87 percent satisfied when receiving the rebate in less than 4 weeks. Participants who reported they had not yet received the rebate on average rated their satisfaction with the Appliance Recycling Program as a 5 on a 0-to-10 scale. All 10 participants who reported not receiving their rebate had initially been sent a digital gift card, and Recleim records showed 6 of customers' gift cards had been redeemed. It is unknown what exactly contributed to this misconception among customers, although it contributed to dissatisfaction nonetheless. According to AEP Ohio program staff, several changes will be implemented in 2018 to address this issue. These changes include: (1) calling the customer the day their incentive is sent to let them know their incentive has been processed, (2) asking the customer specifically for a personal email address, (3) tracking bounce-backs and ensuring a timely follow-up with the customer, and (4) changing the incentive email address to "@aephio.com" to clearly identify the incentive for customers.

- **Recommendation 2: Ensure customers receive their incentive in a timely manner.** The evaluation team recommends targeting rebate receipt within four weeks of pick-up, as satisfaction dropped after this time. While it is unclear why several digital gift card customers did not recall receiving the rebate, AEP Ohio should continue taking steps to correct this perception. For example, the program should make sure it is clearly communicated to customers whether they are choosing a digital gift card or a physical gift card, and ensure correct email addresses are obtained for customers who request a digital gift card. Additionally, AEP Ohio should consider notifying customers of the email address from which they will receive their gift card, and request customers add the email address to their accepted emails list to avoid gift cards being categorized as spam.

6. **While the cancellation rate was lower compared to previous years, participants who cancelled their pick-up appointment were unlikely to reschedule and participate in the program.** In 2017, the overall rate of cancellation (12%) was lower compared to 2014 (21%), the last year we conducted a cancellation data review of the Appliance Recycling Program. Of the 1,740 customers who cancelled an appointment with the Appliance Recycling Program in 2017, only 45 (3%) eventually participated in the program. This contrasts with 2014, when 44 percent of participants who cancelled at least once eventually participated in the program. Of those who cancelled in 2017, tracking data indicated 27 percent were unable to make the appointment, 8 percent gave their unit away, and 6 percent decided to keep their unit. It is unknown what happened to the appliances for those who could not make their appointment, but these cancellations are a lost opportunity for the program.

    - **Recommendation 3: Monitor cancellation rates and take measures to quickly reschedule customers whenever possible.** While the rate of cancellation was overall lower than in 2014, the rate of customers who cancelled but eventually participated is much lower. The evaluation team recommends this circumstance be monitored during the 2018 program year.

7. **An increasing number of participants believe their picked-up appliance was not in good working order.** The program requires that appliances are in working condition (meaning the compressor must be functioning) in order to be picked up. In 2017, 11 percent of survey respondents stated their picked-up appliance "did not cool its contents effectively, but it did turn on," compared with 5 percent in 2014 and 8 percent in 2015. (There was no participant survey in 2016). The fact that this response has increased somewhat compared to previous years is notable. It is also worth noting no respondents reported "it did not turn on," suggesting customers believed their picked-up appliances were, at a minimum, functioning in some capacity.

    - **Recommendation 4: Monitor the condition of picked-up appliances to ensure these meet program requirements.** While it is challenging to define a "working compressor" through a customer survey, a review of how this determination is made in the field would be beneficial to ensure all units meet program requirements. Specifically, if a compressor turns on, but does not effectively cool the contents of the appliance, the unit may not be in use and thus may not offer any real savings for the program. On the other hand, if these units are being used by customers, removing them through the program would result in savings.

1. INTRODUCTION

This section provides a description of the AEP Ohio Appliance Recycling Program and the objectives of the 2017 program evaluation. The program description includes a discussion of program changes in 2017 compared to 2016 and a brief discussion of the underlying program theory and logic. This section concludes with a list of the evaluation objectives for 2017.

1.1 Program Description

The objective of the AEP Ohio Appliance Recycling Program is to reduce energy use and peak demand through the removal of old, inefficient refrigerators and freezers from operation as secondary units in homes. The program prevents primary appliances from being retained and used as secondary units after customers purchase new units. The program also prevents these appliances from getting sold into the secondary market.

AEP Ohio offers free removal and recycling of refrigerators and freezers and provides a cash incentive to customers who retire these appliances. In 2017, the cash incentive was $35 per appliance for refrigerators and freezers. This incentive was increased to $50 in October through the end of 2017 in an effort to meet program targets. For a customer to qualify, the refrigerator or freezer must be between 10 and 30 cubic feet in size, empty, and operational at the time of pick-up. In 2017, the program collected a total of 13,608 appliances (11,038 refrigerators and 2,570 freezers). While this number is higher than the program total in 2016, this number is still lower than previous years, when the incentive was at least $50 throughout the program year.

1.1.1 Program Objectives and Goals

In 2017, the program aimed to reduce energy usage by 11.8 GWh and peak demand by 1.8 MW. As shown in Table 1-1, these goals account for 6 percent of AEP Ohio's 2017 consumer sector portfolio energy-savings goal and 4 percent of the consumer sector portfolio summer peak demand savings goal.

Table 1-1. 2017 Appliance Recycling Program Savings Goals

Metric	Value	Percent of Consumer Sector Portfolio
Estimated Energy Savings	11.8 GWh	6%
Estimated Demand Savings	1.8 MW	4%

1.1.2 Implementation Contractor

A new implementation contractor, Recleim, began providing complete implementation services as of January 1, 2017. Activities carried out by the implementation contractor include verifying customer eligibility, scheduling appliance pick-ups, collecting appliances from customers' homes, transferring the appliances to the implementation contractor's recycling facility in Lima, Ohio, and processing incentives. the implementation contractor's subcontractor, CLEAResult, manages the marketing strategy and promotion of the program to AEP Ohio customers. A separate subcontractor, IT Soft, manages the collection of program data. IT Soft provides handheld devices for pick-up crews to use in order to collect data, tracks data from the call center and website, and also provides a dashboard to the implementation contractor with general statistics regarding current program status.

1.2 Program Changes

The primary change in 2017 was a new implementation contractor, as previously described. Unlike the previous program year, the implementation contractor was able to begin scheduling and conducting pick-ups immediately on January 1. The implementation contractor also opened a new de-manufacturing facility located in Lima, Ohio, which disposes of harmful gases and materials released through the lining of older appliances. Despite the implementation contractor's status as a new contractor, the implementation contractor staff reported little difficulty in program implementation throughout the year.

In 2017 the program also reduced the incentive for recycled appliances from $50 to $35. This switch to a smaller incentive went into effect January 1. Another change regarding the incentive payment includes the addition of a digital payment system. In previous years, customers were either mailed a check or a gift card with the incentive pre-loaded. Starting in 2017, customers have the option to have their gift card sent to their email address.

One final change for 2017 included the addition of free LED light bulbs along with appliance pick-up. This change occurred in November 2017. In order to effectively distribute LED bulbs left over from previous store-exchanges, AEP Ohio chose to offer a "light kit" to customers during their Appliance Recycling pick-up appointment. If a customer accepted the kit, the implementation contractor pick-up staff distributed a kit containing four free LED lightbulbs (these savings were claimed under the Efficient Products Program).

Marketing Strategy and Tactics

There were a few changes in marketing activities in 2017. First, program marketing began in April 2017. This late start can be attributed to the new marketing contract between the implementation contractor and the marketing contractor. Second, rather than a direct retailer partnership, AEP Ohio chose to market in retail stores by placing marketing materials, such as flyers and tear pads, in order to reach customers purchasing new appliances. Additionally, unlike 2016, the 2017 program was marketed through broadcast television/cable as well as select radio stations. The 2017 program was also heavily cross-promoted through the Efficient Products Program. Marketing methods used in 2017 include:

- Email blasts
- Bill inserts
- Facebook (paid promotion)
- Customer newsletter produced by Questline
- Direct mail
- Tear pads
- Door hangers
- In-store recycling fact sheets
- Efficient Products energy kit mailings (Appliance Recycling hand-out included)
- Cross-promotion with Efficient Products appliance rebate incentives
- Lima, Ohio facility opening press conference/event
- Paid search text ads

- Radio ads

- TV ads

- Banner ads on AEP Ohio's website

1.3 Program Theory

The basic program theory of the 2017 program is unchanged compared to the 2016 program theory. As part of the 2011 evaluation, the evaluation team constructed a detailed logic model to thoroughly capture the program theory of the Appliance Recycling Program. Since the program theory has not changed, apart from the removal of the retailer partnership component, a detailed program theory description and logic model are not contained in this report. The reader is instead referred to the 2011 evaluation report.[1]

1.4 Evaluation Objectives

This report presents the findings from the impact and process evaluations of the AEP Ohio Appliance Recycling Program for 2017. The objectives of the evaluation were to: (1) quantify the energy and demand savings impacts; (2) determine program cost-effectiveness; (3) determine key process-related program strengths and weaknesses; and (4) identify ways in which the program can be improved. The evaluation sought to answer the following research questions:

1.4.1 Impact Questions

1. What were the realization rates and the primary factors driving the realization rates? (Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings.)

2. What are the verified (*ex post*) gross energy and peak demand savings from the program?

3. Did the program meet the energy and peak demand savings goals? If not, why not?

4. What are the benefits, costs, and cost-effectiveness of the program?

1.4.2 Process Questions

Marketing and Participation

1. Does the marketing effort appropriately meet current and future program participation goals?

2. Does the program outreach effectively increase awareness of program opportunities?

3. How often does program outreach occur?

4. Are the messages included within the program outreach clear and actionable?

5. What are the key interests and motivations for potential and actual participants beyond the financial incentive offered?

6. What are the key barriers to participation in the program?

7. How many customers enroll in the program but then cancel? How many of these customers re-enroll in the program within the calendar year?

---

[1] *Program Year 2011 Evaluation Report: Appliance Recycling Program.* Navigant Consulting and Energy Market Innovations, Inc. May 8, 2012.

Program Effectiveness and Satisfaction

8. What improvements could be made to create a more effective program and to help increase energy and demand impacts?

9. What is the status of implementing recommendations/issues identified in previous evaluations?

10. How do the findings in the current year's evaluation compare to previous evaluations?

11. Are participants and providers satisfied with the programs?

12. Have implementation changes effectively increased satisfaction and/or participation?

Administration and Delivery

13. Is program administration functioning effectively?

14. Are there any problems with program delivery?

15. Are program tracking systems adequate? Are program tracking systems consistently maintained? Do program tracking systems contain all data required to support AEP Ohio supervision, program tracking, and evaluation?

16. Are program procedures documented and followed?

17. Are verification procedures implemented in a manner consistent with program design?

18. Is the implementation contractor meeting key performance indicators?

19. How has the program design and implementation changed from 2016? How have these changes influenced program outcomes?

2. METHODOLOGY

This section describes the methodology used to conduct the impact and process evaluations. The methodologies for each primary data-collection activity are discussed, as well as the methodology for reviewing tracking data and program documentation and calculating program savings. Table 2-1 summarizes the various activities undertaken for the impact and process evaluation.

Table 2-1. Summary of Data Review and Data Collection Activities

Data Collection Type	Targeted Population	Supported Evaluation Activities
Tracking data review	All program participants	Impact and Process Evaluation
Program documentation review	Any new program documentation	Process Evaluation
In-depth telephone interviews	Program staff	Process Evaluation
Participant online survey	Program participants	Process Evaluation
Appointment cancellation data review	Program participants and near-participants	Process Evaluation

2.1 Tracking Data Review Methodology

The tracking data collected were provided by AEP Ohio for the evaluation team to review. First, the evaluation team determined key data fields essential for consideration in the impact and process evaluations. Next, the team examined frequency distributions for each of the key fields, identifying missing, incomplete, or inconsistent data. Finally, the team resolved any inconsistencies with AEP Ohio.

The evaluation team assessed key characteristics of appliances recycled through the program, including appliance age, size, and configuration. The team also analyzed process dates and service account IDs to determine duplicate entries and the number of customers that recycled more than one appliance through the program. The assessment of the tracking data and program activity is discussed in Section 3.1.

2.2 Program Documentation Review Methodology

For the 2017 program, the evaluation team analyzed new program documentation to understand the details of the program and to inform the evaluation. The evaluation team reviewed the following documents:

- AEP Ohio Appliance Recycling Program website

- Marketing reports from program year 2017

- Program marketing materials

2.3 In-Depth Telephone Interviews Methodology

As part of the process evaluation, the evaluation team conducted in-depth interviews with program staff, as summarized in Table 2-2. The purpose of these interviews was to understand changes in program design and implementation, identify program successes and challenges, and collect feedback on research priorities.

Table 2-2. Summary of In-depth Interviews

Data Collection Type	Targeted Population	Sample Frame	Sample Target	Sample Size	Timing
In-depth Telephone Interviews	AEP Ohio Program Staff	Contacts from AEP Ohio	Program Manager	1	October 2017
	Implementation Contractor Program Staff	Contacts from AEP Ohio	Director of Business Development Program Portfolio Manager Marketing Associate	3	October – November 2017

2.4 Participant Online Survey Methodology

In January 2018, the evaluation team conducted a survey with program participants to address multiple process evaluation research questions. A link to the online survey was sent to participants via email and implemented using Qualtrics survey software.

Table 2-3 shows the number of appliances collected in 2017 through the program, the target number of surveys, the number of survey completions, and the resulting sampling error. The survey sample included 836 participants. In total, 193 program participants completed the survey, resulting in a 23 percent response rate. The proportion of completes from refrigerator and freezer participants was very similar to the proportion from the overall population. At the program level, sampling efforts resulted in +/- 6 percent precision at a 90 percent level of confidence.

Table 2-3. 2017 Participant Survey Completions and Population-Level Sampling Error

Appliances Collected	2017 Population Size	Survey Target Completions	Survey Completions	Sampling Error
Refrigerators	11,308	80	147	6.74%
Freezers	2,570	20	46	12.02%
Total	**13,608**	**100**	**193**	**5.88%**

2.5 Appointment Cancellation Data Review Methodology

In addition to records on completed projects, the evaluation team reviewed appointment cancellation data, which contains all the customers who signed up for the Appliance Recycling Program and then cancelled or changed their pick-up appointment at least once. The evaluation team reviewed these data to determine how many of the program projects were cancelled or rescheduled. To determine how many cancellations represent true dropouts and how many go on to eventually participate in the program, the evaluation team compared the cancellation data with the program tracking data. The assessment of the cancellation data is discussed in Section 3.3.1.

2.6 Impact Evaluation Methodology

The evaluation team calculated *ex post* program savings using the AEP Ohio program tracking data and the Draft 2010 Ohio TRM. Specifically, the evaluation team used the program tracking data to determine

appliance counts by type and the deemed values for Refrigerator and Freezer Retirement (i.e., recycling) contained in the Draft Ohio TRM[2] for per-unit energy savings, as shown in Table 2-4.

Table 2-4. Deemed Per-Unit Savings Values from Draft Ohio TRM

Appliance Type	Deemed Per-Unit Energy Savings (kWh)	Deemed Per-Unit Demand Savings (kW)
Refrigerator	1,376.15	0.22
Freezer	1,244.40	0.20

Total *ex post* energy and demand savings were calculated as the product of the deemed per-unit savings values shown above and the unit counts from the program tracking data.

---

[2] Refrigerator and/or Freezer Retirement (Early Retirement), Draft Ohio TRM, 2010. pp. 23-24.

3. DETAILED EVALUATION FINDINGS

This section presents the detailed findings from the 2017 Appliance Recycling Program evaluation. First, findings related to program activity are shown, followed by results of the *ex post* impact evaluation, process evaluation, and cost-effectiveness.

3.1 Program Activity

As shown in Table 3-1, the 2017 AEP Ohio Appliance Recycling Program collected a total of 13,608 appliances; these units were collected through 12,880 unique orders.

Table 3-1. Appliance Recycling Incentivized Units

Appliance	Number of Units	Percent of Total Appliances
Refrigerator	11,038	81%
Freezer	2,570	19%
Total	**13,608**	**100%**

The following key findings and figures provide a summary of the program tracking data and a detailed description of the appliances collected through the 2017 AEP Ohio Appliance Recycling Program.

- **The average age of recycled appliances was 20.4 years for refrigerators and 26.9 years for freezers.** This is somewhat older than the average age of units in 2016 (19.7 years for refrigerators and 24.2 years for freezers), and fairly similar to the average ages in 2015 (21.2 years for refrigerators and 26.2 years for freezers). This slight increase in age could be attributable to the proportion of secondary units recycled (see next bullet below). The middle 50 percent of appliances were between 27 and 34 years old. The oldest appliances in the tracking data were a 75-year-old refrigerator and two 77-year-old freezers. Figure 3-1 shows a histogram of recycled appliance age, and shows mean age by year for the past three years.

- **Most refrigerators (71.4%) were secondary units, according to the program tracking data.** However, the participant survey indicated significantly fewer participants recycled a secondary refrigerator (36%, n=146). This discrepancy is likely due to the very different question wording used in the field vs. in the survey. While this is not an issue for savings applied to the program now because the current Ohio TRM does not account for differences between a primary or secondary unit, it may be an issue in the future if the Draft Ohio TRM is updated.

- **Most refrigerators were top freezer refrigerators (62%).** Other types included side-by-side (30%), bottom freezer (5%), and single door (3%) refrigerators. This is similar to 2016.

- **Most freezers were upright freezers (67%).** The remaining 33 percent of freezers were chest freezers. This is similar to 2016.

- **The vast majority (92.7%) of participants recycled a single unit.** The other 7.3 percent recycled two units. One participant recycled five units.

- **A total of 13,608 appliances were collected in the 2017 program year.** This contrasts with the 17,734 and 14,641 appliances collected in program years 2014 and 2015 respectively (the 2016 program only operated part of the year). The increased volume during the second half of 2017, when 8,868 appliances were collected, was fairly similar to the same period in 2014, when 9,771 appliances were collected in the second half of the year).

- **December 2017 was the month with the highest number of appliances recycled**, with 1,618 refrigerators and 383 freezers picked up between December 1st and December 31st. This is different from 2016, when the highest volume was recorded in September. This high volume later in the year be attributed to the increase in the incentive payment which occurred in October 2017. Figure 3-3 shows refrigerators and freezers recycled by month.

- **The average size of refrigerators recycled through the program was 19 ft^3. The average size of freezers was 16 ft^3.** Appliance sizes ranged from 10 ft^3 to 30 ft^3. The average sizes have remained relatively unchanged from the previous year. Appliance size is presented in
- Figure 3-4.

Figure 3-1. Program Appliances Recycled by Age (in years)

NAVIGANT

Figure 3-2. Mean Appliance Age Over Time (PY 2015-2017)

Figure 3-3. Program Appliances Recycled by Month

Figure 3-4. Program Appliances Recycled by Size (in ft³)

3.2 Impact Evaluation Findings

This section provides a detailed description of impact findings for the 2017 Appliance Recycling Program, including total energy and demand savings and realization rates for refrigerators and freezers. The evaluation team reviewed the AEP Ohio tracking data file to inform the *ex post* savings estimation.

The 2017 Appliance Recycling Program *ex post* energy savings totaled 18,388 MWh. Refrigerators accounted for 83 percent of those savings. The evaluation team verified the energy savings by multiplying the verified appliance counts by the Draft Ohio TRM deemed per-unit energy savings values. The realization rate is 1.00 for refrigerators, freezers, and overall. Table 3-2 summarizes our findings.

Table 3-2. *Ex Ante* **and** *Ex Post* **Energy Savings and Realization Rates**

Product	Number of Units	Per-Unit Energy Savings (kWh)	Total *Ex Ante* Energy Savings (MWh)	Total *Ex Post* Energy Savings (MWh)	Percent of *Ex Post* Energy Savings	Realization Rate
Refrigerator	11,038	1,376.15	15,189.94	15,189.94	82.61%	1.00
Freezer	2,570	1,244.40	3,198.11	3,198.11	17.39%	1.00
All Products	**13,608**	**N/A**	**18,388.05**	**18,388.05**	**100.00%**	**1.00**

The 2017 Appliance Recycling Program *ex post* demand savings totaled 2.94 MW. Refrigerators accounted for 82.6 percent of demand savings. The evaluation team verified demand savings by multiplying the verified appliance counts by the Draft Ohio TRM deemed per-unit demand savings values. All demand realization rates are 1.00. Table 3-3 summarizes our findings.

Table 3-3. *Ex Ante* and *Ex Post* **Demand Savings and Realization Rates**

Product	Number of Units	Per-Unit Demand Savings (kW)	Total *Ex Ante* Demand Savings (MW)	Total *Ex Post* Demand Savings (MW)	Percent of *Ex Post* Demand Savings	Realization Rate
Refrigerator	11,038	0.22	2.43	2.43	82.53%	1.00
Freezer	2,570	0.20	0.51	0.51	17.47%	1.00
All Products	**13,608**	**N/A**	**2.94**	**2.94**	**100.00%**	**1.00**

In 2017, the Appliance Recycling program surpassed its 2017 program energy savings goal of 11.8 by 55%, and its demand savings goal of 1.8 MW by 63%.

3.3 Process Evaluation Findings

This section provides a summary of process findings for the 2017 Appliance Recycling Program. Data collection activities that informed the process evaluation included interviews with program and implementation staff, surveys with participating customers, and a review of program tracking and appointment cancellation data.

Key process findings center around customer dissatisfaction regarding the incentive and time between appliance pick-up and receipt of the incentive. A portion of those surveyed (13.3%) indicated dissatisfaction with the amount of the incentive, and, in particular, expressed dissatisfaction due to the incentive increasing from $35 to $50 right after they scheduled their pick-up.[3] Additionally, several respondents (n=10) reported they had not yet received their incentive at the time of the survey. These respondents consistently gave negative satisfaction scores throughout the survey.

Detailed findings from the process evaluation of the 2017 Appliance Recycling Program are presented below and include the following topics:

- Marketing and program awareness

- Program effectiveness and satisfaction

- Program administration and delivery

3.3.1 Marketing and Participation

The following section discusses marketing and outreach methods, key interests and motivations for potential and actual participants, key barriers to participation, and a review of near-participant and participant cancellation data.

---

[3] According to AEP Ohio program staff, after the incentive had increased, if a customer contacted AEP Ohio expressing dissatisfaction, the customer was called back, thanked for their comments, and mailed an additional $15 check.

The marketing subcontractor completed a new marketing plan for the program in early 2017, and the new plan was launched in April 2017. The materials targeted print, digital, radio, and television channels. AEP Ohio used geographically targeted banners on social media websites, paid search text ads, and behaviorally, geographically, and demographically targeted banners on popular websites. AEP Ohio placed advertisements in multiple newspapers and broadcast television and cable in major metropolitan areas. Radio advertisements were used in the Athens, Canton, Findlay, Van Wert, and Kenton metro areas. AEP Ohio also sent out bill inserts and bill messages on a quarterly basis in 2017, and sent "eBlasts" (emails) five times in 2017. Direct mail promotional materials were sent in the last quarter of 2017 to market the increased incentive. Other materials marketed towards the end of the year included in-store recycling fact sheets and ads in AEP Ohio's customer newsletter provided by Questline. The Appliance Recycling Program was also heavily cross-promoted with AEP Ohio's Efficient Products kit mailings as well as the appliance rebates throughout the year.

Source of awareness was gathered in the program tracking data and asked about during surveys with participants, as shown in Table 3-4. Both data sources contained similar responses, with respondents mentioning bill inserts, referrals from a friend or neighbor, AEP Ohio email, and the AEP Ohio website as the most frequent source of awareness.

Table 3-4. Primary Sources of Awareness from Tracking Data and Survey

Source of Awareness	Tracking Data Frequency	Tracking Data Percent	Survey Frequency	Survey Percent
Utility bill insert	4,705	34.58%	57	31.15%
Friend/neighbor	2,081	15.29%	23	12.57%
AEP Ohio email	1,752	12.87%	28	15.30%
AEP Ohio web site	1,481	10.88%	24	13.11%
Television	1,136	8.35%	18	9.84%
Appliance retailer	888	6.53%	15	8.20%
Web advertisement/search	345	2.54%	3	1.64%
AEP Ohio postcard	229	1.68%	-	-
AEP employee communications (e.g., AEP Now)	210	1.54%	-	-
Radio	487	3.58%	2	1.09%
AEP Ohio Home Energy Report	210	1.54%	-	-
Newspaper	193	1.42%	3	1.64%
Social media	83	0.61%	2	1.09%
Utility newsletter	62	0.46%	-	-
Truck sign	55	0.40%	-	-
AEP Ohio employee referral	29	0.21%	-	-
Community event	26	0.19%	0	0.00%
Pandora radio	14	0.10%	-	-
Room AC program	3	0.02%	-	-
Previous participation	-	-	2	1.09%
Other AEP Ohio program	-	-	6	3.28%
Total	**13,608**	**100.00%**	**187**	**100.00%**

Note: Results are not shown for six respondents who reported "Don't know" or skipped the question in the participant survey. Totals may not sum to 100 percent due to rounding. "Other AEP Ohio Program" includes "Appliance Rebate Program" (n=5) and "Home Energy Profile" (n=1).

In addition to being asked how they first became aware of the Appliance Recycling program, survey respondents were also prompted to answer whether they had heard of the program any other way. Figure 3-4 shows the detail of how respondents initially became aware of the program, as well as whether they heard of the program through any other sources.

Figure 3-5. Primary and Secondary Sources of Awareness

■ Primary Source of Awareness   ■ Secondary Source of Awareness

Source	Primary	Secondary
Utility bill insert	30%	16%
AEP Ohio email	15%	11%
AEP Ohio website	12%	12%
Friend/neighbor	12%	13%
Television	9%	2%
Appliance retailer	8%	2%
Other	6%	2%
Other AEP Ohio program	3%	3%
Newspaper	2%	
Web advertisement/search	4%	
Social media	4%	
Radio	3%	

Survey respondents who reported they had heard about the Appliance Recycling program through a different AEP Ohio program were asked to indicate through which program. Of the respondents who answered this question (n=6), five stated they had heard about the program through the Efficient Products appliance rebates, whereas one stated they learned about the program through the Home Energy Report Program.

Motivations for Program Participation

Respondents were asked to provide their chief motivations for recycling their appliance through the Appliance Recycling Program. The most frequently cited motivations include:

- The cash incentive (24%)

- The convenience of the home pick-up (23%)

- The free pick-up (24%)

- The appliance was recycled in a way that was good for the environment (21%)

- The program was recommended by a friend or family (4%)

These results largely mirror the results of prior years' evaluations.

Following this question, respondents were asked to identify their primary reason for recycling their appliance. Primary motivations from program participants include:

- The cash incentive (27%)

- The convenience of the home pick-up (26%)

- The appliance was recycled in a way that was good for the environment (26%)

- The free pick-up (19%).

It should be noted the first four reasons were ranked very similarly. This suggests participants value many facets of the Appliance Recycling Program beyond the cash incentive.

To further gauge the impact of the incentive on customers' decision to participate in the program, respondents were asked to rate how influential the incentive was in motivating them to participate on a 0 (Not at all influential) to 10 (Very influential) scale. The mean rating was 7.8 (n=192). 15.6 percent rated it as less than 5 on the 0-to-10 scale. The majority of respondents found the incentive to be highly motivating, with about two-thirds (65.6%) rating it an 8 or higher.

Key Barriers to Program Participation

While the Appliance Recycling Program exceeded its savings goals for 2017, it should be noted participation this year was lower overall than in previous years, apart from 2016 when the program only operated part of the year. A total of 17,734 and 14,641 appliances were collected in program years 2014 and 2015 respectively. This contrasts with 13,608 appliances in the 2017 program year. Several respondents in the survey identified key barriers to their own participation which might also apply to AEP Ohio customers who chose not to participate in the program.[4] Examples of these responses are shown below. Although these responses are specific to certain participants, similar themes emerged in other participant responses.

- "The incentive used to be $50, then was suspended, then was only $35. I wish the money had been more."

- "I would not have given up my refrigerator but AEP makes it seem like old refrigerators cost so much more to run. Sadly, my bill has not decreased. It was 43 years old and worked great!"

- "I had to find space to keep the old refrigerator plugged in and out of the weather after getting the new refrigerator installed in the home."

- "I didn't think it would take a month to get an appointment."

As stated in staff interviews with the implementation contractor, the lower incentive was perceived as a key barrier for program participation rates. Customers could possibly sell their own appliances and receive more money, or may have simply not seen the benefit of the $35 incentive and chose to dispose

---

[4] Ideally, barriers to participation are best identified through a survey on nonparticipants. However, it is possible issues encountered by participants may prevent other customers from ever participating.

of the appliance themselves. According to interviews with the implementation contractor staff, other neighboring utilities also advertised rates as high as $75.[5] This factor might have motivated AEP Ohio customers not to participate, given AEP Ohio's lower incentive.

Cancellation Data Review

As shown in Table 3-4, the overall dropout rate for the 2017 program year was 12 percent, which is similar to the dropout rates from 2013 (11%) and 2014 (12%), when this analysis was last completed. Of all the customers who enrolled in the program at some point, 88 percent eventually participated in the program. It should be noted while the overall cancellation rate for the program was similar to previous years, the rate of customers who cancelled and then participated is much lower than previous years. Of the 1,740 customers who cancelled an appointment with the Appliance Recycling Program at some point, 3 percent (n=45) eventually participated in the program, while the remaining 97 percent (n=1,695) ultimately did not participate in the program. This is contrasted with 2014, which is the last year a cancellation data review was conducted of the Appliance Recycling Program, when the number of participants who cancelled at least once and eventually participated was much higher (44%).

When customers provided a reason for their cancellation, the most frequent responses included:

- Customer unable to make their appointment (26.9%)
- Customer gave their unit away (8%)
- Customer decided to keep their unit (5.8%)
- The unit no longer worked (4.7%)
- The delivery team was unable to meet their scheduled appointment (4.6%).

When viewed per month, the most cancellations occurred in November (13%) and December (20%). Therefore, the majority of cancellations occurred after the incentive was increased to $50 and participation significantly increased. It is possible the higher participation rates caused a backlog of pick-up appointments, which might have led to missed appointments by strained pick-up staff, or customers disposing of their own appliance rather than waiting for their appointment. However, it is also possible cancellations were due to customers' holiday schedules or winter weather.

Table 3-4. Participation and Dropout after Initial Enrollment in the Program

Behavior After Enrollment	Number of Customers	Percent of Customers
Kept original appointment and never cancelled	12,623	87.9%
Cancelled at least once and eventually participated	45	0.3%
Cancelled at least once and never participated (e.g. "Near-Participants" or "Dropouts")	1,695	11.8%
Total Number of Customers Who Initially Enrolled in the Program	14,363	100.00%

Note: Totals may not sum to 100 percent due to rounding.

[5] For example, Dayton Power & Light and FirstEnergy offer a $50 incentive for their Appliance Recycling Program, and FirstEnergy increased their $50 incentive to $75 between September 1 and November 30 in 2017 (see https://www.firstenergycorp.com/content/fecorp/newsroom/news_articles/firstenergy-s-ohio-utilities-boost-fridge-recycling-incentive-to.html).

3.3.2 Program Effectiveness and Satisfaction

The following section summarizes the key survey findings related to respondents' participation in the AEP Ohio Appliance Recycling Program. The findings are detailed as follows:

- Reported conditions of recycled appliances

- Satisfaction with the Appliance Recycling Program overall

- Suggestions for program improvements from AEP Ohio customers

Appendix A.1, found at the end of this document contains more details regarding program effectiveness and satisfaction. These findings include:

- Program enrollment experience

- Scheduling and pick-up experience

- Satisfaction with communication and program staff (if applicable)

- Perceptions of, and satisfaction with, energy savings (if applicable)

Characteristics of Appliances Disposed Through the Program

Overall, most of the respondents who recycled their appliance through the Appliance Recycling Program reported the appliance effectively cooled its contents, although these appliances were not always described as being in "good condition." As shown in Table 3-5, slightly less than half of the survey respondents (48.11%) reported the appliance they recycled was working and in good condition. However, 11 percent of respondents indicated the appliance did not cool its contents effectively, although it did turn on. This is an increase from 5 percent in 2014 and 8 percent in 2015. (There was no participant survey in 2016.)

Table 3-5. Condition of Appliance Disposed Through the Program

Condition of Appliance	Refrigerator (n=147)	Freezer (n=46)	Total (n=185)
Effectively cooled contents and was in good condition	45.39%	56.81%	48.11%
Effectively cooled contents but needed minor repairs	29.79%	18.18%	27.03%
Partially cooled contents but had bigger problems	12.77%	15.90%	13.51%
Did not cool contents effectively but did turn on	12.06%	9.09%	11.35%
Did not turn on	0%	0%	0%
Total	**100.00%**	**100.00%**	**100.00%**

Note: Results are not shown for 8 respondents who reported "Don't know" or skipped the question in the participant survey. Totals may not sum to 100 percent due to rounding.

When asked about the age of their recycled appliance, 31 percent reported the appliance was 10 to 15 years old, 23 percent stated the appliance was 15 to 20 years old, and 20 percent reported that the appliance was 25 years or older. Just 12 percent of survey respondents stated that the appliance was less than 10 years old.

Satisfaction with Incentive Amount and Timing

Customers are informed that the normal processing time for the incentive is 4 to 6 weeks. The frequencies of reported times customers reported between pick-up appointments and receipt of the incentive are shown in Table 3-6. The most common response was from customers who reported they had received their incentive in less than 4 weeks (44%), while almost one-quarter reported it took 4 weeks or longer (23%). About 20 percent were unsure of how long it took to receive their incentive, and 8 percent were unsure if they had received a rebate. Ten customers (5% of all respondents) reported they had not received their incentive at the time of the survey; all ten of these customers had initially been sent a digital gift card. The evaluation team followed up with AEP Ohio and the implementation contractor regarding these payments. According to the implementation contractor tracking data, 6 of these 10 respondents had already received and used their rebates. It is possible these participants forgot about receiving their rebate, someone else in their household received and used the rebate, or the rebate was either lost or stolen and used by someone else. It is also possible for those respondents who had not yet used their gift card, potentially because the gift card was sent to a spam folder or lost in the respondent's inbox. Several changes are being implemented in 2018 to address this issue. These changes include: (1) calling the customer the day their incentive is sent to let them know their incentive has been processed, (2) asking the customer specifically for a personal email address, (3) tracking bounce-backs and ensuring a timely follow-up with the customer, and (4) changing the incentive email address to "@aephio.com" to clearly identify the incentive for customers.
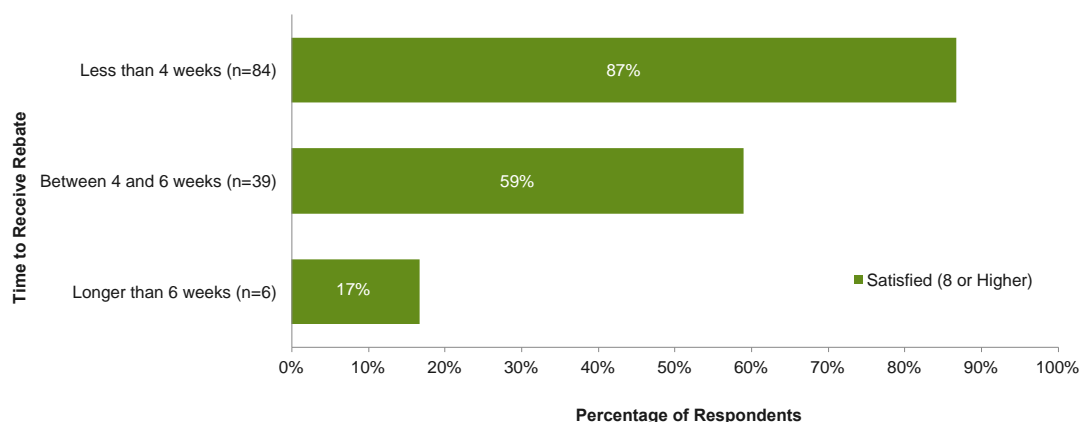
Table 3-6. Reported Time Between Pick-up and Receipt of Incentive

Time	Frequency	Percent
Less than 4 weeks	84	43.52%
4 weeks	27	13.99%
5 weeks	7	3.63%
6 weeks	5	2.59%
Longer than 6 weeks	6	3.11%
Unsure of time between pick-up and incentive	38	19.69%
Unsure if received rebate	16	8.29%
Did not receive rebate	10	5.18%
Total	**193**	**100.00%**

Survey respondents were also asked to indicate their level of satisfaction with the time it took to receive their incentive on a 0 (Not at all satisfied) to 10 (Very satisfied) scale. Overall, respondents were satisfied with the time it took to receive their incentive, with nearly three-quarters of respondents (71.2%) reporting satisfaction scores of 8 or higher. However, there were several participants (7.2%) who ranked their satisfaction as a 0.

As expected, respondents who had received their incentive in less than 4 weeks were more satisfied with the time it took to receive their incentive than those whose incentive had taken 4 weeks or longer. As demonstrated in Figure 3-6, the longer a respondent reported it took to receive their incentive, the less likely they were to report high levels of satisfaction with the incentive. Of those who wait 4 weeks or longer for the rebate, 53 percent were very satisfied with the time it took to receive their rebate.

Figure 3-6. Satisfaction with the Time to Receive Incentive (n=129)

Note: Results not shown for participants who were "unsure" how long it took to receive their rebate or who did not receive a rebate at all.

Interviews with implementation staff revealed they have a contractual obligation to keep their pick-ups scheduled within fourteen days or less of a customer's original request to have their appliance picked up. While most customers (78%) reported the appointment was scheduled within 2 weeks or less in the participant survey, several customers stated longer waiting times for a pick-up appointment, with 10 percent of customers reporting they waited longer than three weeks to have their appliance picked up. This delay in pickup could be due to the customer's location, as collection trucks are sent less frequently to more remote areas. It is also unclear if the delay in pickup was due to the customer's availability or the implementation contractor's availability.

Much like the delayed incentive, this was also a source of dissatisfaction among Appliance Recycling Program participants. For customers who recently purchased a new appliance and wanted to dispose of their old one, long wait times meant having to find extra space for the old appliance. The long wait times might also have contributed to lower participation, as customers may have wished to dispose of their appliance sooner. Detailed results of this section of the participant survey are provided in Appendix A.
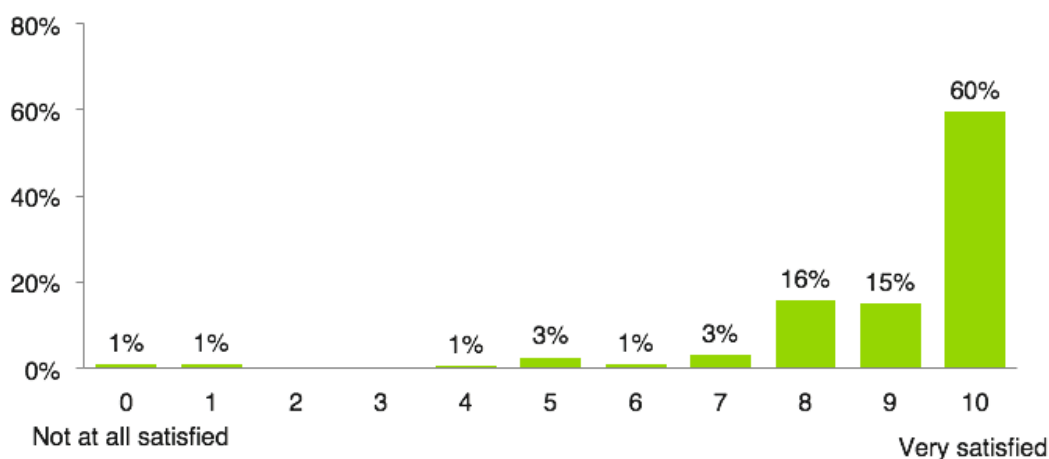
Respondents were also asked how satisfied they were with their incentive amount on a 0 (Not at all satisfied) to 10 (Very satisfied) scale. Most respondents were Very satisfied (77%), rating their scores as 8 or higher. Six percent of respondents were dissatisfied with the incentive amount, and ranked their satisfaction score as a 4 or lower. These participants who noted dissatisfaction with the incentive amount all received a $35 incentive as opposed to the increased $50 incentive.

Program Satisfaction

Overall, as shown in Figure 3-7, respondents were satisfied with their experience with the Appliance Recycling Program. Ninety-one percent of participants who responded to the question ranked their satisfaction as an 8 or higher on a 0 (Not at all satisfied) to 10 (Very satisfied) scale. However, respondents differed in their satisfaction with the program as a function of whether or not they had received their rebate, the amount of rebate they received, and how long they had waited. Respondents who had not received their rebate were the least satisfied with the AEP Ohio Recycling Program, rating their satisfaction with the program an average score of 5 on a 0-to-10 scale. There were also several respondents (n=9) who were dissatisfied with the incentive change from $35 to $50, with several stating that they should be able to, at a minimum, receive the difference in the rebate if they recycled their

appliance within two weeks of the incentive increase. One respondent noted, "Treat all residential customers the same. Give everyone the same incentive amount, whatever it has to be." It is possible these customers were dissatisfied due to the fact that in previous years, AEP Ohio has often offered between $50 to $60 for a recycled appliance. According to program procedures, in 2017, the increased incentive amount was provided to customers who either enrolled or had their appliances picked up during the increased incentive period.

Figure 3-7. Satisfaction with AEP Ohio Recycling Program (n=191)

Note: Results not shown for 2 respondents who skipped the question. Totals may not sum to 100 percent due to rounding.

Ultimately, participants were generally satisfied with all program elements. As shown in Figure 3-8, survey results showed high levels of satisfaction with the collection team, the enrollment experience, the incentive type, and the program overall. Respondents were, on average, the least satisfied with the incentive amount.

Figure 3-8. Mean Satisfaction with Appliance Recycling Program Elements

Note: "Communications with AEP Ohio staff" could also include the implementation contractor's call center.

Regardless of their satisfaction rating, all respondents were asked if they had any suggestions for program improvement. Most said they did not (70%). Of the remaining customers, the most frequent suggestions for improvement included:

- Consistent payment amount (n=9)

- Ability to more appliances beyond just a refrigerator or freezer (n=6)

- Larger incentive (n=4)

- Ability to be paid same day with a check or bill reduction (n=4)

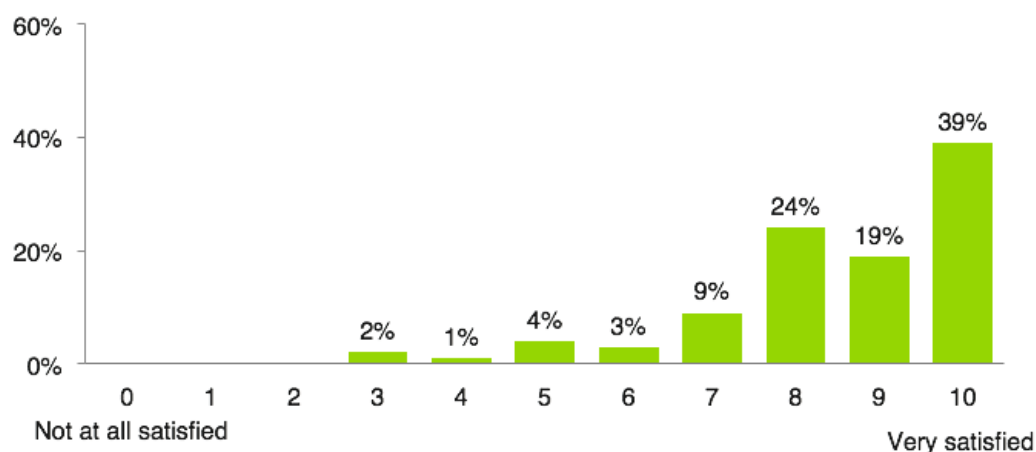- Timely receipt of incentive payment (n=4)

- Ability to schedule a pick-up sooner (n=4)

Satisfaction with AEP Ohio Overall

When asked about their overall level of satisfaction with AEP Ohio as their utility, the majority of respondents (82%) reported satisfaction scores of 8 or higher, as summarized in Figure 3-9. Out of the respondents who reported lower satisfaction scores with AEP Ohio, no one rated AEP Ohio as a 2 or lower. The average satisfaction score was an 8.6.

Figure 3-9. Satisfaction with AEP Ohio (n=186)

Respondents were also asked to indicate whether their participation in the Appliance Recycling Program changed their opinions of AEP Ohio in general. As summarized in Table 3-7, the majority (62%) of respondents indicated that participation made them view AEP Ohio more favorably. The second most frequent response was that participation made "No difference" in their opinions of AEP Ohio (37%); few (1%) indicated that their experience made them view AEP Ohio less favorably.

Table 3-7. Effect of Program Participation on Favorability Toward AEP Ohio

Response	Frequency	Percent
More favorable toward AEP Ohio	112	62%
No different about AEP Ohio	68	37%
Less favorable about AEP Ohio	2	1%
Total	**182**	**100%**

Note: Analysis does not include 11 participants who responded "Don't know" or skipped the question.

3.3.3 Program Administration and Delivery

The program under the new implementer was generally operated similarly to 2016, although there was one significant change in 2017. The program incentive was reduced from $50 in 2016 to $35 in 2017. The incentive was later increased in October 2017 to $50 to increase customer participation in the program. Additionally, marketing for the Appliance Recycling Program was implemented later than in previous years. This delay can be attributed delays in the addition of a new subcontractor responsible for marketing, as their contract was not finalized until April 2017. The delay in marketing might have negatively affected participation rates; however, the program nevertheless surpassed its 2017 program savings goals.

Program Tracking Systems

New program tracking systems implemented by the implementation contractor are performing as expected. According to staff interviews with the implementation contractor, customers are tracked once they schedule an appointment either online or via the implementation contractor's call center. The implementation contractor's subcontractor's pick-up staff collect customer-specific data via tablet during the customer's appointment. After a full week of data collection, a quality review is conducted by the implementation contractor, and then a weekly invoice sent to the implementation contractor by their subcontractor triggers the incentive payment to customers.

Current Program Challenges Identified by Program Staff

Interviews with program staff and the implementation contractor identified lower participation rates as the primary challenge for the Appliance Recycling Program in 2017. According to interviews with the implementation contractor, their goal was to recycle 2,000 units per month. While the program did experience an increase in requested pick-ups in June (after a TV commercial aired), as well as in the last quarter of 2017 (when the incentive was increased), the program only met this target in December of 2017 when 2,001 units were recycled.

The implementation contractor staff also reported that neighboring utilities often offer $50 to $75 for recycled appliances, and, as a result, the reduced incentive may have negatively affected requested pick-ups. To make the program more attractive to participants, the incentive was raised to $50 in the last three months of the program year. While this did cause an increase in appliance pick-ups, customer participation volume was overall lower than in previous years.

AEP Ohio indicated the annual goal collection goal was 15,955 units or roughly 1,330 units per month. Although this annual goal was not met, the monthly goal of 1,330 units was achieved in June, July, August, October, November, and December.

3.4 Cost-Effectiveness Review

This section addresses the cost-effectiveness of the Appliance Recycling Program. Cost-effectiveness is assessed using the Total Resource Cost (TRC) test.

Table 3-8 summarizes the unique inputs used in the TRC test. Based on these inputs, the TRC ratio is 3.5, as shown in Table 3-9. Therefore, the program passes the TRC test.

Table 3-8. Inputs to Cost-Effectiveness Model for Appliance Recycling Program

Item	Value
Average Measure Life	8
Units	13,608
Annual Energy Savings (kWh)	18,388,050
Coincident Peak Savings (kW)	2,940
Third-Party Implementation Costs	$931,530
Utility Administration Costs	$186,478
Utility Incentive Costs	$994,435
Participant Contribution to Incremental Measure Costs	$0

Table 3-9 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-9. Cost-effectiveness Results for the Appliance Recycling Program

Benefit- Cost Test Results – Appliance Recycling	Ratio
Total Resource Cost	3.2
Participant Cost Test	N/A
Ratepayer Impact Measure	0.4
Utility Cost Test	3.2

At this time, additional benefits related to reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions and Recommendations

The 2017 Appliance Recycling Program evaluation resulted in seven primary conclusions and four recommendations.

1. **The program surpassed the savings goals for 2017.** The program surpassed the energy savings goal of 11.8 GWh by 55 percent and the demand savings goal of 1.8 MW by 63 percent. This occurred under a new program implementer and despite a decreased incentive amount.

2. *Ex post* **savings were identical to the program** *ex ante* **values, resulting in realization rates of 1.00.** AEP Ohio appropriately calculated the Draft Ohio TRM annual energy (kWh) and summer peak demand (kW) impacts for the program.

3. **Program participation was reduced from previous years.** In program years 2014 and 2015, 17,734 and 14,641 appliances were collected, respectively (the program operated only part of the year in 2016, collecting 7,352 appliances). In 2017, when the program again operated for the full year, 13,608 appliances were collected. This year-over-year downward trend may be due in part to the incentive amount, which was reduced from $50 to $35 as of January 1, and may also be because marketing did not begin until April. Participation ramped up steadily over the first half of the year and then increased again toward the end of the year when the incentive was increased to $50. The volume during the second half of the year was fairly similar to the same period in previous years, with 9,771 appliances in the second half of 2014, 8,025 appliances in the second half of 2015, and 8,754 appliances in the second half of 2017).

   - **Recommendation 1: Begin marketing earlier in the year.** Marketing occurred later than normal this year, partly because of the selection of a new implementation contractor, which may have resulted in low participation rates at the beginning of the year. Once a marketing plan was in place and implemented, participation nearly doubled towards the second half of the year. To avoid these inconsistencies in program participation, the evaluation team recommends an adjusted marketing timeline that will ensure more consistent program participation throughout the next program year.

4. **Program participants were generally very satisfied with the program and with AEP Ohio.** Survey respondents rated their overall satisfaction with the program an average of 9.0 on a scale from 0 (Not at all satisfied) to 10 (Very satisfied). Program participants rated their average satisfaction with AEP Ohio as an electric company overall as an 8.6 on a 0-to-10 scale. When asked about specific program elements, participants ranked the following elements most highly: the collection team (9.5), their enrollment experience (9.2), and the type of the incentive received (9.0).

5. **Perceived delays in rebate payments resulted in lower satisfaction among some participants.** The 23 percent of participants who reported waiting four weeks or longer to receive a rebate, and the 5 percent of participants who believed they had not yet received their rebate at the time of the survey, reported lower levels of satisfaction. Although customers are informed that they should expect their incentive payment within 4 to 6 weeks, of those who reported they waited 4 weeks or longer for the rebate, 53 percent were very satisfied with the time it took to receive their incentive, compared with 87 percent satisfied when receiving the

rebate in less than 4 weeks. Participants who reported they had not yet received the rebate on average rated their satisfaction with the Appliance Recycling Program as a 5 on a 0-to-10 scale. All 10 participants who reported not receiving their rebate had initially been sent a digital gift card, and Recleim records showed 6 of customers' gift cards had been redeemed. It is unknown what exactly contributed to this misconception among customers, although it contributed to dissatisfaction nonetheless. According to AEP Ohio program staff, several changes will be implemented in 2018 to address this issue. These changes include: (1) calling the customer the day their incentive is sent to let them know their incentive has been processed, (2) asking the customer specifically for a personal email address, (3) tracking bounce-backs and ensuring a timely follow-up with the customer, and (4) changing the incentive email address to "@aephio.com" to clearly identify the incentive for customers.

- **Recommendation 2: Ensure customers receive their incentive in a timely manner.** The evaluation team recommends targeting rebate receipt within four weeks of pick-up, as satisfaction dropped after this time. While it is unclear why several digital gift card customers did not recall receiving the rebate, AEP Ohio should continue taking steps to correct this perception. For example, the program should make sure it is clearly communicated to customers whether they are choosing a digital gift card or a physical gift card, and ensure correct email addresses are obtained for customers who request a digital gift card. Additionally, AEP Ohio should consider notifying customers of the email address from which they will receive their gift card, and request customers add the email address to their accepted emails list to avoid gift cards being categorized as spam.

6. **While the cancellation rate was lower compared to previous years, participants who cancelled their pick-up appointment were unlikely to reschedule and participate in the program.** In 2017, the overall rate of cancellation (12%) was lower compared to 2014 (21%), the last year we conducted a cancellation data review of the Appliance Recycling Program. Of the 1,740 customers who cancelled an appointment with the Appliance Recycling Program in 2017, only 45 (3%) eventually participated in the program. This contrasts with 2014, when 44 percent of participants who cancelled at least once eventually participated in the program. Of those who cancelled in 2017, tracking data indicated 27 percent were unable to make the appointment, 8 percent gave their unit away, and 6 percent decided to keep their unit. It is unknown what happened to the appliances for those who could not make their appointment, but these cancellations are a lost opportunity for the program.

- **Recommendation 3: Monitor cancellation rates and take measures to quickly reschedule customers whenever possible.** While the rate of cancellation was overall lower than in 2014, the rate of customers who cancelled but eventually participated is much lower. The evaluation team recommends this circumstance be monitored during the 2018 program year.

7. **An increasing number of participants believe their picked-up appliance was not in good working order.** The program requires that appliances are in working condition (meaning the compressor must be functioning) in order to be picked up. In 2017, 11 percent of survey respondents stated their picked-up appliance "did not cool its contents effectively, but it did turn on," compared with 5 percent in 2014 and 8 percent in 2015. (There was no participant survey in 2016). The fact that this response has increased somewhat compared to previous years is notable. It is also worth noting no respondents reported "it did not turn on," suggesting customers believed their picked-up appliances were, at a minimum, functioning in some capacity.

- **Recommendation 4: Monitor the condition of picked-up appliances to ensure these meet program requirements.** While it is challenging to define a "working compressor" through a customer survey, a review of how this determination is made in the field would be beneficial to ensure all units meet program requirements. Specifically, if a compressor turns on, but does not effectively cool the contents of the appliance, the unit may not be in use and thus may not offer any real savings for the program. On the other hand, if these units are being used by customers, removing them through the program would result in savings.

APPENDIX A. DETAILED EVALUATION FINDINGS AND DATA COLLECTION INSTRUMENTS

Appendix A describes additional details of findings and data collection instruments used for the 2017 evaluation of the AEP Ohio Appliance Recycling Program. It includes:

- Participant Survey Results
- Participant Survey Instrument

A.1 Participant Survey Results

Program Enrollment Experience

Respondents were asked to indicate satisfaction with their enrollment experience, whether via (1) the AEP Ohio website, or (2) the enrollment call center. According to the program tracking data, more than one-third (37.5%) of program participants enrolled online and nearly two-thirds (62.5%) of participants enrolled through the call center. Most survey respondents reported enrolling online (58%), as shown in Table A-1. The remaining 42 percent of respondents enrolled over the phone. The discrepancy is very likely due to the survey sample design; the survey was only sent to participants with a valid email address, which was more likely included in the tracking data if the customer had enrolled online.

Table A-1. Program Enrollment Methods from Tracking Data and Survey

Enrollment Method	Tracking Data Frequency	Tracking Data Percent	Survey Frequency	Survey Percent
Online	5,096	37.5%	93	58.4%
Telephone	8,512	62.5%	66	41.5%
Total	**13,608**	**100.0%**	**159**	**100.0%**

Note: Results are not shown for respondents who reported another individual enrolled them in the program, responded "Don't know", or skipped the question.

Across methods, respondents were highly satisfied with their sign-up experience:

- The vast majority (93.2%) reported satisfaction scores of 8 or higher on a 0 (Not at all satisfied) to 10 (Very satisfied) scale.

- At least 90 percent of respondents from each sign-up channel reported satisfaction scores of 8 or higher with their specific sign-up experience.

- One participant who signed up online was dissatisfied, reporting a satisfaction score of less than 5, whereas no participants who signed up over the phone were dissatisfied.

Appliance Pick-up Process

Over three-quarters (78%) of respondents stated the time lapse between scheduling the pick-up appointment and actual appliance pick-up was two weeks or less. Ten percent of customers stated it

took 3 weeks or longer to have their appliance picked up. The frequencies of reported times between enrollment and pick-ups are shown in Table A-2.

Table A-2. Reported Time between Program Enrollment and Appliance Pick-up

Time	Frequency	Percent
1 week or less	50	35%
More than 1 week to 2 weeks	62	43%
More than 2 weeks to 3 weeks	17	12%
More than 3 weeks to 4 weeks	12	8%
More than 4 weeks to 5 weeks	1	1%
More than 5 weeks to 6 weeks	0	0%
More than 6 weeks to 7 weeks	0	0%
Longer than 7 weeks	1	1%
Total	**143**	**100%**

Note: Results are not shown for 50 respondents who responded "Don't know" or skipped the question. Totals may not sum to 100 percent due to rounding.

Respondents were asked about their experience with the time it took between when the pick-up was scheduled and when the appliance was picked up:

- Respondents overwhelmingly (80.7%) indicated being satisfied with this aspect of the program by rating their satisfaction as 8 or higher on a 0 to 10 scale.

- Few (4%) reported being dissatisfied by reporting a score of less than 5.

In addition, the vast majority of respondents (98%) indicated that they were able to schedule a convenient pick-up date and time.

As wait time for the appliance pick-up increased, satisfaction with this time decreased. Satisfaction with the time between scheduling and pick-up declined at around the three-week mark. Of those respondents who were dissatisfied with the time it took between scheduling and pick-up, most were frustrated by having to "find space" for their old appliance while waiting for pick-up. Examples follow:

- "I had to find space to keep the old refrigerator plugged in and out of the weather after getting the new refrigerator installed in the home."

- "[It was inconvenient to have] two refrigerators running at the same time since we had to be sure it was still in working order."

Respondents were also highly satisfied with the appliance collection team. The majority of respondents (94.1%) reported satisfaction scores with the team of an 8 or higher on a 0 (Not at all satisfied) to 10 (Very satisfied) scale.

Once a respondent's account is confirmed by AEP Ohio, a pick-up time is scheduled either online or by phone. Two days before their appointment, customers are sent a reminder via the channel they enrolled through.

- Seventy-four percent of respondents stated that they were notified of their pick-up by phone.

- Twenty-two percent stated that they received an email.

- Two respondents reported that they received notification of their pick-up appointment by text message.

Respondents also stated that the appliance pick-up team arrived within the scheduled appointment window (98%).

Payment Type

This year, program participants were offered the option to receive a digital gift card rather than the pre-loaded debit card or check.
- 61 percent of respondents received their payment via a mailed gift card.
- 21 percent received a check payment in the mail.
- 12 percent of respondents this year chose to receive their gift card by email.
- The remaining 6 percent reported not receiving a payment.

Most respondents (88.7%) reported satisfaction scores of an 8 or higher with the type of payment they received on a 0 (Not at all satisfied) to 10 (Very satisfied) scale. When broken out by payment type:
- The respondents who received their payment via a mailed gift card reported the highest satisfaction scores, with 96 percent reporting a score of an 8 or higher.
- 90 percent of respondents who received an email gift card reported a satisfaction score of an 8 or higher.
- 89 percent of those who received their gift card via a mailed check reported satisfaction scores of an 8 or higher.

Respondents who were dissatisfied with the type of payment they received (4.8%) provided several reasons. Examples are provided below.
- "I would have liked cash or a direct deposit that day."

- "It's a pain to remember to spend the gift card—and has to be exact or the card will not work."

Interactions with AEP Ohio Staff

Respondents were asked whether they had contacted AEP Ohio during their participation in the program: one-quarter of respondents (25%) reported contact with AEP Ohio. Of those respondents who contacted AEP Ohio during the program:

- 80 percent contacted them only one time.
- 16 percent contacted them two or three times.
- 4 percent contacted them four or more times.
The majority (85.7%) of those who contacted AEP Ohio did so by telephone.

Most (78%) who contacted AEP Ohio during the program rated their satisfaction with the communication as an 8 or higher on a 0-to-10 scale. Respondents who had not received their rebate and had contacted AEP Ohio (n=2) were less satisfied with the communication and offered the following explanations for their dissatisfaction:

- "I still have not received my program incentive."

- "I never received the email after pick-up regarding the incentive. I finally had to initiate a phone call. The incentive provider never answered the phone and never responded to requests initiated on their website…I finally had to demand the incentive directly from AEP Ohio (took multiple phone calls to resolve)."

Perceived Energy Savings

Slightly more than half (58%) of those who responded reported noticing energy savings on their bill. Compared to those who recycled refrigerators (57%), a greater percentage of those who recycled freezers (61.5%) noticed energy savings.

- The majority of the respondents who noticed energy savings were satisfied with the amount of energy savings they saw in their utility bills (79.8%).
- Nine respondents (5%) reported dissatisfaction with the amount of energy savings they noticed.

In terms of their satisfaction with energy savings, there was no difference between those who recycled a freezer and those who recycled a refrigerator.

A.2 Participant Survey Instrument

Section A: Introduction and Screener

INTRO: Thank you for taking the time to participate in this survey for the AEP Ohio Appliance Recycling Program. AEP Ohio appreciates your input, and will use the information you provide to improve the program.

This survey should take approximately 15 minutes to complete. Your responses will be kept confidential and will only be reported anonymously.

Once you begin this survey, you can navigate forwards and backwards using the buttons at the bottom of the screen.

[DISPLAY IF COUNT > 1]
A0a.   Our records indicate that you recycled more than one **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]** through the Appliance recycling program in 2017. Please focus on the **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]** that you most recently recycled.

A0b.   Does AEP Ohio provide electric service to your home?
   1.   Yes
   2.   No

A1.   Our records show that you had a **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]** picked up for recycling in 2017 at **<ADDRESS>**. Is this correct?
   1.   Yes
   2.   No
   98.   Unsure

[ASK IF A1 = 2 or A1 = 98]
A1a.   Just to clarify, your appliance should have been picked up by AEP Ohio's subcontractor Recleim. Do you recall having your appliance picked up by this organization?
   1.   Yes

2. No **[TERMINATE]**
98. Unsure **[TERMINATE]**

A2. Was the **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]** picked up at your primary residence?
1. Yes
2. No
98. Unsure

[ASK IF A2 = 2]
A2a. Where was the **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]** removed from?
1. My business
2. My rental property
3. My vacation home
4. My home
0. Other, please specify: **[OPEN END]**

[ASK IF STRATA = 1]
A3. A primary refrigerator is the one used most frequently by the household, and is typically located in the kitchen.

Was the recycled appliance the primary refrigerator in your home during the 12 months before pick-up?
1. Yes
2. No, it was secondary to a different primary refrigerator
98. Unsure

A4. What was the condition of the **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]**?
1. It effectively cooled its contents and was in good physical condition
2. It effectively cooled its contents but needed minor repairs like a door seal or handle
3. It partially cooled its contents but had some bigger problems
4. It did not cool its contents effectively, but it did turn on
5. It did not turn on
98. Unsure

[ASK IF STRATA = 1]
A5. Where was the refrigerator located before it was removed? If you moved the refrigerator while waiting to have it picked up, we are interested in where it was located **before** you moved it.
1. Kitchen
2. Garage
3. Porch/Patio
4. Basement
0. Other, please specify: **[OPEN-END]**
98. Unsure

A6. How old was the **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]** that you recycled through the Appliance Recycling program?
1. Less than 10 years old
2. 10 to 15 years old
3. 15 to 20 years old
4. 20 to 24 years old
5. 25 years or older
98. Unsure

A7. The ENERGY STAR® label helps consumers identify and purchase energy-efficient products. An example of the label is below.

Was the **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]** that you recycled with AEP Ohio in 2017 an ENERGY STAR® labeled appliance?
1. Yes
2. No
98. Unsure

Section B: Process Questions

The following questions ask about your experience with the AEP Ohio Appliance Recycling Program.

B1. How did you <u>first</u> learn about the Appliance Recycling Program? **[RANDOMIZE, ANCHOR 0,98 LAST, SINGLE RESPONSE ONLY]**
1. Utility bill insert
2. TV ad
3. Friend/relative/neighbor
4. AEP Ohio website
5. Newspaper
6. Community event
7. AEP Ohio email
8. Appliance retailer
9. Social media
10. Web advertisement/search
11. Other AEP Ohio program
12. Radio ad
0. Other, please specify: **[OPEN-END]**
98. Unsure

[ASK IF B1 = 11]
B1a. Through which AEP Ohio program did you first learn about the Appliance Recycling Program? **[RANDOMIZE, ANCHOR 13,0,98 LAST, SINGLE RESPONSE ONLY]**
1. Efficient lighting discounts **[ROLLOVER TEXT: You can get instant, in-store discounts when you buy ENERGY STAR certified LEDs at participating retailers or through our online store.]**
2. Appliance rebates **[ROLLOVER TEXT: These are cash rebates offered by AEP Ohio for the purchase of qualifying ENERGY STAR Appliances.]**
4. Community Energy Savers **[ROLLOVER TEXT: The Community Energy Savers Program creates partnerships between communities and AEP Ohio that bring the benefits of energy efficiency to residents, businesses and the community itself by encouraging participation in AEP Ohio energy saving programs. Partner communities are eligible for incentives as AEP Ohio and the community work together to expand energy efficiency programs to homes and businesses that qualify.]**
5. Multifamily program **[ROLLOVER TEXT: AEP Ohio offers free, energy saving products to multifamily buildings**

with individually-metered residential properties with five or more units. AEP Ohio handles the installation at no cost to the property manager or resident.]

6. Community Assistance program **[ROLLOVER TEXT: Customers enrolled in an AEP Ohio payment assistance plan can receive free energy efficiency and repair services for their home.]**

7. EfficiencyCrafted New Homes **[ROLLOVER TEXT: If you are interested in building a new home, a participating builder works with you to build an ENERGY STAR® New Home, which can help you reduce your energy usage by as much as 35%.]**

10. e3smart education programs for kids **[ROLLOVER TEXT: For this program, AEP Ohio provides energy efficiency education curriculum to schools in the AEP Ohio service area for children in grades 5 through 12. The e3smart curriculum as developed by the Ohio Energy Project meets Ohio and National Science Standards and was recognized as an Outstanding Energy Education Project by the Ohio EPA in 2008.]**

11. Agriculture program **[ROLLOVER TEXT: AEP Ohio offers qualifying agriculture customers incentives on energy consuming equipment including lighting, ventilation, motors, fans, and equipment unique to the agricultural industry.]**

12. Home Energy Report **[ROLLOVER TEXT: AEP Ohio offers provide select electric customers a report comparing electricity use with similar homes and the customers own energy use to the same period in previous years. The report also provides simple actions the participant can take to reduce electricity usage and estimates savings the customer may see on the electricity bill if a specific action is taken.]**

13. Commercial business programs, please specify: **[OPEN END]**

0. Other, please specify: **[OPEN END]**

98. Unsure

B2. Through which other sources have you heard about AEP Ohio's Appliance Recycling program? Please select all that apply. **[DO NOT SHOW ANSWER SELECTED IN B1 AS RESPONSE OPTION, MULTIPLE RESPONSES ALLOWED, RANDOMIZE, ANCHOR 0,97 LAST]**
1. Utility bill insert
2. TV ad
3. Friend/relative/neighbor
4. AEP Ohio website
5. Newspaper
6. Community event
7. AEP Ohio email
8. Appliance retailer
9. Social media
10. Web advertisement/search
11. Other AEP Ohio program
12. Radio ad
0. Other, please specify: **[OPEN-END]**
97. None **[EXCLUSIVE]**

[ASK IF B2 = 11]
B2a. Through which AEP Ohio program did you learn about the Appliance Recycling Program? **[RANDOMIZE, ANCHOR 13,0,98 LAST, SINGLE RESPONSE ONLY, DO NOT SHOW B1a RESPONSE OPTION]**
1. Efficient lighting discounts **[ROLLOVER TEXT: You can get instant, in-store discounts when you buy ENERGY STAR certified LEDs at participating retailers or through our online store.]**
2. Appliance rebates **[ROLLOVER TEXT: These are cash rebates offered by AEP Ohio for the purchase of qualifying ENERGY STAR Appliances.]**
4. Community Energy Savers **[ROLLOVER TEXT: The Community Energy Savers Program creates partnerships between communities and AEP Ohio that bring the benefits of energy efficiency to residents, businesses and the community itself by encouraging participation in AEP Ohio energy saving programs. Partner**

communities are eligible for incentives as AEP Ohio and the community work together to expand energy efficiency programs to homes and businesses that qualify.]

5. Multifamily program **[ROLLOVER TEXT: AEP Ohio offers free, energy saving products to multifamily buildings with individually-metered residential properties with five or more units. AEP Ohio handles the installation at no cost to the property manager or resident.]**

6. Community Assistance program **[ROLLOVER TEXT: Customers enrolled in an AEP Ohio payment assistance plan can receive free energy efficiency and repair services for their home.]**

7. EfficiencyCrafted New Homes **[ROLLOVER TEXT: If you are interested in building a new home, a participating builder works with you to build an ENERGY STAR® New Home, which can help you reduce your energy usage by as much as 35%.]**

10. e3smart education programs for kids **[ROLLOVER TEXT: For this program, AEP Ohio provides energy efficiency education curriculum to schools in the AEP Ohio service area for children in grades 5 through 12. The e3smart curriculum as developed by the Ohio Energy Project meets Ohio and National Science Standards and was recognized as an Outstanding Energy Education Project by the Ohio EPA in 2008.]**

11. Agriculture program **[ROLLOVER TEXT: AEP Ohio offers qualifying agriculture customers incentives on energy consuming equipment including lighting, ventilation, motors, fans, and equipment unique to the agricultural industry.]**

12. Home Energy Report **[ROLLOVER TEXT: AEP Ohio offers provide select electric customers a report comparing electricity use with similar homes and the customers own energy use to the same period in previous years. The report also provides simple actions the participant can take to reduce electricity usage and estimates savings the customer may see on the electricity bill if a specific action is taken.]**

13. Commercial business programs, please specify: **[OPEN END]**

0. Other, please specify: **[OPEN END]**

98. Unsure

[ASK IF B1=8 OR B2=8]

B2b. From which retail stores did you learn about the Appliance Recycling Program? Please select all that apply. **[MULTIPLE RESPONSES ALLOWED]**
1. Sears
2. ABC Warehouse
0. Other, please specify: **[OPEN-END]**

B3. There are a number of ways you could have disposed of your appliance. Why did you choose the AEP Ohio Appliance Recycling Program instead of some other way? Please select all that apply. **[MULTIPLE RESPONSES ALLOWED; RANDOMIZE, ANCHOR 0,98 LAST]**
1. The cash incentive
2. The convenience of the home pick-up
3. Pick up was free
4. Appliance was recycled in a way that was good for environment
5. Was recommended by friend or family
6. Did not know of any other way
0. Other, please specify: **[OPEN-END]**
98. Unsure **[EXCLUSIVE]**

[SHOW IF MORE THAN ONE ITEM SELECTED IN B3]

B4. What was the most important reason you chose to dispose of your appliance through the AEP Ohio Appliance Recycling Program? **[RANDOMIZE, ANCHOR 0,98 LAST; SHOW ONLY RESPONSES SELECTED IN B3]**

B5. For participating in the program, you received an incentive either as a physical check in the mail from AEP Ohio, a physical gift card in the mail, or an electronic gift card by email. How did you receive your incentive?
1. Gift card by mail
2. Gift card by email
3. Check by mail
4. Have not received my incentive payment yet
98. Unsure

B6. How influential was the incentive in motivating you to participate in the Appliance Recycling program? **[SCALE RESPONSE, WHERE 0 = "Not at all influential" AND 10 = "Very influential"]**

B7. Are you the one that signed up for the appliance pick-up, or did someone else in your household sign up?
1. I signed up
2. Someone else signed up
98. Unsure

[ASK IF B7= 1, ELSE SKIP TO E6]
B8. Did you sign up by phone or online?
1. Phone
2. Online
98. Unsure

Section C: Online Sign-up Battery

[ASK IF B8=2, ELSE SKIP TO D1]
C1. How satisfied were you with the online appliance recycling scheduling website? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF C1 < 5]
C1a. Why did you rate it that way? **[OPEN-END]**

C2. Did AEP Ohio's website answer all your questions about the program?
1. Yes
2. No
3. Not applicable
98. Unsure

[ASK IF C2=2]
C3. What questions did you have that were unanswered? **[OPEN-END]**

Section D: Phone Sign-up Battery

[ASK IF B8=1, ELSE SKIP TO E1]
D1. How satisfied were you with the interactions you had with the phone representative who helped you schedule an appliance pick-up? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF D1 < 5]

D1a.   Why did you rate it that way? **[OPEN-END]**

D2.   Did the representative answer all your questions about the program?
   1.   Yes
   2.   No
   6.   Not applicable
   98.   Unsure

[ASK IF D2=2]
D3.   What questions did you have that were unanswered? **[OPEN-END]**

Section E: Participant Satisfaction

E1.   How satisfied were you with the sign-up experience? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF E1 < 5]
E2.   Why did you rate it that way? **[OPEN-END]**

[ASK IF B7 = 1, ELSE SKIP TO E6]
E3.   Were you able to schedule a pick-up date and time that was convenient for you?
   1.   Yes
   2.   No
   98.   Unsure

E4.   How much time passed between when you scheduled the appointment and when your appliance was picked up?
   1.   1 week or less
   2.   More than 1 week to 2 weeks
   3.   More than 2 weeks to 3 weeks
   4.   More than 3 weeks to 4 weeks
   5.   More than 4 weeks to 5 weeks
   6.   More than 5 weeks to 6 weeks
   7.   More than 6 weeks to 7 weeks
   8.   Longer than 7 weeks
   98.   Unsure

E5.   How satisfied were you with the time it took between when you scheduled the appliance pick-up and when it was actually picked up? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF E5 < 5]
E5b.   Why did you rate it that way? **[OPEN-END]**

E6. Did you receive a notice in advance to confirm the appliance pick-up appointment or to let you know the collection team was coming?
1. Yes
2. No
6. Not applicable
98. Unsure

[ASK IF E6=1]
E6a. How were you notified?
1. Phone call
2. Email
0. Other, please specify: **[OPEN END]**

E6b. Were you present when the collection team picked up your recycled appliance?
1. Yes
2. No
98. Unsure

[ASK IF E6b = 1, ELSE SKIP TO E10]
E7. Did the collection team arrive during the scheduled appointment window?
1. Yes
2. No
6. Not applicable
98. Unsure

E8. How satisfied were you with the collection team who picked up your appliance? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF E8 < 5]
E9. Why did you rate it that way? **[OPEN-END]**

[ASK IF B5 =1,2,3]
E10. From the time you had your appliance picked up; about how many weeks did it take to receive your incentive?
1. Less than 4 weeks
2. 4 weeks
3. 5 weeks
4. 6 weeks
5. Longer than 6 weeks
98. Unsure

[ASK IF E10 = 5]
E11. How long have you been waiting to receive your incentive? **[OPEN-END]**

[ASK IF E10 < 98]
E12. How satisfied were you with how long it took to receive the incentive? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF E12 < 5]
E13.   How many weeks from the time you had your appliance picked up would be reasonable to
         receive the incentive?
         1.   Less than 1 week
         2.   1 week
         3.   2 weeks
         4.   3 weeks
         5.   **[SHOW IF E10 > 1]** 4 weeks
         6.   **[SHOW IF E10 > 2]** 5 weeks
         7.   **[SHOW IF E10 > 3]** 6 weeks
         8.   Other, please specify: **[OPEN-END]**
         98.   Unsure

[ASK IF E12 < 5]
E13a. Before taking this survey, were you aware that AEP Ohio typically mails out incentives between
         four and six weeks after an appliance has been recycled?
         1.   Yes
         2.   No

**[CALCULATE INCENT_TYPE = "gift card by mail" IF B5=1, INCENT_TYPE = "gift card by email" IF
B5=2, OR INCENT_TYPE = "check by mail" IF B5=3]**

[ASK IF B5 =1,2,3]
E14.   You stated that you received your AEP Ohio Appliance Recycling incentive as a
         <INCENT_TYPE>. How satisfied are you with the type of incentive you received? **[SCALE
         RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF E14 < 5]
E15.   Why did you rate it that way? **[OPEN-END]**

E16.   In the course of participating in the AEP Ohio program, how often did you contact AEP Ohio or
         program staff with questions or issues? This **does not include** the initial scheduling call or a call
         to reschedule your appliance pick-up appointment.
         1.   Never
         2.   Once
         3.   2 or 3 times
         4.   4 times or more
         98.   Unsure

[ASK IF E16=2,3,4]
E16a. How did you contact them? Please select all that apply. **[MULTIPLE RESPONSES ALLOWED,
         RANDOMIZE, ANCHOR 98 LAST]**
         1.   Phone
         2.   Email
         3.   Fax
         4.   Letter
         5.   In person
         98.   Unsure **[EXCLUSIVE]**

E16b. How satisfied are you with your communications with AEP Ohio and program staff? **[SCALE
         RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF E16b < 5]
E16c. Why did you rate it that way? **[OPEN-END]**

[ASK IF B5 =1,2,3]
E17. How satisfied were you with the incentive amount? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

E18. Have you noticed reduced energy usage on your electric bill since removing your old **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]?**
   1. Yes
   2. No
   98. Unsure

[ASK IF E18 = 1]
E19. How satisfied are you with the reduced energy usage you noticed on your electric bill since removing your old **[IF STRATA = 1: refrigerator / IF STRATA = 2: freezer]**? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

E20. Overall, how satisfied were you with the AEP Ohio Appliance Recycling Program? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

E21. Why did you give it that rating? **[OPEN-END]**

E22. Do you have any suggestions to improve the program? **[OPEN-END]**

E23. Would you say participating in this program has made you feel more favorable, less favorable, or no different about AEP Ohio?
   1. More favorable about AEP Ohio
   2. Less favorable about AEP Ohio
   3. No different about AEP Ohio
   98. Unsure

JDP5. Thinking about all aspects of your experience with AEP Ohio, how would you rate your satisfaction with AEP Ohio as an electric company overall? **[SCALE RESPONSE, WHERE 0 = "Not at all satisfied" AND 10 = "Very satisfied"]**

[ASK IF JDP5 < 8]
JDP5b. Why did you rate it that way? **[OPEN-END; 98=Unsure]**

Section G: Demographics

[ALLOW PARTICIPANT SKIP WITHOUT VALID RESPONSE FOR ALL QUESTIONS IN DEMOGRAPHIC BATTERY]

G1. Which of the following best describes your home/residence? **[RANDOMIZE, ANCHOR 0 LAST]**
   1. Single-family home, detached construction (not a duplex, townhome, or apartment; attached garage is ok)
   2. Factory manufactured/modular (Single family home)
   3. Mobile home (Single family)
   4. Row House
   5. Two or three-family attached residences
   6. Apartment (4 + families)
   7. Condominium
   0. Other, please specify: **[OPEN-END]**

G1b. Do you own or rent this residence?
1. Own
2. Rent

[ASK IF G1b=2]
G2. Do you pay your own electric bill or is it included in your rent?
1. Pay bill
2. Included in rent

G3. Approximately when was your residence constructed?
1. Before 1960
2. 1960-1969
3. 1970-1979
4. 1980-1989
5. 1990-1999
6. 2000-2005
7. 2006 or later
98. Unsure

G4. Approximately how many total square feet is your residence?
1. Less than 1,000 square feet
2. Between 1,001 and 2,000 square feet
3. Between 2,001 and 3,000 square feet
4. Between 3,001 and 4,000 square feet
5. Between 4,001 and 5,000 square feet
6. Greater than 5,000 square feet
0. Other, please specify: **[OPEN-END]**
98. Unsure

G5a. Would you estimate the <u>above-ground</u> living space is:
1. Less than 1,000 square feet
2. Between 1,001 and 2,000 square feet
3. Between 2,001 and 3,000 square feet
4. Between 3,001 and 4,000 square feet
5. Between 4,001 and 5,000 square feet
6. Greater than 5,000 square feet
0. Other, please specify: **[OPEN-END]**
98. Unsure

G5b. Would you estimate the <u>below-ground</u> living space is:
1. Less than 1,000 square feet
2. Between 1,001 and 2,000 square feet
3. Between 2,001 and 3,000 square feet
4. Between 3,001 and 4,000 square feet
5. Between 4,001 and 5,000 square feet
6. Greater than 5,000 square feet
0. Other, please specify: **[OPEN-END]**
98. Unsure

G6.   What is your yearly household income?
1.   Less than $15,000
2.   Between $15,001 and $30,000
3.   Between $30,001 and $50,000
4.   Between $50,001 and $75,000
5.   Between $75,001 and $100,000
6.   Greater than $100,000

Those are all of our questions. Thank you for your time and participation.

APPENDIX D

e³smart[SM] **Program**

2017 Evaluation Report

Prepared for:

AEP Ohio

April 11, 2018

Submitted by:
Navigant Consulting, Inc.
30 S. Wacker Drive
Suite 3100
Chicago, IL 60606

312.583.5700
navigant.com

NAVIGANT

Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

Randy Gunn
Managing Director
Navigant Consulting, Inc.
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director   Stu Slote, Director
312.583.5714   802.526.5113
randy.gunn@navigant.com   stu.slote@navigant.com

Prepared by:

Damon Clark, Senior Consultant
802.526.5115
damon.clark@navigant.com

Robbie Sanchez, Consultant
305.341.7865
robert.sanchez@navigant.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF EQUATIONS

EXECUTIVE SUMMARY

This report presents the results of an evaluation of AEP Ohio's *e³smart^{SM}* Program for the 2016-2017 school year. This section provides a high-level description of the program, key impact and process findings, and conclusions and recommendations stemming from the findings. Detailed methodology and findings are described in the body of the report.

ES.1 Program Summary

The primary goal of the *e³smart^{SM}* Program is to educate teachers, students, and the community about steps to take that lead to greater energy efficiency. The program intends to influence students (grades 4–12) about energy efficient choices early on so they will be more cognizant of and receptive to energy efficiency choices throughout their lives. Additionally, students pass on the *e³smart^{SM}* education to their families' increasing the energy efficiency knowledge of the community.

The program achieves energy savings from the measures included in energy efficiency kits provided free of charge through the program. The kits include low-cost energy efficiency measures for students to install in their homes. Students bring the kits home and with the help of a parent or guardian, install the measures appropriate for their household. Each student is asked to complete a survey reporting the measures installed and replaced. AEP Ohio contracts Ohio Energy Project (OEP) to implement the *e³smart^{SM}* Program.

The program provides a curriculum for teachers with six different lesson plans: 1) Introduction to Energy, 2) Insulation, Heating, and Cooling, 3) Water Heating, 4) Lighting, 5) Appliances and Machines, and 6) Summary of the Material. The lessons teach the fundamentals of energy and energy efficiency, as well as instruct students on how to properly install the measures included in the kit. The implementation contractor examines the lesson plans annually to meet State of Ohio teaching requirements. Additionally, the implementation contractor trains teachers at a 1-day professional development workshop where teachers are taught the key points of the different lessons and how to incorporate the lessons into their curriculum.

The 2016-2017 school year kits contained the following energy efficiency measures:

1. One 11-Watt light emitting diode (LED)
2. Two 9-Watt LED
3. LED nightlight
4. Kitchen faucet aerator (1.5 GPM)
5. Bathroom faucet aerator (1.0 GPM)
6. Earth Massage showerhead (1.25 GPM)
7. Closed cell foam weather strip (17" roll)
8. Hot water temperature gauge card
9. Small roll of Teflon tape
10. Flow meter bag
11. Refrigerator/freezer thermometer
12. Marketing materials for AEP Ohio's other energy efficiency/peak demand reduction programs

ES.2 Key Impact Evaluation Findings and Recommendations

During the 2016–2017 school year, 364 teachers from 247 different schools participated in the program, with energy efficiency kits distributed to 25,000 students.

Table ES-1-1 shows the 2016–2017 program goals, *ex ante* savings claimed by the program, *ex post* savings calculated by Navigant, and realization rates. The *ex post* energy and demand savings for the 2016–2017 school year were 3,295 MWh and 0.45 MW, respectively.

To estimate the *ex post* savings, the evaluation team independently applied the methods and assumptions outlined in the Draft 2010 State of Ohio Technical Reference Manual (Draft 2010 Ohio TRM). Several measures are not included in the Draft 2010 Ohio TRM. In these cases, the evaluation team applied the most appropriate engineering estimates. Due to differences in the number of anticipated installed LEDs in plan goal and the actual LEDs installed in the 2016-2017 school year, the program did not meet its energy savings goals. This program has shown consistent installation rates for several years the plan should use historical evidence to design a realistic number of installed measures.

AEP Ohio calculated the *ex ante* savings from the 19,648 submitted participant surveys. For the 5,352 participants who did not submit a survey, AEP Ohio applied half of the per kit *ex ante* savings. In contrast, for students not completing a survey, the evaluation team first calculated measure-specific installation rates from the completed participant surveys and then applied these rates to the total program population of 25,000 participants.

Table ES-1-1. 2016-2017 *e³smart^SM* Program Evaluation Results

	2017 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	6,773	2,973	3,295	111%	49%
Demand Savings (MW)	0.525	0.387	0.453	117%	86%

[1] VOLUME 1: 2017 TO 2019 ENERGY EFFICIENCY/PEAK DEMAND REDUCTION (EE/PDR) ACTION PLAN, June 15, 2016.

1. **Finding 1: Measure Installation Rate.** The evaluation team used survey results from 79 percent of the program population to calculate the measure installation rates, this sample size exceeds a measure level confidence and precision of 90/10. Previous year's analysis has shown very consistent installation rates lending to the validity of these installation rates. Previous evaluation of this program examined whether anything was different about the population that did not return their survey that would suggest different installation rates. It was determined that limited access to computer labs was the reason the majority of the surveys were not returned. Limited access to computers should not influence measure installation rates.

   - **Impact Recommendation 1:** Apply the installation rates gathered from the online surveys to the entire population of students receiving a kit to estimate ex post savings. Continue to examine if the installation rates for the population that do not return their survey differs from the population that does return the survey.

ES.3 Key Process Evaluation Findings and Recommendations

The process evaluation objectives were to develop an understanding of the final program design and implementation strategies, document program processes and tracking efforts, and identify and recommend potential program improvements. The data collection approach for the process evaluation included in-depth interviews with program implementers and teacher surveys.

1. **Finding 1: Stipend Level.** Three years ago, the program changed the stipend level for returning teachers whose class returned at least 75 percent of student installation surveys. The stipend was increased from $100 to $200.

   - **Process Recommendation 1:** If cost-effective, continue to provide the current stipend level as it is highly appreciated by teachers who are the key component to implementing this program.

2. **Finding 2:** The most common tip from teachers on how to successfully implement the teaching material was teachers should prioritize which lessons from the *e³smart^{SM}* teaching material fit into the educational standards they are required to teach and use those lessons first. Teachers made this recommendation because the limited amount of classroom time often does not allow teachers to use all the lesson plans.

   - **Process Recommendation 2:** Instruct teachers to prioritize the selection of lesson plans based on the required standards of their classroom. OEP could give this advice during the instructional period before the school year for new teachers and in annual teacher updates for returning teachers.

3. **Finding 3: Additional lab materials for the labs the teacher uses.** Teachers indicated additional lab materials would be useful. The additional lab materials teachers request is based on the lessons they administer.

   - **Process Recommendation 3:** If administratively and financially possible, provide additional material to teachers when requested. Providing additional materials will make the lessons more effective and likely improve teacher and student satisfaction.

4. **Finding 4: Technology question format.** The teacher survey question asking "What technology do you currently use or would you like to use with the energy efficiency lessons? (i.e. Google Docs, Smartboard, Kahoot, etc.)" This question is asked as an open-ended question.

   - **Process Recommendation 4a:** This question would be more effective if the different technologies were listed as multiple-choice options with multiple technology selections possible. This would allow OEP to identify which technologies are most popular so they can target their material to those technologies.

   - **Process Recommendation 4b:** It would also be useful to have an open-ended question option at the end of the multiple-choice question or have an additional question that asks for different technology suggestions. This additional question would allow OEP to identify if there are additional technological opportunities to consider including in the program.

1. PROGRAM DESCRIPTION

This section provides an overview of the AEP Ohio *e³smart^{SM}* Program, beginning with a brief description of the program, followed by a summary of various aspects of the implementation strategy.

1.1. Program Overview and Description

The *e³smart^{SM}* Program has multiple goals. One goal is to educate teachers, students, and the community about steps to take that lead to greater awareness and an appreciation of energy efficiency. Another goal is to determine the energy and demand savings impacts of the energy efficiency kits students install in their homes.

The *e³smart^{SM}* Program is designed to teach fourth through twelfth-grade students and their families the benefits of energy efficiency. Kits containing energy efficiency measures are provided to students to install in their homes. AEP Ohio contracts with the Ohio Energy Project (OEP) to administer the program.

The program provides a curriculum for teachers that focuses on energy sources, how energy is transformed, and energy uses. These lessons were created to teach the fundamentals of energy and energy efficiency, as well as to instruct students on how to properly install the measures included in the kit. The program examines the lesson plans annually to meet the State of Ohio teaching requirements in addition to training teachers at a 1-day professional development workshop. The program creates a detailed curriculum divided into six lesson plans. Each lesson has a classroom and an at-home component.

Teachers are provided with a stipend once students return the student installation surveys. The amount of the stipend is based on the percentage of returned participant surveys. As a further incentive to returning the surveys, teachers who have 90 percent of their surveys returned are entered into a drawing for a Fitbit. Teachers also receive continuing education credits for the professional development training session and a reduced rate for graduate credits at Ashland University.

Each student takes an energy efficiency kit home, and with the help of a parent or guardian, installs the measures appropriate for their home. Each student is instructed to complete an online survey reporting the measures installed and replaced. If completing the survey online is not possible, a paper option is available.

Each energy efficiency kit contains a combination of the following measures:

1. One 11-Watt light emitting diode (LED)
2. Two 9-Watt LED
3. LED nightlight
4. Kitchen faucet aerator (1.5 GPM)
5. Bathroom faucet aerator (1.0 GPM)
6. Earth Massage showerhead (1.25 GPM)
7. Closed cell foam weather strip (17" roll)
8. Hot water temperature gauge card
9. Small roll of Teflon tape
10. Flow meter bag
11. Refrigerator/freezer thermometer
12. Marketing materials for AEP Ohio's other energy efficiency/peak demand reduction programs

1.2.   Evaluation Objectives

Evaluation objectives are to: (1) report energy and peak demand savings estimates based on the measures installed, (2) assess process performance, satisfaction, program operational conditions, and ways to improve the program, and (3) determine program cost-effectiveness. The evaluation seeks to answer the following key research questions.

Impact Questions

1. What are the annual level of energy (MWh) and peak demand (MW) savings induced by the program?

2. What are the program measure realization rates?

3. What are reasonable saving estimates for each of the energy efficiency kit measures?

4. What are the benefits, costs, and cost-effectiveness of the program?

Process Questions

Program Characteristics and Barriers

5. Is the program meeting its participation goals?

6. Are teachers incorporating the program into their lesson plans?

Administration and Delivery

7. Is the program administration functioning as expected?

8. Are there any problems with implementing the program?

9. Are program tracking systems adequate? Do they contain all data required to support program tracking and evaluation?

2. EVALUATION METHODS

This section describes the analytic methods and data collection activities implemented as part of the evaluation of the *e³smart^{SM}* Program, including the data sources and sample designs used as the foundation for the data collection activities and analysis.

2.1 Overview of Approach

To meet the objectives of this evaluation, Navigant undertook the following activities:

1. **Development of Evaluation Questions.** Key evaluation questions were established during the development of the 2016–2017 evaluation plan with AEP Ohio staff and from a review of the key outcomes of the 2015–2016 program evaluation.

2. **Tracking Data Review.** Navigant reviewed the program tracking data collected by OEP in response to the participant online survey conducted by the program.

3. **Primary Data Collection.** Three primary data collection efforts were conducted in support of this evaluation: 1) in-depth interviews with program staff, 2) participant online surveys, and 3) teacher questionnaires.

4. **Methods Used to Analyze Impact Data.** Navigant reviewed measure saving algorithms and tracking system data to verify measure eligibility and the correct application of energy and demand savings algorithms.

5. **Methods Used to Analyze Process Data.** Navigant assessed the effectiveness of the program processes by analyzing program tracking data, in-depth interview data, and participant survey data.

Table 2-1 summarizes data collection activities, along with the details regarding the sampling and timing.

Table 2-1. Summary of Data Collection Activities

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis (Participant Online Survey)	All Program Participants	Tracking Database	-	19,648	September 2017
In-Depth Telephone Interview	Implementation Contractor	Contact from Implementation Contractor	Program Implementer	1	January 2018

2.2 Tracking System Review

Navigant conducted a review of program data in the AEP Ohio *e³smart^{SM}* audit tracking system to assess its accuracy and effectiveness for use in recording, tracking and reporting the processes and impacts of the program. The evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

2.3 Engineering Algorithm Review

Navigant conducted a review of measure savings algorithms and underlying assumptions for each measure compared to the Draft 2010 Ohio TRM algorithms. Navigant also calculated energy and demand savings for each measure in the tracking database to ensure algorithms were applied correctly.

2.4 *Ex Post* Savings Evaluation Methods

Program savings were assessed using the program tracking data and the Draft 2010 Ohio TRM. Navigant conducted a review of measure savings recorded in the tracking system to verify the algorithms matched the Draft 2010 Ohio TRM (TRM) and were correctly applied for each project. The evaluation team independently calculated energy savings for each measure in the database using the *ex ante* calculation methods based on the TRM. For measures not included in the TRM, the evaluation team used the most appropriate calculation methods from secondary sources (i.e., other TRMs). *Ex post* savings estimates then were used to calculate adjusted energy and demand savings for each measure.

2.5 Program Material Review

Navigant reviewed all program materials provided to date by AEP Ohio and OEP including:

- Program tracking data
- Program impact algorithms and assumptions
- Program lesson plans and teacher instructions
- Program implementation plans

3. PROGRAM LEVEL RESULTS

This section presents the AEP Ohio *e³smart*^{SM} Program impact and process evaluation results.

3.1 Impact Evaluation Results

25,000 energy efficiency kits were distributed to participants during the 2016–2017 school year through 364 teachers participating from 247 schools. Of those kits distributed, 19,648 kit recipients returned information regarding the energy efficiency measures they installed.

3.1.1 Program Impact Results

AEP Ohio and the evaluation team estimated savings based on the participant online survey. Table 3-1 and Table 3-2 present the program savings estimates. The *ex post* savings estimates for the *e³smart*^{SM} Program were developed by the evaluation team using the installation rates gathered from the student survey. These values were then applied to all kits distributed during the 2016-2017 school year. In contrast, AEP Ohio applies 50 percent of the savings, determined by the tracking data, to the remaining kits without a returned survey.

Table 3-1. Energy Savings Estimates

Measure	*Ex Ante* Number of Installed Measures (a)	*Ex Post* Number of Installed Measures (b)	*Ex Ante* kWh Savings per Measure (c)	*Ex Post* kWh Savings per Measure (d)	*Total Ex Ante* kWh (e) = (a) * (c)	*Total Ex Post* kWh (f) = (b) * (d)
11 W LED (1 Bulb)[1]	10,049	12,786	32.82	32.82	329,773	419,601
9 W LED (2 Bulb)[2]	21,400	27,465	30.48	30.48	652,235	837,073
Kitchen Aerators (1.5 GPM)	2,990	3,804	54.87	55.25	164,065	210,188
Bathroom Aerators (1.0 GPM)	3,037	3,864	94.06	94.71	285,675	365,987
LED Nightlight	6,165	7,844	20.59	20.59	126,937	161,514
Lower Water Heater Temperature	688	875	81.60	81.56	56,141	71,398
Earth Massage Showerhead	3,739	4,757	237.01	237.01	886,180	1,127,571
Weather Stripping	7,168	9,121	11.1	11.1	79,565	101,238
Outboard Non-Response Adjustment[3]	5,352	N/A	73.28	N/A	392,195	N/A
Total	-	-	-	-	**2,972,766**	**3,294,571**

[1] The savings per measure for 11 W LEDs is a weighted average of the reported replaced wattage bulbs.
[2] The savings per measure for 9 W LEDs is a weighted average of the reported replaced wattage bulbs.
[3] AEP Ohio applied 50 percent of per-kit savings from the tracking data to kits without returned surveys.
* Note: The numbers in this table are the actual numbers from the evaluation analysis. Totals may not sum due to rounding.
 Source: 2017 *AEP Ohio tracking data and 2016-2017 participant survey.*

Table 3-2. Peak Demand Savings Estimates

Measure	Ex Ante Number of Installed Measures (a)	Ex Post Number of Installed Measures (b)	Ex Ante kW Savings per Measure (c)	Ex Post kW Savings per Measure (d)	Total Ex Ante kW (e) = (a) * (c)	Total Ex Post kW (f) = (b) * (d)
11 W LED (1 Bulb)[1]	10,049	12,786	0.0058	0.0058	58	74
9 W LED (2 Bulbs)[2]	21,400	27,465	0.0054	0.0054	115	147
Kitchen Aerators (1.5 GPM)	2,990	3,804	0.0068	0.0069	21	26
Bathroom Aerators (1.0 GPM)	3,037	3,864	0.0117	0.0117	36	46
LED Nightlight	6,165	7,844	0.0000	0.0000	0	0
Lower Water Heater Temperature	688	875	0.0090	0.0090	6	8
Earth Massage Showerhead	3,739	4,757	0.0303	0.0303	113	144
Weather Stripping[4]	4,121	5,244	0.0014	0.0014	6	7
Outboard Non-Response Adjustment[3]	5,352	N/A	0.0086	N/A	32	N/A
Total	-	-	-	-	**387**	**453**

[1] The savings per measure for 11 W LEDs is a weighted average of the reported replaced wattage bulbs.
[2] The savings per measure for 9 W LEDs is a weighted average of the reported replaced wattage bulbs.
[3] AEP Ohio applied 50% of per kit saving from the tracking data to kits without returned surveys.
[4] The number of installed measures differs from the kWh table due to kW savings only being allocated for respondents who reported having CAC or Air source heat pumps.
* Note: The numbers in this table are the actual numbers from the evaluation analysis.
Totals may not sum due to rounding.
Source: 2017 *AEP Ohio tracking data and 2016-2017 participant survey.*

3.1.2 Measure Installation Rates

The evaluation team calculated installation rates for each measure using data from the participant online surveys. The online survey was offered to every student who received a kit. Of the 25,000 kits distributed, 19,648 surveys were returned.

Table 3-3 presents the evaluation teams' *ex post* calculation of installed measures. The evaluation team applied the participant online survey installation rate to the total possible measures installed based on the number of kits distributed. The *e³smart^SM* Program is unique in that it gives away measures without the participant first asking to receive a particular measure.

The percentages reported in Table 3-3 represent the number of measures where surveys indicate the respondent installed the measure. The savings realization rates will differ from the reported installed rates depending on numerous factors: what wattage bulbs were replaced for LEDs, what type of water heater the respondent reported for aerators, showerhead, and water heater setback, if the respondent said they replaced an incandescent nightlight for the LED nightlight and the type of heating reported for weather stripping.

Table 3-3. *Ex Post* Number of Measures Installed: 2016–2017 School Year

Measure	2016-2017 school year	2015-2016 school year	2014-2015 school year	2013-2014 school year
11 W LED (1 Bulb)	51%	13 W CFL (1 bulb) 52%	13 W CFL (1 bulb) 50%	13 W CFL (2 bulbs) 46%
9 W LED (2 Bulbs)	57%	23 W CFLs (2 Bulbs) 55%	23 W CFLs (2 Bulbs) 57%	23 W CFLs (2 Bulbs) 59%
Kitchen Aerator (1.5 GPM)	33%	34%	33%	32%
Bathroom Aerator (1.0 GPM)	34%	35%	34%	33%
LED Nightlight	71%	72%	72%	68%
Lower Water Heater Temperature	9%	9%	8%	7%
Earth Massage Showerhead	41%	45%	43%	40%
Weather Stripping	36%	39%	39%	40%

Source: 2016-2017,2015-2016,2014-2015,2013-2014 parent/student surveys

3.1.3 Tracking System Review

Navigant conducted a review of the program data in the AEP Ohio *e³smart^{SM}* Program tracking system to verify its accuracy and effectiveness for use in recording, tracking and reporting the processes and impacts of the program. The program's tracking data extract contained separate databases for participant online surveys and teacher surveys. The participant survey dataset contained 19,648 records. The tracking system was well-organized and accurate. The evaluator did not address whether the tracking system is adequate for regulatory prudency reviews or corporate requirements.

3.1.4 Ex Post Savings Evaluation (Algorithm Review)

Navigant conducted a review of measure savings recorded in the tracking system to verify the algorithms matched the Draft 2010 Ohio TRM and were correctly applied for each measure. The evaluation team independently calculated energy savings for each measure in the database using the *ex ante* calculation methods based on the Draft 2010 Ohio TRM. Navigant's research of the algorithms and variables used to populate the algorithms confirms these are reasonable.

3.1.5 LEDs

Navigant used a combination of the Draft 2010 Ohio TRM-specified deemed values, program gathered values of delta watts, and installation rates from the team's evaluation to determine measure savings.

- For 11 Watt LEDs, the participant survey recorded 10,049 installed LEDs. Of those 10,049 installed LEDs, respondents reported the wattage for 8,859 of the replaced LEDs. There were 1,190 respondents who did not report the wattage of the replaced light bulb.

- For 9 Watt LEDs, the participants reported 21,400 installed LEDs. 12,831 participants reported the wattage of the replaced lightbulb. There were 2,236 respondents who did not report the wattage of the replaced light bulb.

The difference in the *ex ante* and *ex post* LED counts are due to the evaluation team applying the participant survey installation rate to the entire program participant population.

Equation 3-1, and Equation 3-2 present the equations used to calculate the LED savings. If the replaced bulb wattage was not reported it was assumed a 43-Watt Halogen bulb was the replaced bulb. The in-service rates are already applied to the measure count. Table 3-4 lists the key parameters used in the equations.

AEP Ohio conducted a Lighting Metering Study to determine residential lighting interactive effects factors (IEFs) for the AEP Ohio service territory population. The objective of this modeling effort was to develop IEFs for summer peak demand and annual energy.

An IEF is often applied to efficient lighting savings calculations to account for interactions between the efficient lighting and other energy-using equipment. The IEF is equivalent to the ratio of the total building savings to the lighting savings due to the efficient lighting. The most significant interactions occur between lighting and HVAC systems. Efficient lighting typically requires heating systems to use more energy, thereby reducing savings; the reverse effect typically occurs for cooling systems. Further details can be found in the 2016 E3Smart program evaluation Appendix B.

Equation 3-1. AEP Ohio Residential Lighting Metering Study- Energy Savings – LEDs

$$Annual\ kWh\ Savings = (W_b - LED\ Watts) / 1000 * HOURs * IEF_e$$

Equation 3-2. AEP Ohio Residential Lighting Metering Study- Demand Savings – LEDs

$$Summer\ Coincident\ Peak\ kW\ Savings = ((W_b - LED\ Watts)/1000) * IEF_d * CF$$

Table 3-4. Key Parameters – LEDs

Parameter Description	Parameter	Value	Source
Average Hours of Use per Year	HOURs	1051	AEP Ohio 2016 Residential Lighting Metering Study
Waste Heat Factor for Energy	IEF_e	0.93	AEP Ohio 2016 Residential Lighting Metering Study
Waste Heat Factor for Demand	IEF_d	1.34	AEP Ohio 2016 Residential Lighting Metering Study
Summer Peak Coincidence Factor	CF	0.13	AEP Ohio 2016 Residential Lighting Metering Study
Baseline Watts	W_b	Varies by size	Draft 2010 Ohio TRM
Installation Rate 11 W LEDs	IR	51%	2016-2017 Participant Survey
Installation Rate 9 W LEDs	IR	57%	2016-2017 Participant Survey

Table 3-5. Algorithm Review Findings

Measure Type	Ex Ante per-unit kWh Savings (a)	Ex Ante per-unit kW Savings (b)	Ex Post per-unit kWh Savings (c)	Ex Post per-unit kW Savings (d)	kWh Realization Rate RR = (c) / (a)	kW Realization Rate RR = (d) / (b)
11 W LED	32.82	0.006	32.82	0.006	100%	100%
9 W LED	30.48	0.005	30.48	0.005	100%	100%

*Note: The *ex ante* and *ex post* per-unit savings are weighted averages. The savings values varied based on the bulb replaced.

3.1.6 Energy and Demand Savings Calculations for Low-Flow Showerheads

The Draft 2010 Ohio TRM specifies a formula and deemed values for low-flow showerheads. Equation 3-3 and Equation 3-4 present the formulas for energy and demand savings for low-flow showerheads. AEP Ohio and the evaluation team used these formulas for calculating savings. Table 3-6 lists the key parameters used in the equations. Table 3-7 presents the saving results.

Equation 3-3. Draft 2010 Ohio TRM-Specified Energy Savings – Low-Flow Showerheads

*Annual kWh Savings = (GPMbase – GPMlow) * kWh/GPMreduced*

Equation 3-4. Draft 2010 Ohio TRM-Specified Demand Savings – Low-Flow Showerhead

*Annual kW Savings = kWh Savings/Hours * CF*

Table 3-6. Key Parameters – Low-Flow Showerheads

Parameter Description – Showerheads	Parameter	Draft 2010 Ohio TRM Value
GPM of Baseline Showerhead	GPMbase	2.87
GPM of Low-Flow Showerhead	GPMlow	1.5 program specified
Assumed kWh Savings per GPM Reduction	kWh/GPMreduced	173 kWh[1]
Hours of Use per Year	Hours	29
Summer Peak Coincidence Factor	CF	0.0037

[1]Draft Ohio TRM - VEIC Response 11/15/2010

Table 3-7. Low-Flow Showerhead Algorithm Review Findings

Low-Flow Showerheads	*Ex Ante* per-unit Savings (a)	*Ex Post* per-unit Savings (b)	Realization Rate RR = (b) / (a)
Energy (kWh)	237.01	237.01	100%
Demand (kW)	0.03	0.03	100%

3.1.7 Energy and Demand Savings Calculations for Faucet Aerators

The Draft 2010 Ohio TRM specifies deemed values for faucet aerators. Each energy efficiency kit includes two faucet aerators, one for kitchen faucets with a 1.5 GPM rating, and the other for bathroom faucets with a 1.0 GPM rating.

The equations used to calculate energy and demand savings are specified in Equation 3-5 and Equation 3-6. Table 3-8 lists the key parameters used in the equations. Table 3-9 and Table 3-10 present the savings results.

The evaluation team updated the value for average number of people per household based on the 2016-2017 *e³smart^{SM}* participant survey. The survey more accurately represents the *e³smart^{SM}* population. The Ohio TRM is based on households in the East North Central Census Division where the smallest possible number of people living in a home would be one person. The smallest possible number of people living in a home of an *e³smart^{SM}* participant is two people, the child, and a guardian. The 2016–2017 survey reported the average number of people per household as 4.40. This is consistent with last year's survey that reported the average number of people per household as 4.37.

Equation 3-5. Draft 2010 Ohio TRM-Specified Energy Savings – Faucet Aerators

*Annual kWh savings = ((GPMbase – GPMlow) / GPMbase) * (# people * gals/day * days/year * DR) / F/home) * 8.3 * (Tft - Tmains) / 1,000,000)) / DHW Recovery Efficiency / 0.003412*

Equation 3-6. Draft 2010 Ohio TRM-Specified Demand Savings – Faucet Aerators

*Annual kW Savings = kWh savings/ hours * CF*

Table 3-8. Key Parameters – Faucet Aerators

Parameter Description – Faucet Aerators	Parameter	Draft 2010 Ohio TRM Value
GPM of Baseline Faucet	GPMbase	2.2
GPM of Low-Flow Faucet	GPMlow	1.5 GPM for kitchen faucet aerators 1.0 GPM for bathroom faucet aerators Program specified
Average Number of People per Household	# people	4.40[1]
Average Gallons per Day Used by all Faucets in Home	gals/day	10.9
Days Faucet Used per Year	days/y	365
Percentage of Water Flowing Down Drain	DR	63%
Average Number of Faucets in the Home	F/home	3.5
Constant to Convert Gallons to Pounds	-	8.3
Assumed Temperature of Water Used by Faucet	Tft	80
Assumed Temperature of Water Entering House	Tmains	57.8
Recovery Efficiency of Electric Water Heater	DHW Recovery Efficiency	0.98
Constant to Converts MMBtu to kWh	-	0.003412
Average Number of Hours per Year Spent Using Faucet	Hours	21
Summer Peak Coincidence Factor	CF	0.00262

[1] *2017 Participant Survey – Draft Ohio TRM assumes 2.46 People per Household*

Table 3-9. Bathroom Aerator Algorithm Review Findings

Bathroom Aerator (1.0 GPM)	*Ex ante* Savings (a)	*Ex Post* Savings (b)	Realization Rate RR = (b) / (a)
Energy (kWh)	94.06	94.71	101%
Demand (kW)	0.012	0.012	100%

Table 3-10. Kitchen Aerator Algorithm Review Findings

Bathroom Aerator (1.0 GPM)	*Ex ante* Savings (a)	*Ex Post* Savings (b)	Realization Rate RR = (b) / (a)
Energy (kWh)	54.87	55.25	101%
Demand (kW)	0.007	0.007	100%

3.1.8 Weather Stripping

Weather stripping is not included in the Draft 2010 Ohio TRM. The evaluation team used parameters from the Draft 2010 Ohio TRM, the Department of Energy, and the Iowa Energy Center to construct the *ex post* estimate of energy and demand savings for the measure. Table 3-13 shows a summary of the total *ex ante* and *ex post* savings for the measure.

For kW savings, credit was only given if the respondent reported their primary cooling system as Central Air Conditioner or Air Source Heat Pump.

Equation 3-7 and

Equation **3-8** present the energy and demand savings for weather stripping. Table 3-11 and Table 3-12 list the key parameters used in the equations.

Equation 3-7. *Ex Post* Energy Savings – Weather Stripping

*Annual kWh savings per foot of weather stripping = (Maximum savings potential from weatherization) * (Fraction of air leaks through windows, ceiling, walls, and floors) * (Fraction of heat transfer due to air leakage [versus conductive heat transfer]) * (Percentage of total leakage area covered per foot of weather stripping)*

Maximum savings potential from weatherization = (Average annual usage Maximum energy savings potential from weatherization measures)*

*Average annual usage = All Electric Residences Average Annual Usage * Percentage of homes that are all electric + Non-All Electric Residences Average Annual Usage * (1- Percentage of homes that are all electric)*

Percentage of total leakage area covered per foot of weather stripping = Area covered per foot of weather stripping / Average leakage area per house

Table 3-11. Key Parameters – Weather Stripping Energy Savings

Parameter Description – Weather Stripping	*Ex Post* Value
All Electric Residences Average Annual Usage	15,202[1]
Percentage of Homes that are All Electric	19.27%[1]
Non-All Electric Residences Average Annual Usage	10,469[1]
Maximum Energy Savings Potential from Weatherization Measures	35%[2]
Fraction of Air Leaks through Windows, Ceiling, Walls, and Floors	41%[3]
Fraction of Heat Transfer due to Air Leakage	60%[3]
Area Covered per Foot of Weather Stripping	12 * average width of leakage area
Average Width of Leakage Area	0.25[3]
Average Leakage Area per House	374.4 square inches[4]

[1]https/File/EE%20ramp%20up%20page/AEPOHIO%20All%20Electric%20Homes%20J_Williams%207_26_12.ppt
[2]http://energy.gov/articles/weatherized-homes-saving-money-families-across-us.
[3]Navigant engineering estimate.
[4] Krarti, Moncef. *Energy audit of building systems: an engineering approach*. 2nd ed. CRC Press 2011.

Equation 3-8. *Ex Post* Demand Savings – Weather Stripping

*Annual kW savings per foot of weather stripping = Cooling savings per foot of weather stripping / Full Load Cooling Hours * Percent runtime during peak period * Summer peak coincidence factor*

*Cooling savings per foot of weather stripping = kWh savings * Percent of HVAC kWh expenditure on cooling*

Table 3-12. Key Parameters – Weather Stripping Demand Savings

Parameter Description – Weather Stripping	*Ex Post* Value	*Source*
Percent of HVAC kWh Expenditure on Cooling	50%	Navigant engineering estimate
Full Load Cooling Hour	503.1	Draft Ohio TRM, average of all locations
Percent Runtime During Peak Period	25%	Navigant engineering estimate
Summer Peak Coincidence Factor	35%	http://energy.gov/articles/weatherized-homes-saving-money-families-across-us.
Fraction of Air Leaks through Windows, Ceiling, Walls, and Floors	0.5	Draft Ohio TRM
Fraction of Heat Transfer due to Air Leakage	60%	Navigant engineering estimate
Area Covered per Foot of Weather Stripping	12 * Average width of leakage area	-
Average Width of Leakage Area	0.25	Navigant engineering estimate
Average Leakage Area per House	374.4 square inches	Krarti, Moncef. *Energy audit of building systems: an engineering approach*. 2nd ed. CRC Press 2011

Table 3-13. Total Savings – Weather Stripping

Weather Stripping	*Ex ante* Savings (a)	*Ex Post* Savings (b)	Realization Rate RR = (b) / (a)
Energy (kWh)	11.1	11.1	100%
Demand (kW)	0.001	0.001	100%

3.1.9 Lower Water Heater Temperature

Lowering the temperature of a water heater is not included in the Draft 2010 Ohio TRM. The evaluation team used the Illinois TRM to construct an *ex post* estimate of energy and demand savings for the measure. Table 3-15 shows a summary of the total *ex ante* and *ex post* savings for the measure.

Equation 3-9 and Equation 3-10 present the energy and demand savings for lowering the temperature of a water heater. Table 3-14 lists the key parameters used in the equations.

Equation 3-9. *Ex Post* Energy Savings – Lowering Water Heater Temperature

For homes with electric DHW tanks:

$$Annual\ kWh\ savings = (UA * (Tpre - Tpost) * Hours) / (3412 * RE\_electric)$$

Equation 3-10. *Ex Post* Demand Savings – Lowering Water Heater Temperature

$$Annual\ kW\ savings = \Delta kWh / Hours * CF$$

Table 3-14. Key Parameters – Lower Water Heater Temperature Savings

Parameter Description – Lower Water Heater Temperature	Parameter	Ex Post Value
Overall heat transfer coefficient of tank	U	0.083
Surface area of storage tank (square feet)	A	24.99[1]
Actual hot water setpoint prior to adjustment	Tpre	135
Actual new hot water setpoint	Tpost	120
Number of hours in a year	Hours	8,766
Conversion from Btu to kWh		3,412
Recovery efficiency of electric water heater	RE_electric	0.98[2]
Summer Peak Coincidence Factor for measure	CF	1

[1] http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final/IL-TRM_Effective_060116_v5.0_Vol_3_Res_021116_Final.pdf

[2] Electric water heaters have recovery efficiency of 98%: http://www.ahridirectory.org/ahridirectory/pages/home.aspx

Table 3-15. Total Savings – Lower Water Heater Temperature

Lower Water Heater Temperature	Ex Ante Savings (a)	Ex Post Savings (b)	Realization Rate RR = (b) / (a)
Energy (kWh)	81.6	81.6	100%
Demand (kW)	0.009	0.009	100%

3.2 Process Evaluation Results

This section provides the process findings for the 2016–2017 e³smart^SM Program. Data collection activities informing the process evaluation include:

- Interviews with program and implementation staff
- Participant installation surveys
- Teacher surveys

The process evaluation data collection efforts indicate the e³smart^SM Program is running exceptionally well. The way the teaching material is incorporated into the teacher's curriculum is the best practice for a utility-sponsored school educational program. First time participating teachers spend a day-long instruction period with OEP before the school year begins. This instruction period allows the teachers to integrate the material into their curriculum. Other school programs provide the material to the teachers after a presentation during the school year, making it difficult to incorporate the lessons into their established lesson plans.

The administration of the program is functioning as expected with continual effort to improve the delivery of the program. At this time there are no problems implementing the program.

The biggest challenge expressed by the teachers has to do with time constraints. The teachers highly valued the lessons and were very disappointed when they did not get the opportunity to teach them due to a lack of time.

3.2.1 Survey Return Rates

The program continues to do an excellent job obtaining an extremely high survey return rate. The measure installation rates remained similar to last year's survey. The excellent survey rate with similar installation rates indicates the survey accurately represents the program population installation rate.

3.2.2 Teacher Satisfaction

Table 3-16 displays the teacher satisfaction ratings for different aspects of the program. OEP changed the survey questions for the 2016–2017 school year. For numerous years the same survey questions were asked with consistent results. In the attempt to find new areas of improvement OEP asked new survey questions.

Teachers reported the program influenced desired program outcomes, with "Strongly Agree or Agree" at a very high rate (nearly 90% for all questions). Teachers who rated the program influence questions as Strongly Disagree tend to answer Strongly Disagree to all the program influence questions. The rating of Strongly Disagree did not reflect the teachers' comments about the program where almost all respondents gave extremely positive comments about the program. Every teacher who responded with "Strongly Disagree", except for one teacher (who provided no response), stated that they would conduct the unit again.

In response to the question "The activities helped my students better understand energy and efficiency." 93% of the teachers stated, "Strongly Agree or Agree". This reflects the strong belief the program is meeting the primary goal of the *e³smart^SM* program – to increase student's understanding of energy efficiency. The following teacher response provides an example of this sentiment.
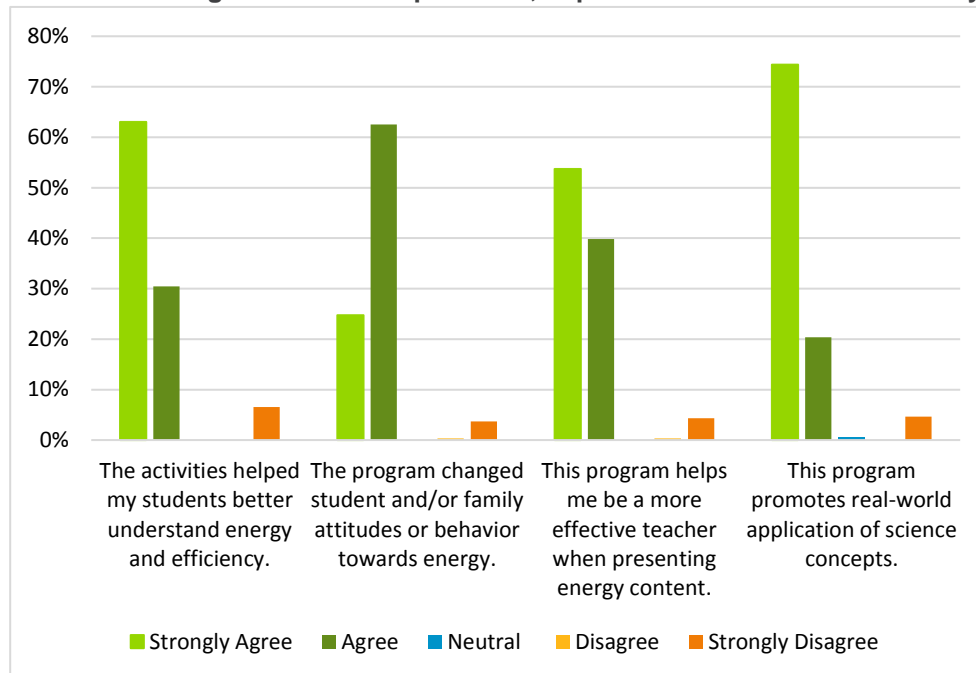
> *"Yes, I would conduct the unit again as it not only helps students understand the various forms of energy but helps them put into practice. The parents also are very supportive of the program."* AEP Ohio *e³smart^SM* teacher

When responding to the question "The program changed student and/or family attitudes or behavior towards energy." 88 percent of the teachers said they "Strongly Agree or Agree". This question received the lowest ranking which is consistent with a similar question from previous years that asked do you receive "Support and participation of families". Interviews from previous years have identified time restraints on teachers and families is the main reason for lack of teacher and parent/guardian interaction. Even though teachers report having a difficult time connecting with parents or guardians many teachers have stated the *e³smart^SM* program provides an excellent opportunity to interact positively with parents and guardians.

When responding to "This program helps me be a more effective teacher when presenting energy content." 94 percent of teachers either "Strongly Agreed or Agreed" with this statement. Teachers highly value the quality of the material and the support OEP gives on how to effectively incorporate the material into the teacher's lesson plans.

For the question "This program promotes real-world application of science concepts." 94 percent of teachers report they "Strongly Agree or Agree" the *e³smart^SM* program provides real-world application of science concepts. Additionally, teachers commented additional real-world material like an energy bill would be beneficial in providing useful information to the students.

Table 3-16. Program influence questions, Implementation Contractor Survey

Source: OEP online teacher survey

The teacher's survey also asked eight open-ended questions that attempted gather information on how to improve the program.

Question #1: Would you conduct the unit again? Please explain why or why not.

Main take away from teacher's responses: Almost all teachers stated they would conduct the unit again. Less than one percent of teachers said they were unsure whether they would conduct the unit again. The program is functioning in a way that makes teachers want to participate again.

Question #2: What are the biggest challenges you face in teaching this unit? What worked well? What did not work well?

Main take away from teacher's responses: Eighty teachers said their biggest challenge was the amount of time allotted for lessons. The teachers stated they like all the lessons, but the limited time to implement them was a challenge. OEP has redone the teaching material to better integrate it into Ohio's teaching standards and incorporate new energy efficiency information. While OEP is attempting to make the lessons fit into the teacher's curriculum, the limited amount of time in a teacher's day is beyond the scope of the *e³smart*^{SM} program.

Question #3: What other lab materials would be useful in the Teacher Kit?

Main take away from teacher's responses: The teachers indicated they highly valued and utilized the teaching material. Teachers have asked for additional lab materials for the labs they teach to improve the delivery of the lessons.

Question #4: How can the Student and Family Guide be improved?

Main take away from teacher's responses: Numerous teachers have said that the take-home sections in the student guide should be perforated so it is easier for students to take home. Teachers also said

the page numbers for the teacher and student guides should match to make it easier for them to reference their guide with the students. Teachers stated the 2016 – 2017 booklet improvements are excellent.

Question #5: What technology do you currently use or would you like to use with the energy efficiency lessons? (i.e. Google Docs, Smartboard, Kahoot, etc.)

Main take away from teacher's responses: Teachers reported Google Docs was their most used technology with Kahoot being the second most popular technology. This question would have been better asked as a multiple-choice question with the option for additional text.

Question #6: What tips or strategies would you offer to new energy efficiency teachers starting the program?

Main take away from teacher's responses: This question asked the teachers to reflect on their experience and give suggestions on how to improve the teacher's delivery of the program. The teachers provided a plethora of very useful program improvement information.

The teacher's main advice to other teachers was to keep in mind the Ohio teaching standards when creating the curriculum. The frequent comment "keep in mind your standards" relates to the limited amount of time that was mentioned as the biggest challenge in the previous question. Teachers enjoyed the lesson plans so much they wished they could use them all. Responding teachers cautioned teachers to make sure they stick to their standards so they fit the necessary items into the limited amount of time.

Teachers appreciate the lesson plan so much they wanted to use the entire packet and gave the advice to not become overwhelmed with the amount of material provided. Teachers said to pick the lessons they most want to use and do not feel obligated to use every lesson in the packet.

3.2.3 Educational Impact and Raising Energy Efficiency Awareness

The program created a curriculum focusing on energy sources, the transformation of energy, and energy uses. These lessons were created to teach students the fundamentals of energy and energy efficiency, as well as instructions on how to properly install the energy efficiency kit measures. The implementation contractor provides teachers of grades four through twelve with a detailed matrix to assist them in identifying the standards met by the e³smart^SM lesson plan.

The evaluation team compared the e³smart^SM Program to other similar programs across the country. Based on this review, Navigant believes how the e³smart^SM Program implements the educational component of the program is the most effective way of ensuring the educational material is used. The most common approach other school programs use to educate students is with a presentation given by the implementer followed by the implementer distributing teaching material to the teachers. The e³smart^SM Program provides new teachers with a daylong instruction on how to incorporate the material into their lesson plan before the beginning of the school year. This instructional period allows the teachers and OEP to get to know each other, paving the way for future communication. Teacher buy-in is key to a successful program. Providing the lesson plan material prior to the beginning of the school year allows teachers to mindfully incorporate the material into their lesson plans.

3.2.4 Installing LEDs

The installation rates for LEDs are consistent with installation rates for CFLs. Several state technical resource manuals indicate installation rates for LEDs should be higher than CFLs due to their improved features, such as increased savings, no mercury, and increased durability. The evaluation team researched other energy efficiency programs that have switched from offering CFLs to LEDs. The 2015

and 2016 Evaluation of DTE Energy's Think!Energy Program report stated there is little or no change in the installation rate when switching from CFLs to LEDs.

3.2.5 Program Marketing and Channeling to Other Programs

AEP Ohio met the program goal of 25,000 participants who received the kits. The implementation contractor only allows teachers to continue to participate in the program if they have demonstrated a commitment to the *e³smartSM* Program by achieving a participant survey submission rate of at least 50 percent.

AEP Ohio sends teacher applications to every school in the AEP Ohio service territory. Teachers can also obtain the application from the implementation contractor's website. Program staff also attend numerous energy conferences in the region to promote the *e³smartSM* Program.

The *e³smartSM* Program provides a marketing opportunity for AEP Ohio's other residential energy efficiency programs. The program provided materials in each kit containing information about AEP Ohio's EE/PDR programs and includes the URL to AEP Ohio's energy efficiency programs website.

3.3 Cost-Effectiveness Review

This section addresses the cost-effectiveness of the *e³smartSM* Program. Cost-effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-17 summarizes the unique inputs used in the TRC test.

Table 3-17. Cost-Effectiveness Model Inputs – *e3smartSM* Energy Program

Item	Value
Average Measure Life	14
Kit Recipients	25,000
Annual Energy Savings (kWh)	3,294,571
Coincident Peak Savings (kW)	453
Third Party Implementation Costs	$288,568
Utility Administration Costs	$73,705
Utility Incentive Costs	$551,093
Participant Contribution to Incremental Measure Costs	$0

Based on these inputs, the TRC ratio is 2.3. Therefore, the program passes the TRC test. Table 3-18 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant Cost Test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-18. Cost-Effectiveness Results – *e3smart^SM* Program

Benefit-Cost Ratio– Test Results	Ratio
Total Resource Cost	2.1
Participant Cost Test	N/A
Ratepayer Impact Measure	0.4
Utility Cost Test	2.1

At this time, additional benefits related to the reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

4. CONCLUSIONS AND RECOMMENDATIONS

This section highlights the findings from the impact and process evaluation of the *e³smart*^{SM} Program for the 2016-2017 school year.

4.1 Key Evaluation Impact Findings and Recommendations

During the 2016–2017 school year, 364 teachers from 247 different schools participated in the program, with energy efficiency kits distributed to 25,000 students.

Table 4-1 shows the 2016–2017 program goals, *ex ante* savings claimed by the program, *ex post* savings, and realization rates. The *ex post* energy and demand savings for the 2016–2017 school year were 3,295 MWh and 0.45 MW, respectively.

To estimate the *ex post* savings, the evaluation team independently applied the methods and assumptions outlined in the Draft 2010 State of Ohio Technical Reference Manual (Draft 2010 Ohio TRM). Several measures are not included in the Draft 2010 Ohio TRM. In these cases, the evaluation team applied the most appropriate engineering estimates. Due to differences in the number of anticipated installed LEDs in plan goal and the actual LEDs installed in the 2016-2017 school year, the program did not meet its energy savings goals. This program has shown consistent installation rates for several years the plan should use historical evidence to design a realistic number of installed measures.

AEP Ohio calculated the *ex ante* savings from the 19,648 submitted participant surveys. For the 5,352 participants who did not submit a survey, AEP Ohio applied half of the per kit *ex ante* savings. In contrast, for students not completing a survey, the evaluation team first calculated measure-specific installation rates from the completed participant surveys and then applied these rates to the total program population of 25,000 participants.

Table 4-1. 2016-2017 Overall Evaluation Results

	2015 Program Goals[1] (a)	*Ex ante*[1] Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	6,773	2,973	3,295	111%	49%
Demand Savings (MW)	0.525	0.387	0.453	117%	86%

[1] VOLUME 1: 2017 TO 2019 ENERGY EFFICIENCY/PEAK DEMAND REDUCTION (EE/PDR) ACTION PLAN, June 15, 2016.

1. **Finding 1: Measure Installation Rate.** The evaluation team used survey results from 79 percent of the program population to calculate the measure installation rates, this sample size exceeds a measure level confidence and precision of 90/10. Previous year's analysis has shown very consistent installation rates lending to the validity of these installation rates. Previous evaluation of this program examined whether anything was different about the population that did not return their survey that would suggest different installation rates. It was determined that limited access to computer labs was the reason the majority of the surveys were not returned. Limited access to computers should not influence measure installation rates.

- **Impact Recommendation 1:** Apply the installation rates gathered from the online surveys to the entire population of students receiving a kit to estimate ex post savings. Continue to examine if the installation rates for the population that do not return their survey differs from the population that does return the survey.

4.2 Key Process Evaluation Findings and Recommendations

The process evaluation objectives were to develop an understanding of the final program design and implementation strategies, document program processes and tracking efforts, and identify and recommend potential program improvements. The data collection approach for the process evaluation included in-depth interviews with program implementers and teacher surveys.

1. **Finding 1: Stipend Level.** Three years ago, the program changed the stipend level for returning teachers whose class returned at least 75 percent of student installation surveys. The stipend was increased from $100 to $200.

   - **Process Recommendation 1:** If cost-effective, continue to provide the current stipend level as it is highly appreciated by teachers who are the key component to implementing this program.

2. **Finding 2:** The most common tip from teachers on how to successfully implement the teaching material was teachers should prioritize which lessons from the *e³smart^SM* teaching material fit into the educational standards they are required to teach and use those lessons first. Teachers made this recommendation because the limited amount of classroom time often does not allow teachers to use all the lesson plans.

   - **Process Recommendation 2:** Instruct teachers to prioritize the selection of lesson plans based on the required standards of their classroom. OEP could give this advice during the instructional period before the school year for new teachers and in annual teacher updates for returning teachers.

3. **Finding 3: Additional lab materials for the labs the teacher uses.** Teachers indicated additional lab materials would be useful. The additional lab materials teachers request is based on the lessons they administer.

   - **Process Recommendation 3:** If administratively and financially possible, provide additional material to teachers when requested. Providing additional materials will make the lessons more effective and likely improve teacher and student satisfaction.

4. **Finding 4: Technology question format.** The teacher survey question asking "What technology do you currently use or would you like to use with the energy efficiency lessons? (i.e. Google Docs, Smartboard, Kahoot, etc.)" This question is asked as an open-ended question.

   - **Process Recommendation 4a:** This question would be more effective if the different technologies were listed as multiple-choice options with multiple technology selections possible. This would allow OEP to identify which technologies are most popular so they can target their material to those technologies.

   - **Process Recommendation 4b:** It would also be useful to have an open-ended question option at the end of the multiple-choice question or have an additional question that asks for different technology suggestions. This additional question would allow OEP to identify if there are additional technological opportunities to consider including in the program.

Appendix A. 2016 – 2017 SCHOOL YEAR ONLINE STUDENT SURVEY

2016-17 FAMILY INSTALLATION SURVEY
AEP Ohio / Columbia Gas of Ohio

LIGHTING

1) How many of the 9 WATT LED's did you install? ☐ One ☐ Two ☐ None

2) When installing the 9 WATT LED's, which of the following bulbs did you replace? (IL = incandescent light bulb)

40w IL ☐ One ☐ Two 60w IL ☐ One ☐ Two 75w IL ☐ One ☐ Two 100w IL ☐ One ☐ Two

13w CFL ☐ One ☐ Two 23w CFL ☐ One ☐ Two Other ☐ One ☐ Two

3) Did you install the 11 WATT LED? ☐ Yes ☐ No

4) When installing the 11 WATT LED, which of the following bulbs did you replace?

☐ 40w IL ☐ 60w IL ☐ 75w IL ☐ 100w IL ☐ 13w CFL ☐ 23w CFL ☐ Other

5) Did you install the LED NIGHTLIGHT? ☐ Yes ☐ No

If YES, did you replace an incandescent nightlight? ☐ Yes ☐ No

INSULATION

1) Did you install the WEATHER STRIPPING? ☐ Yes ☐ No

HVAC

1) What type of PRIMARY HEATING SYSTEM does your home use? ☐ Gas furnace ☐ Electric furnace

☐ Air source heat pump ☐ Baseboard/In-wall unit ☐ Other ☐ Don't know

2) During the HEATING season, did you check the thermostat setting in your home? ☐ Yes ☐ No

If YES, what was the setting?
☐ 61-63ºF ☐ 64-66ºF ☐ 67-69ºF ☐ 70-72ºF ☐ 73-75ºF ☐ 76-78ºF ☐ 79ºF + ☐ Don't know

3) For HEATING, did you decrease the thermostat setting in your home? ☐ Yes, we decreased the setting

☐ No, our thermostat is already at the recommended setting of 68ºF ☐ No, other reason

If YES, by how much did you decrease the setting?
☐ 1-2º F ☐ 3-4º F ☐ 5-6º F ☐ 7-8º F ☐ 9º F or more

If YES, when did you decrease the setting?
☐ Both day and night ☐ Only during the day ☐ Only at night

4) What type of PRIMARY COOLING SYSTEM does your home use? ☐ Central AC ☐ Window AC
☐ Air source heat pump ☐ Other ☐ Don't know ☐ None

5) During the COOLING season, did you check the thermostat setting in your home? ☐ Yes ☐ No

If YES, what was the setting?
☐ 64-66ºF ☐ 67-69ºF ☐ 70-72ºF ☐ 73-75ºF ☐ 76-78ºF ☐ 79-81ºF + ☐ 82ºF + ☐ Don't know

6) For COOLING, did you increase the thermostat setting in your home? ☐ Yes, we increased the setting

☐ No, our thermostat is already at the recommended setting of 78ºF ☐ No, other reason

If YES, by how much did you increase the setting?
☐ 1-2º F ☐ 3-4º F ☐ 5-6º F ☐ 7-8º F ☐ 9º F or more

WATER

1) What type of water heater does your home use? ☐ Natural Gas ☐ Electric ☐ Other ☐ Don't know

2) Did you check the hot water temperature in your home? ☐ Yes ☐ No

If YES, was the hot water temperature higher than 120ºF? ☐ Yes ☐ No

If YES, did you decrease the temperature setting of your water heater?
☐ Yes, we decreased the setting ☐ No

If you adjusted the water heater setting, by how many degrees was it decreased?

☐ 1-9ºF ☐ 10-20ºF ☐ 21-29ºF ☐ 30-39ºF ☐ 40ºF or more

3) Did you install the KITCHEN FAUCET AERATOR? ☐ Yes ☐ No

4) Did you install the BATHROOM FAUCET AERATOR? ☐ Yes ☐ No

5) Did you install the LOW-FLOW SHOWERHEAD? ☐ Yes ☐ No

If YES, how many showers are taken in your household on an average day using that showerhead?
☐ 1-2 ☐ 3-4 ☐ 4-5 ☐ 6+

REFRIGERATOR/FREEZER

1) Did you adjust the setting on your REFRIGERATOR to the recommended setting (34-40ºF)?
☐ Yes ☐ No

2) Did you adjust the setting on your FREEZER to the recommended setting (0-5ºF)?
☐ Yes ☐ No

CONCLUSION

1) How many people live in your home? ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6+

2) Is your home a single-family building? (This means your walls don't touch another building.)
☐ Yes ☐ No

3) OPTIONAL - Your utility is constantly striving to improve their programs. If you, the parent or guardian of the student, would like to participate in a short follow-up survey to help the utility understand your experience with this program, please provide the following information and your utility MAY contact you:

Parent/Guardian Name: _____

Street: _____ City: _____ Zip Code: _____

Phone with Area Code: (_____ _____ _____) _____ _____ _____ - _____ _____ _____ _____

APPENDIX E

Community Assistance Program

2017 Evaluation Report

Prepared for:

AEP Ohio

May 1, 2018

Submitted by:
Navigant Consulting, Inc.
30 S. Wacker Drive
Suite 3100
Chicago, IL 60606

312.583.5700
navigant.com

NAVIGANT

Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

Randy Gunn
Managing Director
Navigant Consulting
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director
312.583.5714
randy.gunn@navigant.com

Stu Slote, Director
802.526.5113
stu.slote@navigant.com

Prepared by:

Damon Clark, Senior Consultant
802.526.5115
damon.clark@navigant.com

Emma Van Beuningen, Consultant
312.573.5602
Emma.van.beuningen@navigant.com

TABLE OF CONTENTS

LIST OF FIGURES, TABLES AND EQUATIONS

Equations

EXECUTIVE SUMMARY

This document presents a summary of the findings and results from the evaluation of the Community Assistance Program (CAP) implemented by AEP Ohio for the program year January 1, 2017 through December 31, 2017. The objectives of the evaluation include quantifying the energy and demand savings impacts of the program, determining process-related program strengths and weaknesses, and providing feedback to AEP Ohio on program cost effectiveness. Detailed methodology and findings are described in the body of the report.

ES.1 Program Description

The CAP's primary objective is to reduce energy usage for residential low-income customers by installing a range of cost-effective weatherization upgrades and energy efficiency measures in eligible dwellings. In 2017, the program was administered by AEP Ohio through Ohio Partners for Affordable Energy (OPAE), and a network of local community-based agencies (agencies). Eligible participants include AEP Ohio customers with a total annual household income at or below 200 percent of federal poverty guidelines.

ES.2 Key Program Findings and Recommendations

The program reported *ex ante* 6,049 MWh of energy savings and 0.89 MW of demand savings in 2017. The verified (*ex post*) energy and demand savings for 2017 were 5,805 MWh and 0.88 MW. *Ex post* energy savings did not meet the program goal of 8,436 MWh, while the *ex post* demand savings goal of 0.76 MW was exceeded, as shown in Table ES-1-1. The realization rates were 0.96 for energy and 1.00 for peak demand savings.

Table ES-1-1. Savings Estimates for 2017 Community Assistance Program

	2017 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	8,436	6,049	5,805	0.96	69%
Demand Savings (MW)	0.76	0.89	0.88	1.00	116%

[1] VOLUME 1: 2017 TO 2019 ENERGY EFFICIENCY/PEAK DEMAND REDUCTION (EE/PDR) ACTION PLAN, June 15, 2016.

1. **Finding 1:** The Draft 2010 Ohio Technical Reference Manual (Draft 2010 Ohio TRM)[1] does not contain guidance for replacement of a freezer. AEP Ohio is claiming 1,045 kWh for freezer replacement savings, which is a ratio based on appliance recycling savings for freezers.

---

[1] Draft State of Ohio Energy Efficiency Technical Reference Manual. Prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation, August 6, 2010.

Recommendation 1: Replace the present recycling freezer savings calculation with a current TRM method, such as the Illinois TRM.

2. **Finding 2:** AEP Ohio's calculation method for Attic-Roof-Ceiling Insulation (A-R-C Insulation) does not match the Draft 2010 Ohio TRM.

   Recommendation 2: Follow the Draft 2010 Ohio TRM equations and use the tracking data R-values to calculate both energy and demand savings for A-R-C Insulation.

3. **Finding 3:** AEP Ohio claims no demand savings for smart strips. The tracking data does not indicate if the installed smart strip is 5-plug or 7-plug.

   Recommendation 3: To calculate demand savings use the deemed savings outlined in the Draft 2010 Ohio TRM. Gather data indicating if the smart strip is a 5-plug or 7-plug to provide more accurate savings.

4. **Finding 4:** This the first year LEDs have been implemented by CAP. The in-service rate (ISR) for LEDs in 2017 was 94 percent, this is a large increase compared to last year's CFL ISR of 76 percent. In 2017, ISRs for all measures increased or remained at 100 percent.

5. **Finding 5:** Agencies stated if CAP provided a more robust list of measures, the agencies would be able to serve more customers as stand-alone CAP projects. Agencies stated some customers wait for energy efficiency services because they fall lower on the Home Weatherization Assistance Program (HWAP) Priority for Service Delivery list. AEP Ohio currently works with HWAP representatives and agencies in the attempt to best integrate CAP and HWAP.

   Recommendation 5: Continue to explore the best way to leverage CAP with other available low-income programs. Also, explore if expanding the list of program measures is desirable.

6. **Finding 6:** The tracking data is now gathering reasonable values for most of the measure variables. In previous years, the tracking data was not populated with values that could be considered reasonable for many variable fields, such as SEER, EER, pre and post R-values, and blower door results.

1. INTRODUCTION

1.1 Program Overview

In 2017, CAP was administered by AEP Ohio through the implementer, and agencies. Eligible participants must have a total annual household income at or below 200 percent of federal poverty guidelines and be the customer of record for AEP Ohio. The program's objective is to reduce energy use for residential low-income customers by installing a range of cost-effective weatherization upgrades and energy efficiency measures in eligible dwellings.

The overall implementation strategy for CAP is to provide funding to the agencies to target weatherization services and energy-efficient measure installations in the low-income sector.

1.1.1 Role of AEP Ohio Employees

The AEP Ohio CAP Program Coordinator is responsible for day-to-day program management responsibilities for the utility, including communication with the implementer and the agencies. The data for CAP is managed by an AEP Ohio Energy Efficiency Analyst who receives the data and performs a quality control check. If there are issues, the data is sent back to the agencies for corrections or clarification.

1.1.2 Roles of the Agencies

In 2017, AEP Ohio contracted with the implementerand the agencies, subcontractors to the implementer, to conduct weatherization services and energy-efficient measure installations. The agencies receive their training from the OWTC. The agencies, as subcontractors to the implementer are contracted with AEP Ohio to be in compliance with insurance liability and federal law.

1.1.3 Measures and Incentives

The objective of the CAP is to reduce energy use for residential low-income customers by installing a range of cost-effective weatherization upgrades and energy efficiency measures in eligible dwellings. CAP provides direct installation services for numerous measures at no cost to the customer. Each of the more than 30 agencies may employ a different approach to deliver the program, which can influence the types and number of measures installed.

1.2 Evaluation Objectives

The three major objectives of the evaluation were to: (1) quantify energy and demand savings impacts from the program, (2) determine key process-related program strengths and weaknesses , and (3) determine program cost-effectiveness; and (4) identify ways in which the program can be improved. Navigant conducted the following activities to collect the information necessary to achieve the evaluation objectives:

- In-depth interviews with the agencies

- Tracking system review

- In-depth interviews with AEP Ohio staff

- Onsite verification of installed measures, quantities, and other parameters critical to estimating energy and demand savings

1.2.1 Research Questions

This evaluation sought to answer the following key research questions.

Impact Questions
1. Were the impacts reported by the program achieved?
2. What were the realization rates? (Defined as evaluation *ex post* savings divided by program reported, *ex ante*, savings.)
3. What are the benefits, costs, and cost-effectiveness of this program?

Process Questions
1. Is the program administration running as expected?
2. Are there any problems with program delivery?
3. Are program tracking systems adequate? Is the program tracking system consistently maintained? Does the tracking system contain all data required to support program tracking and evaluation?
4. How can the program be improved?

2. EVALUATION METHODS

This section describes the data collection activities and analytic methods implemented as part of the 2017 evaluation.

2.1 Overview of Approach

Navigant undertook the following activities:

1. **Development of Evaluation Questions.** Key evaluation questions were established during the development of the 2017 evaluation plan and a review of the key outcomes of the 2016 program evaluation.

2. **Tracking Data Review.** The program tracking data collected by the agencies were reviewed.

3. **Primary Data Collection.** Three primary data collection efforts were conducted in support of this evaluation: 1) in-depth interviews with program staff, 2) onsite field verification surveys, and 3) agency in-depth telephone interviews.

4. **Methods Used to Analyze Impact Data.** Program savings were assessed using the AEP Ohio program tracking data, onsite verifications, and the Draft 2010 Ohio TRM. A review of program algorithms and the tracking system was completed to verify measure eligibility and determine the correct application of energy and demand savings.

5. **Methods Used to Analyze Process Data.** The effectiveness of the program processes was assessed by analyzing program tracking data and in-depth interview data.

Table 2-1 summarizes data collection activities, along with the details regarding sampling and timing.

Table 2-1. Summary of Data Collection Activities

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis	All Program Participants	Tracking Database	Census	All	February 2018
In-Depth Telephone Interview	AEP Ohio Program Coordinator	Contact from AEP Ohio	Census	1	March 2018
Onsite Field Surveys	Program Participants	Tracking Database	Random Sample	75	December 2017 to January 2018
Community-Based Agencies Telephone Surveys	Program Participants	Tracking Database	Random Sample	5	February to March 2018

2.2 Onsite Verifications

Navigant conducted onsite field verification visits to a sample of 75 projects during the months of December 2017 and January 2018. Navigant used a stratified random sample from the population of program participants in the 2017 tracking database at the site level. The sample targets confidence and

precision of 90 percent +/- 10 percent and was stratified to ensure the sample properly reflects the true population's impacts and installation rates.

Once on site, the evaluation team field technicians toured the home to inspect and record the type and quantity of measures installed, and compared these results against the corresponding information in the program tracking database, which informed the evaluation's in-service rate (ISR). Where discrepancies were identified in the type or quantity of measures, the field technicians attempted to gather information from the participant regarding the reason(s) for such discrepancies. This was the first year that the onsite Fulcrum application was used to collect onsite data. The Fulcrum application was used to provide an easier and more accurate way for field technicians to collect data. The Fulcrum application was also intended to reduce that amount of time entering the onsite information. Data entered into the Fulcrum application was sent directly to the Navigant team thus providing the opportunity for quality control checks while the field technicians were still in the field.

2.3 Tracking System Review

The evaluation team performed a review of the tracking system database to examine outliers, missing values, and potentially missing variables. The purpose of the tracking system review was to ensure it gathered the data required to enable program managers to monitor key aspects of program performance at regular intervals and to support evaluation activities. The evaluation did not address whether the tracking system is adequate for regulatory prudency reviews or corporate requirements.

2.4 Engineering Algorithm Review

Navigant conducted a review of the measure savings algorithms and underlying assumptions for each measure to compare these to the Draft 2010 Ohio TRM algorithms. Navigant also recalculated energy and peak demand savings for each measure in the tracking database to ensure the algorithms were applied correctly.

2.5 Program Management Interviews

An in-depth interview with program staff was conducted by telephone in March 2018. The interview lasted approximately one hour and covered program design and implementation. Questions primarily focused on:

- Program goals and objectives
- Program design and participation
- Program tracking
- Quality assurance and quality control (QA/QC)
- Staffing and communication

2.6 Community-Based Agency Interviews

In-depth interviews were conducted with five participating community-based agencies to engage those most intimately involved with program delivery. The list of interview candidates was developed based on a review of the program database and the evaluation onsite field visits. The key objective of the interviews was to explore ways the program could improve for AEP Ohio and the agencies. The interviews included questions about program quality control, installation procedures, program communications, the tracking system, and program delivery. The majority of questions were open-ended to facilitate an open discussion of the topics.

Consistent with standard market research procedures, the confidentiality of each person interviewed was guaranteed, and comments are not attributed to any one individual; rather the evaluation focused on trends and issues that arose from a variety of perspectives.

2.7 Program Material Review

The evaluation team reviewed all program materials provided by AEP Ohio for 2017 and conducted a review of best practices for implementing residential low-income programs. A summary list of program materials reviewed for this report includes:

- Implementation plans
- Operation manuals

3. PROGRAM LEVEL RESULTS

3.1 Impact Evaluation

This section provides a detailed description of impact findings for the 2017 CAP.

3.1.1 Program Impact Evaluation Results

Navigant used engineering algorithms to verify energy and demand savings. The results were applied to all projects in the database to determine program total *ex post* savings.

Table 3-1 shows the program goals, *ex ante* and *ex post* savings estimates for energy and peak demand savings, and the 2017 realization rates. Using the engineering algorithms, Navigant confirmed in program year 2017 CAP reported *ex ante* energy savings of 6,049 MWh and 0.89 MW of demand savings. The verified (*ex post*) energy and demand savings for 2017 were 5,805 MWh and 0.88 MW. *Ex post* energy savings did not meet the program goal of 8,436 MWh, while the *ex post* demand savings goal of 0.76 MW was exceeded. The realization rates were 0.96 for energy and 1.00 for demand.

Table 3-1. Savings Estimates for 2017 Community Assistance Program

	2017 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	8,436	6,049	5,805	0.96	69%
Demand Savings (MW)	0.76	0.89	0.88	1.00	116%

[1] VOLUME 1: 2017 TO 2019 ENERGY EFFICIENCY/PEAK DEMAND REDUCTION (EE/PDR) ACTION PLAN, June 15, 2016.

3.1.2 Ex Post Savings Evaluation

The evaluation team conducted a review of measure savings recorded in the tracking system to verify the algorithms matched the Draft 2010 Ohio TRM and were correctly applied for each project. The evaluation team calculated per unit energy savings based on the algorithms in the Draft 2010 Ohio TRM and compared these to what was submitted in the tracking system.

The evaluation team's algorithm review found the energy and demand savings algorithms were constructed properly. In some cases, Navigant's algorithm review found the tracking system used the average deemed value for per unit savings based on the Draft 2010 Ohio TRM equation. While the Draft 2010 Ohio TRM allows for per household specific calculations, the use of averages, when necessary, were used since some of the detailed measure fields in the tracking system were empty or had questionable data.

3.1.3 Tracking Systems

The tracking system accurately gathers data on installed measures reported by the agencies. The evaluation team's review of the tracking system revealed that measure variables that were not previously entered with reasonable values now contain reasonable values, these variables included but are not limited to SEER, EER, pre and post R-values, and blower door results. Before reasonable values were entered AEP Ohio and the evaluation team used deemed variable values from the Draft 2010 Ohio TRM. The tracking data values will allow for more accurate reported savings. The evaluation did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

3.1.4 Measure In-Service Rates

The evaluation team conducted 75 onsite visits to 2017 participant's homes to verify if measures were installed as described in the tracking database. Table 3-2 displays the ISRs per measure verified by the evaluation team's onsite visits. The evaluation team applied the 2017 ISRs to the verified energy and demand savings. The ISRs for all measures increased from 2016's evaluation or remained at 100 percent.

Table 3-2. Onsite Verified Measure In-Service Rates

Measure	Number of Claimed Units (a)	Number of Verified Installed Units (b)	In-Service Rate 2017 ISR = (b) / (a)	In-Service Rate 2016
LEDs	698	654	94%	76%[1]
Low-Flow Showerhead	18	17	94%	82%
Faucet Aerator	23	23	100%	64%
Refrigerators	49	49	100%	100%
Freezer	13	13	100%	100%
Smart Strips	35	32	91%	78%

[1] The In-Service Rate for 2016 is based on CFLs. CAP changed from installing CFLs to installing LEDs in 2017.

3.1.5 Per Measure Savings

The evaluation team adjusted AEP Ohio's *ex ante* savings based on the per measure ISRs determined from the onsite verification visits and updated calculation variables based on the tracking data. Table 3-3 presents the energy savings for each measure. Table 3-4 presents the demand savings for each measure.

Table 3-3. *Ex Post* Energy Savings Totals by Measure

	Ex Ante Number of Units	*Ex Post* Number of Units	Total *Ex Ante* Energy Savings (MWh) (a)	Total *Ex Post* Energy Savings (MWh) (b)	Energy Savings Realization Rate RR = (b) / (a)	Percent of Total *Ex Post* Savings
Refrigerator Replacement	2,721	2,721	2,656	2,656	1.00	45.8%
LEDs	54,314	50,892	1,945	1,823	0.94	31.4%
Freezer Replacement	746	746	780	658	0.84	11.3%
Attic-Roof-Ceiling Insulation	188,139	188,139	239	191	0.80	3.3%
Smart Strip	1,668	1,525	136	121	0.89	2.0%
Water Pipe Insulation	1,801	1,801	30	94	3.13	1.6%
Showerhead	892	842	48	57	1.19	1.0%
Air Sealing	70,853	70,853	80	55	0.69	0.9%
Other[1]	25,801	N/A	50	50	1.00	0.9%
Faucet Aerator	1,215	1,215	30	30	1.00	0.5%
Water Heat Replacement	18	18	24	23	0.96	0.4%
Heat Pump	19	18	5	21	4.20	0.4%
Duct Sealing	2,403	2,403	9	9	1.00	0.2%
Hot Water Wrap	79	79	6	6	1.00	0.1%
Refrigerator Retirement	4	4	6	6	1.00	0.1%
Freezer Retirement	3	3	4	4	1.00	0.1%
CFL	18	17	1	1	1.08	0.0%
Total			**6,049**	**5,805**	**0.96**	**100%**

1 Other, includes numerous miscellaneous measures that do not fit into the other categories. The limited number of each type of measure and the limited savings impact do not warrant a detailed analysis. The measures include but are not limited to; Central Air Conditioners, varying types of vents, water heater replacements, varying types of insulation. If the installation of these measures increase in coming years the evaluation team will provide detailed explanation of the savings calculations.

Table 3-4. *Ex Post* Demand Savings Totals by Measure

Measure	Total *Ex Ante* Demand Savings (MW) (a)	Total *Ex Post* Demand Savings (MW) (b)	Demand Savings Realization Rate RR = (b) / (a)	Percent of Total *Ex Post* Savings
Refrigerator Replacement	0.4245	0.4245	1.00	48.0%
LED	0.3276	0.3070	0.94	34.7%
Freezer Replacement	0.1030	0.1006	0.98	11.4%
Smart Strip	0.0000	0.0140	N/A	1.6%
Water Pipe Insulation	0.0035	0.0107	3.06	1.2%
Showerhead	0.0054	0.0063	1.17	0.7%
Attic-Roof-Ceiling Insulation	0.0054	0.0038	0.70	0.4%
Faucet Aerator	0.0038	0.0038	1.00	0.4%
Water Heater Replacement	0.0034	0.0031	0.91	0.3%
Other[1]	0.0029	0.0029	1.00	0.3%
Air Source Heat Pump	0.0020	0.0027	1.35	0.3%
Duct Sealing	0.0011	0.0011	1.00	0.1%
Refrigerator Retirement	0.0009	0.0009	1.00	0.1%
Air Sealing	0.0008	0.0008	1.00	0.1%
Hot Water Tank Wrap	0.0007	0.0007	1.00	0.1%
Freezer Retirement	0.0006	0.0006	1.00	0.0%
CFL	0.0002	0.0002	0.86	0.0%
Total	**0.8858**	**0.8837**	**1.00**	**100%**

1 Other, includes numerous miscellaneous measures that do not fit into the other categories. The limited number of each type of measure and the limited savings impact do not warrant a detailed analysis. The measures include but are not limited to; Central Air Conditioners, varying types of vents, water heater replacements, varying types of insulation. If the installation of these measures increase in coming years the evaluation team will provide detailed explanation of the savings calculations.

NAVIGANT

Figure 3-1 and Figure 3-2 are graphic representations of the energy and demand savings by measure.

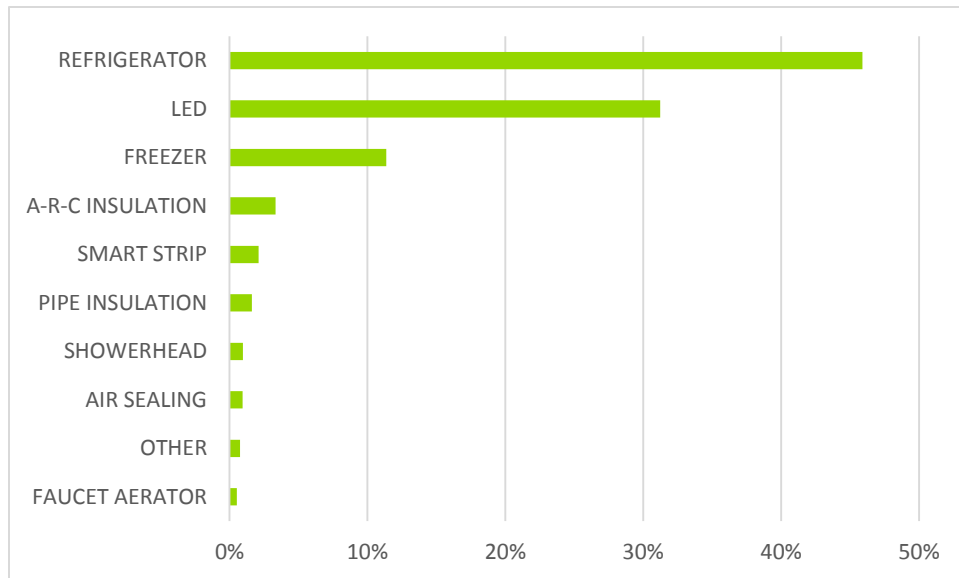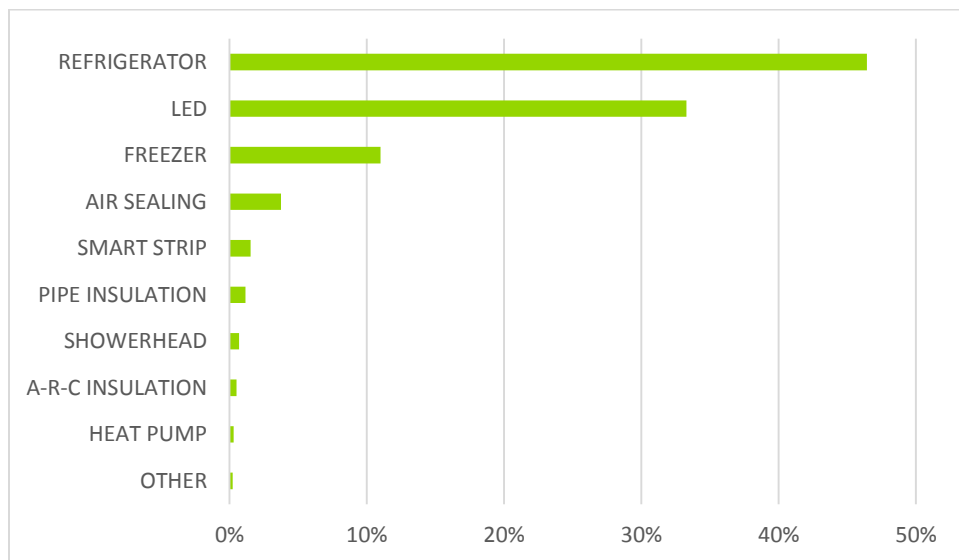**Figure 3-1. Percentage of Energy Savings by Measure**

Figure 3-2. Percentage of Demand Savings by Measure

3.1.6 Energy and Demand Savings Calculations for Air Source Heat Pumps

Navigant used the Draft 2010 Ohio TRM to estimate energy and demand savings for air source heat pumps (Equation 1, Equation 2).

Equation 1. Draft 2010 Ohio TRM-Specified Energy Savings for Air Source Heat Pumps

$$Annual\ kWh\ Savings = (FLHcool * BtuH * (1/13 - 1/SEERee))/1000 + (FLHheat * BtuH * (1/7.7 - 1/HSPFee))/1000$$

Equation 2. Draft 2010 Ohio TRM-Specified Demand Savings for Air Source Heat Pumps

$$Summer\ Coincident\ Peak\ kW\ Savings = (BtuH * (1/11 - 1/EERee))/1000 * 0.5$$

Navigant used the actual size of equipment in British Thermal Units per Hour (BtuH), seasonal energy efficiency ratio (SEER) efficiency of unit, heating season performance factor (HSPF) efficiency of unit, and energy efficiency ratio (EER) of efficiency unit from AEP Ohio's tracking database. The calculation results in unit energy savings exceeding those outlined in the Draft Ohio 2010 TRM. The efficiency of installed rebated equipment has increased over time, while the Draft Ohio 2010 TRM baseline has stayed constant. Therefore, the increase in savings is expected.

Table 3-5. Key Parameters for Air Source Heat Pumps

Parameter Description	Parameter	Value	Source
Full load cooling hours	FLHcool	552	Draft 2010 Ohio TRM
Size of equipment in BtuH	BtuH	Varies	Database (Actual) Average
Seasonal Energy Efficiency Ratio (SEER) efficiency of unit	SEERee	Varies	Database (Actual) Average
Full load heating hours	FLHheat	1,272	Draft 2010 Ohio TRM
Heating Season Performance Factor (HSPFee)	HSPFee	Varies	Database (Actual) Average
Energy Efficiency Ratio (EER) Efficiency of unit	EERee	Varies	Database (Actual) Average

3.1.7 Energy and Demand Savings Calculations for LEDs

The Navigant team used a combination of equations from the Draft 2010 Ohio TRM, the installation rate collected from onsite visits, tracking data LED wattages, AEP Ohio Residential Lighting Interactive Effects Modeling Study[2], and an AEP Ohio Residential Lighting Metering Study[3] in order to calculate savings for LEDs. The Draft 2010 Ohio TRM equations are shown in Equation 3 and Equation 4. Table 3-6 shows the values of the key parameters.

Equation 3. Ex Ante Energy Savings for LEDs

$$kWh\ Savings = (BaselineWatts - LEDWatts/1000) * ISR_{LED} * HOU_{LED} * WHF_{E,\ LED}$$

---

[2] AEP Ohio Residential Lighting Interactive Effects Modeling Results" memo, January 2016.
[3] *Residential Lighting Metering Study (Final Report), March 25, 2015.*

Equation 4. Ex Ante Demand Savings for LEDs

$$kW\ Savings = (BaselineWatts - LEDWatts/1000) * ISR_{LED} * CF_{LED} * WHF_{D,\ LED}$$

Table 3-6. Key Parameters for LEDs

Parameter Description	Parameter	Value	Source
Energy efficient LED Wattage (W)	LEDWatts	Varies	Tracking Data
Replaced bulb Wattage (W)	BaselineWatts	Varies	Recommendation from 2016 Evaluation based on 2016 ENERGY STAR® product list[1], Tracking Data
In-Service Rate	ISR_{LED}	0.937	Evaluation onsite audit
Hours of Use (hours/year)	HOU_{LED}	1,051	Lighting Metering Study[2]
Coincidence Factor	CF_{LED}	0.13	
Waste Heat Factor for Energy	$WHF_{E,\ LED}$	0.93	Interactive Effects Modeling Study[3]
Waste Heat Factor for Demand	$WHF_{D,\ LED}$	1.34	

[1]*2015 Efficient Products Evaluation Report.*
[2]*Residential Lighting Metering Study (Final Report), March 25, 2015.*
[3]*"AEP Ohio Residential Lighting Interactive Effects Modeling Results" memo, January 2016.*

3.1.8 Energy and Demand Savings Calculations for Attic-Roof-Ceiling Insulation

Navigant used a combination of the equations specified in the Draft 2010 Ohio TRM (Equation 5, Equation 6) with inputs as noted in the measure description from the program tracking database in order to calculate savings for this measure. The attic-roof-ceiling (A-R-C) insulation measure category includes several different measure types differentiated by base and efficient R values, as well as electric cooling and/or heating applicability. Navigant compared these measures separately. The measure savings are rolled up to present category level summary realization rates.

Equation 5. Draft 2010 Ohio TRM-Specified Energy Savings for Attic-Roof-Ceiling Insulation

$$Air\ Conditioning\ Savings: \Delta kWh = ((1/Rexist - 1/Rnew) * CDH * DUA * Area) / 1000 / \eta Cool$$
$$Heating\ Savings: ((1/Rexist - 1/Rnew) * HDD * 24 * Area) / 1{,}000{,}000 / COP * 293.1$$

Equation 6. Draft 2010 Ohio TRM-Specified Demand Savings for Attic-Roof-Ceiling Insulation

$$\Delta kW = \Delta kWh / FLHcool * CF$$

Table 3-7. Key Parameters for Attic-Roof-Ceiling

Parameter Description	Parameter	Value	Source
Existing effective whole-assembly thermal resistance value or R-value	Rexist	Varies	Measure Description (Actual)
New total effective whole-assembly thermal resistance value or R-value	Rnew	Varies	Measure Description (Actual)
Cooling degree hours	CDH	4,367	Draft 2010 Ohio TRM
Discretionary use adjustment	DUA	0.75	Draft 2010 Ohio TRM
Efficiency of air conditioning equipment	ηCool	10	Deemed average
Full load cooling hours	FLHcool	552	Draft 2010 Ohio TRM
Summer Peak Coincidence Factor for measure	CF	0.5	Draft 2010 Ohio TRM
Heating degree days	HDD	4,100	Draft 2010 Ohio TRM
Coefficient of performance	COP	1 for electric resistance, 1.61 for heat pumps	Deemed average

The realization rate for A-R-C Insulation was 79 percent for energy savings and 75 percent for demand savings. The savings discrepancy is partially caused by the evaluation team using Rexist and Rnew values from the tracking data for all applicable measures.

3.1.9 Energy and Demand Savings Calculations for Refrigerator and Freezer Retirement

Navigant used the following deemed savings from the Draft 2010 Ohio TRM for the refrigerator and freezer retirement.

Table 3-8. Draft 2010 Ohio TRM-Specified Savings for Refrigerator and Freezer Retirement

	Average Annual kWh Savings per Unit	Average Summer Coincident Peak kW Savings per Unit
Refrigerator	1,376	0.22
Freezer	1,244	0.20

3.1.10 Energy and Demand Savings Calculations for Refrigerator and Freezer Replacement

3.1.10.1 Refrigerators

Navigant used the deemed savings values from the Draft 2010 Ohio TRM (Table 3-9) for *ex-post* savings from refrigerator replacement, which are based on Equation 7 and Equation 8. Navigant determined a realization rate of 1.00 for energy and demand.

Table 3-9. Draft 2010 Ohio TRM-Specified Savings for Refrigerator Replacement

	Average Annual kWh Savings per Unit	Average Summer Coincident Peak kW Savings per unit
Remaining life of existing unit (first 8 years)	976	0.156
Remaining measure life (next 9 years)	100	0.018

Equation 7. Draft 2010 Ohio TRM-Specified Energy Savings Equations for Refrigerator Replacement

kWh for remaining life of existing unit (first 8 years) = $UEC_{existing}$ – UEC_{ES}

kWh for remaining measure life (next 9 years) = UEC_{base} – UEC_{ES}

Where: $UEC_{existing}$ = Unit Energy Consumption of existing refrigerator = 1,376 kWh

UEC_{ES} = Unit Energy Consumption of new ENERGY STAR refrigerator = 400 kWh

UEC_{base} = Unit Energy Consumption of new baseline refrigerator = 500 kWh

kWh for remaining life of existing unit (first 8 years) = 1376 – 400 = 976 kWh
kWh for remaining measure life (next 9 years) = 500 – 400 = 100 kWh

Equation 8. Draft 2010 Ohio TRM-Specified Demand Savings Equations for Refrigerator Replacement

$\Delta kW = (\Delta kWh/8760) * TAF * LSAF$
Where: TAF = Temperature Adjustment Factor = 1.30
$LSAF_{exist}$ = Load Shape Adjustment Factor for existing unit = 1.074
$LSAF_{new}$ = Load Shape Adjustment Factor for new unit = 1.18

3.1.10.2 Freezers

The Draft 2010 Ohio TRM does not contain guidance for replacement of a freezer. Navigant used Equation 9 to calculate freezer replacement savings. The energy realization rate was 0.84 and the demand realization rate was 0.99. AEP Ohio claims 1,045 kWh for freezer replacement savings, which is a ratio based on appliance recycling savings for refrigerators and freezers. The inputs Navigant used to calculate freezer replacement savings are in Equation 9.

Equation 9. Navigant Savings Equations for Freezer Replacement

kWh for remaining life of existing unit (first 8 years) = $UEC_{existing}$ – UEC_{ES}

Where: $UEC_{existing}$ = Unit Energy Consumption of existing refrigerator = 1244 kWh

UEC_{ES} = Unit Energy Consumption of new ENERGY STAR refrigerator = 361.8 kWh[4]

---

[4] Average unit consumption of 16 cubic feet of the following Federal standard freezers: Upright freezer with manual defrost, upright freezers with automatic defrost, chest freezer, and all other freezers except compact freezers

kWh for remaining life of existing unit (1_{st} 8 years) = 1376 – 361.8 = 882.2 kWh

3.1.11 Energy and Demand Savings Calculations for Low-Flow Showerheads

Navigant used the following calculations from the Draft 2010 Ohio TRM in order to calculate showerhead savings.

Equation 10. Draft 2010 Ohio TRM-Specified Energy Savings for Low-Flow Showerheads

Annual kWh savings = ISR * (2.87 – GPMlow) * 179
Where: *GPMlow = 2.5*

Equation 11. Draft 2010 Ohio TRM-Specified Demand Savings for Low-Flow Showerheads

ΔkW = ΔkWh/Hours * CF

3.1.12 Energy and Demand Savings Calculations for Faucet Aerators

The Draft 2010 Ohio TRM specifies deemed values for faucet aerators. Aerator savings realization rates are 1.00 for energy, and for demand. AEP Ohio and the evaluation team calculated savings using the following equations from the Draft 2010 Ohio TRM.

Equation 12. Draft 2010 Ohio TRM-Specified Energy Savings for Faucet Aerators

Annual kWh Savings =ISR *((2.2 – GPMlow) / 2.2) * 77
GPMlow = 1.5

Equation 13. Draft 2010 Ohio TRM-Specified Demand Savings for Faucet Aerators

ΔkW = ΔkWh * 0.000125

3.1.13 Energy and Demand Savings Calculations for Air Sealing

Air sealing savings realization rates were 0.69 for energy, and 40.95 for demand. Navigant calculated savings using the following equations provided in the Draft 2010 Ohio TRM.

Equation 14. Draft 2010 Ohio TRM-Specified Energy Savings for Air Sealing

Annual Cooling kWh Savings = (((CFM50Exist – CFM50New) /N-Factor) *60 * CDH * 0.0135) / 1000 / ηCool

kWh Savings (electric heating) = ((((CFM50Exist – CFM50New) / N-factor) *60 * 24 * HDD * 0.018) / 1,000,000 / COP) * 293.1

Equation 15. Draft 2010 Ohio TRM-Specified Demand Savings for Air Sealing

ΔkW = ΔkWh / FLHcool * CF

Table 3-10. Key Parameters for Air Sealing

Parameter Description	Parameter	Value	Source
Existing cubic feet per minute at 50 Pascal pressure differential	CFM50Exist	Varies	Measure Quantity (Actual)
New cubic feet per minute at 50 Pascal pressure differential	CFM50New	Varies	Measure Quantity (Actual)
Cooling degree hours	CDH	4,367	Draft 2010 Ohio TRM
Conversion factor to convert 50 Pascal air flows to natural airflow	N-factor	29.4	Draft 2010 Ohio TRM
Efficiency of air conditioning equipment	ηCool	10	Deemed average
Full load cooling hours	FLHcool	552	Draft 2010 Ohio TRM
Summer Peak Coincidence Factor for measure	CF	0.5	Draft 2010 Ohio TRM
Heating degree days	HDD	4,100	Draft 2010 Ohio TRM
Coefficient of performance	COP	1 for electric resistance, 1.61 for heat pumps	Deemed average

CFM50Exist–CFM50New is assumed to be the measure quantity recorded in the database, though it unknown if this is from the actual blower door measures; there appeared to be bad or missing data within the actual blower door inputs in the database (the following database fields: before_blower_door_reading_whole, before_blower_door_reading_envel, before_pressure_subtraction_fact, after_blower_door_reading_whole, after_blower_door_reading_envelo, after_pressure_subtraction_fact).

The evaluation team and AEP Ohio both assumed CFM50exist-CFM50new was equal to the invoice quantity in the database. AEP Ohio assumed an N-factor of 17.8 for the electric heating portion of savings, while the evaluation team used 29.4. The Draft 2010 Ohio TRM supports the 29.4 value based on a Lawrence Berkeley Laboratory methodology. This is the cause of the energy realization rate difference.

3.1.14 Energy and Demand Savings Calculations for Duct Sealing

The energy and demand savings realization rates for duct sealing both were 1.00. Navigant was unable to find usable CFM and SCF information from the tracking data and was unable to utilize Equation 16 and Equation 17 to calculate savings in accordance with the 2010 Ohio Draft TRM. Therefore, Navigant used AEP Ohio's average values.

Equation 16. Draft 2010 Ohio TRM-Specified Energy Savings for Duct Sealing

*Annual Cooling kWh savings = (((CFM50Whole House – CFM50Envelope Only) * SCF)before – (CFM50Whole House – CFM50Envelope Only) * SCF)after) * 60 * CDH * 0.0135) / 1000 / ηCool*

*Annual Electric kWh savings = ((((CFM50Whole House – CFM50Envelope Only) * SCF)before – (CFM50Whole House – CFM50Envelope Only) * SCF)after) * 60 * 24 * HDD * 0.018) / 1,000,000 / ηHeat) * 293.1*

Equation 17. Draft 2010 Ohio TRM-Specified Demand Savings for Duct Sealing

*ΔkW = ΔkWh / FLHcool * CF*

3.1.15 Energy and Demand Savings Calculations for Pipe Insulation

The energy and demand savings realization rates for this measure both were 310 percent. Navigant used equations from the Draft 2010 Ohio TRM to calculate savings. The increased realization rate for energy and demand are caused primarily by Navigant using tracking data weighted averages for equation inputs. AEP Ohio used the same savings for all pipe insulation measures.

Equation 18. Draft 2010 Ohio TRM-Specified Energy Savings for Pipe Insulation

$$Annual\ kWh\ Savings = ((1/Rexist - 1/Rnew) * (L * C) * \Delta T * 8{,}760) / \eta DHW / 3413$$

Equation 19. Draft 2010 Ohio TRM-Specified Demand Savings for Pipe Insulation

$$\Delta kW = \Delta kWh / 8{,}760$$

Table 3-11. Key Parameters for Pipe Insulation

Parameter Description	Parameter	Value	Source
Pipe Heat Loss Coefficient of Uninsulated Pipe	Rexist	1	Draft 2010 Ohio TRM
Pipe Heat Loss Coefficient of Insulated Pipe	Rnew	Varies	Measure Description (Actual)
Length of Pipe from Water Heating Source Covered by Pipe Wrap	L	Varies	Measure Description (Actual)
Circumference of Pipe	C	Varies	Measure Description (Actual)
Average Difference between Supplied Water and Outside Air Temperature	Delta T	65	Draft 2010 Ohio TRM
Recovery Efficiency of Electric Hot Water Heater	ηDHW	0.98	Draft 2010 Ohio TRM

3.1.16 Energy and Demand Savings Calculations for Smart Strips

The energy savings realization rate for smart strips was 89 percent. AEP Ohio claims no demand savings for this measure. The evaluation team followed the deemed values from the Draft 2010 Ohio TRM to calculate savings for the smart strip. Navigant took an average from both the 5-plug and 7-plug savings, as it was unclear in the tracking data what type of smart strip was installed.

AEP Ohio claims savings of 82 kWh and no kW for this measure; these values are based on the 2012-2014 EE/PDR Action Plan developed by Navigant.

Table 3-12. Draft 2010 Ohio TRM-Specified Savings for Smart Strips

	Average Annual kWh Savings per Unit	Average Summer Coincident Peak kW Savings per Unit
5-plug	56.5	0.0063
7-plug	102.8	0.012

3.1.17 Energy and Demand Savings for Water Heater Replacement

The evaluation team followed the deemed values from the Draft 2010 Ohio TRM to calculate energy and demand savings for Water Heater Replacement. Water Heater Replacement realization rate is 95 percent for energy and demand savings. The realization rate is attributed to the different values used for the electric heating resistance variable.

Table 3-13. Draft 2010 Ohio TRM-Specified Savings for Water Heater Replacement

Heating System	Average Annual kWh savings per unit	Average Summer Coincident Peak kW savings per Unit	Average Annual Fossil Fuel heating fuel savings (MMBTU) per unit	Average Annual Water savings per unit
Electric Resistance Heat	499	0.068	N/A	N/A
Heat Pump	1297	0.18	N/A	N/A
Fossil Fuel	2076	0.28	-7.38	N/A

Equation 20. Draft 2010 Ohio TRM-Specified Energy Savings for Water Heater Replacement

$$kWh\ Savings = ((COPnew - COPbase) / COPnew) + kWhcooling - kWhheating$$

Where:

KWHbase	*= Average electric DHW consumption*
	= 3460
COPnew	*= Coefficient of Performance (efficiency) of Heat Pump water heater*
	= 2.0
COPbase	*= Coefficient of Performance (efficiency) of standard electric water heater*
	= 0.904
kWhcooling	*= Cooling savings from conversion of heat in home to water heat*
	= 180
kWhheating	*= Heating cost from conversion of heat in home to water heat.*

Dependent on heating fuel as follows:
KWHheating (electric resistance)   *= 1,577*
KWHheating (heat pump COP 2.0)   *= 779*
KWHheating (fossil fuel)   *= 0*

Equation 21. Draft 2010 Ohio TRM-Specified Demand Savings for Water Heater Replacement

$$\Delta kW = \Delta kWh / Hours * CF$$

Where:

Hours	*= Full load hours of hot water heater*
	= 2533
CF	*= Summer Peak*
	= 0.346

3.2 Process Evaluation

The purpose of the process evaluation is to identify possible program improvements in the administration of the program by AEP Ohio, the implementer, and the agencies. Data collected for the process evaluation were collected through in-depth interviews with AEP Ohio staff and community action agencies.

3.2.1 Installation Verification and Quality Control

Similar to what was reported last year, agencies stated an audit is conducted of the participant's home to identify the measures needed, then the agency schedules a time to install measures that need to be ordered. Once the installations are complete, the agencies report the audit results. Some of the agencies stated every home had a post installation inspection to verify measures. Other agencies reported they chose a random sample of homes to inspect in order to verify the measures installed.

All agencies reported their staff train at the Ohio Weatherization Training Center (OWTC). The OWTC has been in operation since 1981 providing training on home performance, weatherization, heating system services and procedures, industry safety, and other topics revelant to the delivery of CAP services.

3.2.1.1 LED In-Service Rate

This the first year LEDs have been implemented by CAP. The ISR for LEDs in 2017 was 94 percent, this is large jump compared to last year's CFL ISR of 76 percent.

The agencies said customers prefer the LEDs to the CFLs due to the brighter light the LEDs give off compared to the CFL lighting. Agencies also said some customers were worried about the mercury in the CFLs. The desirability of LEDs is likely the main driver for the increase in the ISR with customers wanting the LEDs installed immediately and leaving the LEDs installed because they like the light they give off. In previous year's CFL were found in boxes at the customer's home. The evaluation team's onsite visits found no LEDs in boxes this year.

3.2.2 Customer and Agency Satisfaction

Similar to previous years the agencies reported high program satisfaction from customers. Similar to last year, agencies reported what customers like best about the program is getting a new (free) refrigerator installed. Agencies reported customers often say the refrigerators are the nicest thing in their home. Agencies reported what customers like least about CAP is when their refrigerator or other appliance has a service issue.

3.2.3 Communication

Similar to last year, agencies said communication with AEP Ohio works well. Agencies reported frequent communication with AEP Ohio, from once a week to once a month, depending on how much program related work they undertake.

The evaluation team asked the agencies if they relay customers' opinions and concerns to AEP Ohio. The agencies said they relay the most urgent, but not all, messages from customers to AEP Ohio. To gather information from CAP customers, a uniform document created by the implementer and approved by AEP Ohio for all agencies would make the information easier to gather and organize. Ensuring all customer input is gathered will allow AEP Ohio to continue to provide quality service to CAP customers and help promote program improvements. AEP Ohio reported it will soon have an online option to gather customer feedback.

The contract for CAP requires the implementer to provide a monthly report regarding customer's complaints. The purpose of the reports is to detect common customer concerns across agencies. Agencies are to inform AEP Ohio if a resolution to a customer's problem is not addressed in three business days.

3.2.4 Agency Perception of the CC Tracking System

The agencies stated the tracking system captures the needed program information. Agencies reported they are getting better at entering the pre- and post-measure information. The main factor in entering accurate information consistently is the experience of their staff.

3.2.5 Agency Response to Coordinating CAP with other Low-Income Programs

Agencies reported they have been attempting to integrate the services CAP and other low-income programs offer for years. All agencies stated they use funds from CAP for measures the HWAP does not provide which avoids using HWAP's health and safety funding.

Agencies stated if CAP expanded the available measures so they could do standalone CAP projects they would be able to serve their customers better. The reason increasing the number of measures would serve customers better is it would allow customers who fall lower on the HWAP priority list to be served sooner. CAP is often combined with HWAP to provide full home energy efficiency services. If a customer is lower on the Priority for Service Delivery[5] list for HWAP those customers often have to wait until the higher priority customers are served. Due to limited amount of staff time and to avoid the costs of revisiting a home multiple times agencies avoid doing piece meal work if possible. Agencies stated that the customers who are put on a waiting list due to their lower priority could be served if CAP provided a more robust list of measures to serve the entire home's energy efficiency needs.

3.3 Cost Effectiveness Review

This section addresses program cost-effectiveness. The cost effectiveness of CAP is assessed using the Total Resource Cost (TRC) test. Table 3-14 summarizes the unique inputs used in the TRC test.

---

[5] PY 2017 **OHIO** HWAP **POLICIES AND PROCEDURES MANUAL** https://development.ohio.gov/files/is/Attachment%201.pdf

Table 3-14. Inputs to Cost-Effectiveness Model for CAP Program

Item	Value
Average Measure Life	17
Residences	4,397
Annual Energy Savings (kWh)	5,805,351
Coincident Peak Savings (kW)	884
Third Party Implementation Costs	$882,037
Utility Administration Costs	$491,721
Utility Incentive Costs	$4,906,354
Participant Contribution to Incremental Measure Costs	$0

Based on these inputs, the TRC ratio is 0.6. Therefore, the program does not pass the TRC test. The following table summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant Cost Test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-15. Cost Effectiveness Results for CAP Program

Benefit-Cost Test Results	B/enefit-Cost Ratio
Total Resource Cost	0.6
Participant Cost Test	N/A
Ratepayer Impact Measure	0.3
Utility Cost Test	0.6

At this time, additional benefits related to reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1   Key Impact Evaluation Findings and Recommendations

The program reported *ex ante* 6,049 MWh of energy savings and 0.89 MW of demand savings in 2017. The verified (*ex post*) energy and demand savings for 2017 were 5,805 MWh and 0.88 MW. *Ex post* energy savings did not meet the program goal of 8,436 MWh, while the *ex post* demand savings goal of 0.76 MW was exceeded, as shown in Table ES-1-1. The realization rates were 0.96 for energy and 1.00 for peak demand savings.

Table ES-4-1. Savings Estimates for 2017 Community Assistance Program

	2017 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	8,436	6,049	5,805	0.96	69%
Demand Savings (MW)	0.76	0.89	0.88	1.00	116%

[1] VOLUME 1: 2017 TO 2019 ENERGY EFFICIENCY/PEAK DEMAND REDUCTION (EE/PDR) ACTION PLAN, June 15, 2016.

1. **Finding 1:** The Draft 2010 Ohio Technical Reference Manual (Draft 2010 Ohio TRM)[6] does not contain guidance for replacement of a freezer. AEP Ohio is claiming 1,045 kWh for freezer replacement savings, which is a ratio based on appliance recycling savings for freezers.

   Recommendation 1: Replace the present recycling freezer savings calculation with a current TRM method, such as the Illinois TRM.

2. **Finding 2:** AEP Ohio's calculation method for Attic-Roof-Ceiling Insulation (A-R-C Insulation) does not match the Draft 2010 Ohio TRM.

   Recommendation 2: Follow the Draft 2010 Ohio TRM equations and use the tracking data R-values to calculate both energy and demand savings for A-R-C Insulation.

3. **Finding 3:** AEP Ohio claims no demand savings for smart strips. The tracking data does not indicate if the installed smart strip is 5-plug or 7-plug.

   Recommendation 3: To calculate demand savings use the deemed savings outlined in the Draft 2010 Ohio TRM. Gather data indicating if the smart strip is a 5-plug or 7-plug to provide more accurate savings.

---

[6] Draft State of Ohio Energy Efficiency Technical Reference Manual. Prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation, August 6, 2010.

4. **Finding 4:** This the first year LEDs have been implemented by CAP. The in-service rate (ISR) for LEDs in 2017 was 94 percent, this is a large increase compared to last year's CFL ISR of 76 percent. In 2017, ISRs for all measures increased or remained at 100 percent.

5. **Finding 5:** For pipe insulation, the realization rate was 310 percent for energy and demand savings. This is due to Navigant using the tracking data weighted averages for the calculation inputs. AEP Ohio uses a standard values for the calculation inputs.

   Recommendation 5: AEP Ohio should use the tracking data for all available pipe insulation variables when calculating savings.

6. **Finding 6:** Air sealing realization rate was 69 percent for energy savings and 4,095 percent for demand savings. The realization rates reflect AEP Ohio calculations that do not use the tracking data CFM inputs. This is the first year e tracking data has reasonable CFM data for air sealing.

   Recommendation 6: AEP Ohio should use the CFM values from the tracking data to calculate air sealing savings, this will provide the most accurate savings data.

7. **Finding 7:** Water Heater Replacement realization rate is 95 percent for energy and demand savings. The realization rate is attributed to the evaluation team and AEP Ohio using different values for the electric heating resistance variable. The evaluation team used the Draft 2010 Ohio TRM value.

   Recommendation 7: AEP Ohio should use the deemed value for electric heating resistance from the Draft 2010 Ohio TRM.

8. **Finding 8:** Heat Pump realization rate is 441 percent for energy savings and 130 percent for demand savings. The realization rate is due to Navigant using the tracking database variable values to calculate savings. This is the first year that reasonable values for heat pumps have been entered into the tracking database.

   Recommendation 8: Utilize the tracking database for all heat pump variables to ensure the most accurate savings values.

9. **Finding 9:** Agencies stated if CAP provided a more robust list of measures, the agencies would be able to serve more customers as stand-alone CAP projects. Agencies stated some customers wait for energy efficiency services because they fall lower on the Home Weatherization Assistance Program (HWAP) Priority for Service Delivery list. AEP Ohio currently works with HWAP representatives and agencies in the attempt to best integrate CAP and HWAP.

   Recommendation 9: Continue to explore the best way to leverage CAP with other available low-income programs. Also, explore if expanding the list of program measures is desirable.

10. **Finding 10:** Agencies stated staffing at the Ohio Weatherization Training Center (OWTC) is not sufficient to train their staff. Additional certification requirements have increased the need for training.

Recommendation 10: AEP Ohio should impress upon the Ohio Department Services Agency (ODSA) that the OWTC needs to ensure agencies can train their staff to continue to provide adequate services to the public.

11. **Finding 11:** The tracking data is now gathering reasonable values for most of the measure variables. In previous years, the tracking data was not populated with values that could be considered reasonable for many variable fields, such as SEER, EER, pre and post R-values, and blower door results.

Appendix A. 2017 CAP COMMUNITY AGENCY IN-DEPTH INTERVIEW GUIDE

Statement of purpose:	These surveys will be used by the evaluation team to determine program effectiveness, satisfaction with the program, ease of participation and suggestions for improvements.
Sample size:	5 in-depth interviews.
Survey timeline:	February 2018

Key Evaluation Questions

How is communication and coordination between the agencies and AEP Ohio?

How are the CAP agencies reaching participants?

How do the agencies track activities, customers, measures, and other data?

What are your agency's Quality Assurance/Quality Control procedures?

How satisfied are customers with the program?

What is the overall effectiveness of CAP?

****

Hello, this is [INTERVIEWER NAME] calling from Navigant on behalf of AEP Ohio.

INTRO. We're conducting interviews with program managers and key staff in order to improve our understanding of AEP Ohio's Community Assistance Program (CAP).

Is this a good time to talk? [IF NOT, SCHEDULE A CALL BACK.]

I'd like to better understand how agencies implement the program.

All individual comments will remain confidential.

Roles and Responsibilities

1. Please describe the services your organization provides for CAP.

2. Could you describe your duties and responsibilities for CAP?

Communication and Coordination

3. How frequently do you communicate with AEP Ohio about CAP?

    a. What works best in the relationship?

    b. What could be improved regarding communication with AEP Ohio?

4. Could the communication and coordination process be improved?

Program Participation

5. Can you please describe the process you use to enroll program participants?

    a. What works best in this process?

    b. What could be improved in the enrollment process?

6. Is there anything that could be done to improve the participants' experiences?

Tracking Systems

7. How effective is AEP Ohio's CC tracking system?

    a. Ease of capturing data

    b. Ease of reporting

    c. Flexibility

8. Detailed information about the equipment you installed and replaced allows AEP Ohio to report more accurate savings values. Are there barriers to reporting detailed information about the installed and removed equipment in the CC tracking system?

9. Are there any changes you could suggest to improve the system?

Quality Control

10. What are your agency's quality control policies and procedures?

11. What instructions or guidance have you received from AEP Ohio about measure installation?

    a. Do you have any recommendations to improve this guidance?

12. What are your procedures for installing LEDs?

13. Have these procedures changed in the last year?

14. How do you feel aboutLEDs being left behind for participants to install themselves?

15. How do you inspect the quality of the refrigerators installed?

    a. Have you seen any quality issues with the refrigerators you install?

        i. If Yes – What issues? (Open Ended)

16. Does your staff train at the Ohio Weatherization Training Center?

    a. Has the training changed in the past year?

Customer Satisfaction

17. Overall, what do customers seem to like best about CAP?

18. What do customers seem to have problems with or dislike about the program?

    a. Did you relay these concerns back to AEP Ohio? (If yes, probe for how they felt customer concerns were addressed.)

19. Do customers have any confusion on who is providing these measures?

    a. If Yes – What confusion? (Open Ended)

Program Effectiveness

20. Overall, how successful was CAP for your agency in 2017?

21. Is there any way CAP could coordinate with other low-income programs you are involved in to improve how CAP is delivered? (Probe to see how they use the different low-income programs for one participant.)

22. Can you think of any other equipment that would be useful to offer through CAP?

23. Do you have suggestions to improve the program?

24. Do you have anything else you'd like to add?

Thank you very much for taking the time in assisting us with this evaluation. Your contribution is a very important part of the process.

We might follow-up with you by phone later, if additional questions arise.

Appendix B. ONSITE VISIT FORM

The following guides were used to create the Fulcrum tool that onsite auditors used to collect data.

AEP Ohio Community Assistance Program Participant Survey (Audit/Assessment Recipients)

Community Assistance Program Onsite Verification Form	
Field Staff Name:	Date:
	Time In:
Site ID:	Time Out:
Customer Name:	Total Time:
Phone Number:	Travel Time (hours):
Street Address:	Travel Dist. (miles):
City:	Zip Code:

Section 1: Refrigerator

1) Refrigerator replacement	Notes
2) Refrigerator replacement Verified	
3) Location of freezer (T,B,S)	
4) Size	
5) Model Number	
6) ENERGY STAR?	

Section 2: Freezer

1) Freezer replacement	Notes
2) Freezer replacement Verified	
3) Type of Freezer (Chest, upright)	
4) Size	
5) ENERGY STAR?	

Section 3: LEDs

1) Number Received During Audit	Notes
2) Number Installed During Audit (ask homeowner)	
3) Number Removed (after initial installation)	
4) Number Visually Verified	
5) Installation Location (Primary/Secondary)	

For CFLs Visually Verified (fill out the following for each bulb verified)

Location (enter number) 1) Kitchen　　6) Closet 2) Living　　　7) Basement 3) Bedroom　　8) Garage 4) Bathroom　9) Outdoor 5) Hall　　　10) Other	Quantity	Wattage	Base Type (Pin Based / Screw Based)

Notes

Section 4: Attic Insulation - complete if insulation was installed

Attic Insulation Reported?	Insulation Area Reported
Attic Insulation Verified?	Insulation Area Verified
Insulation Type (enter number) 1) Fiberglass Batt 2) Fiberglass Blown 3) Cellulose Blown 4) Spray Foam 5) Other	
Depth Pre-Retrofit (if known)	
Depth of Insulation Added (in)	
Effectiveness (enter Number) 1) Good 2) Average 3) Poor	
Notes	

Section 5: Wall Insulation - verify with homeowner

Wall Insulation Reported?	Notes
Homeowner able to confirm installation? (Yes / No)	
Wall Insulation Visually Verified? (Y/N)	
Insulation Type (if known)	
Insulated Wall Area (sq. ft.)	

Section 6: Envelope Air Sealing - Visual Inspection

Air Sealing Reported?	Notes
Homeowner able to confirm installation? (Yes / No)	
Evidence of Sealing Verified? (Y/N)	

Section 7: Showerheads

1) Number Received During Audit	Notes
2) Number Installed During Audit (ask homeowner)	
3) Number Removed (after initial installation)	
4) Number Visually Verified	
5) Installation Location (Primary/Secondary)	

Section 8: Aerators

1) Number Received During Audit	Notes
2) Number Installed During Audit (ask homeowner)	
3) Number Removed (after initial installation)	
4) Number Visually Verified	
5) Number Installed in Kitchen	
6) Number Installed in Bath	

Section 9: Pipe Insulation

1) Amount Received During Audit (feet)	Notes
2) Amount Installed During Audit (ask homeowner)	
3) Amount Removed (after initial installation)	
4) Amount Visually Verified	

Section 10: Hot Water Heater Tank Wrap

HW Tank Wrap Reported?	Notes
HW Tank Wrap Visually Verified	

Section 11: Miscellaneous vents and insulation

Number of Roof Vents reported
Number of Roof Vents Verified
Wall Foundation insulation (feet) Reported
Wall Foundation insulation (feet) Verified
Band Joint Insulation (feet) Reported
Band Joint Insulation (feet) Verified
Mobile Home Belly Patch Reported
Mobile Home Belly Patch Verified
Mobile Home Underneath Vapor Retarder Reported
Mobile Home Underneath Vapor Retarder Verified

Section 12: Replace Electric Water Heater

Replaced Electric Water Heater Reported	
Replaced Electric Water Heater Verified	
Model Number	
CAPACITY GALLONS	
Type (Gas/Electric)	Notes

Section 14: Smart Strips

Number Smart Strips Reported
Number Smart Strips Verified
Type
Number of outlets

APPENDIX F

EFFICIENCYCRAFTED[TM] HOMES PROGRAM

2017 Evaluation Report

Prepared for:

AEP Ohio

Draft April 20, 2018

Submitted by:
Navigant Consulting, Inc.
30 S Wacker Drive
Suite 3100
Chicago, IL 60606

312.583.5700
navigant.com

NAVIGANT

Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

Randy Gunn
Managing Director
Navigant Consulting, Inc.
30 S Wacker Drive, Suite 3100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director	Stu Slote, Director
312.583.5714	802.526.5113
randy.gunn@navigant.com	stu.slote@navigant.com

Prepared by:

Lee Wood, Managing Consultant
802.526.5116
lee.wood@navigant.com

Vijeta Jangra, Managing Consultant
203-298-8866
vijeta.jangra@navigant.com

TABLE OF CONTENTS

LIST OF TABLES

Tables

EXECUTIVE SUMMARY

This report describes the results of an evaluation of the 2017 AEP Ohio EfficiencyCrafted™ New Homes Program. The Executive Summary provides a high-level description of the program and key findings. Detailed methodology and findings are described in the body of the report following the Executive Summary.

ES.1 Program Summary

The purpose of the EfficiencyCrafted™ New Homes Program is to: 1) increase market penetration of energy efficient homes in AEP Ohio's service territory, and 2) to move builders to even higher levels of energy savings through ENERGY STAR® certification. The program implementation contractor recruits and educates participating builders and their trades on the building practices and benefits associated with energy-efficient homes.

ES.2 Key Impact Findings

Navigant used REM/Rate™ building simulation modeling to verify energy and peak demand savings for the EfficiencyCrafted™ New Homes Program, as specified by the Draft 2010 Ohio Technical Reference Manual (TRM)[1]. Navigant reviewed the User Defined Reference Home (UDRH) baseline inputs to ensure the energy characteristics of the UDRH matched the 2009 International Energy Conservation Code (IECC), which is the current Ohio energy code for residential new construction. The annual energy and demand savings associated with the program homes were calculated as the difference between the UDRH and program home simulation results for a random sample of 25 program homes. The energy and demand realization rates from the sample were applied to the entire program savings to determine program total *ex post* savings.

AEP Ohio reported *ex ante* 5,298,604 kWh of energy savings and 2752 kW of demand savings for the EfficiencyCrafted™ New Homes Program in 2017. The *ex post* energy and demand savings for 2017 were 5,298,604 kWh and 2752 kW. These savings exceeded the program goals, as shown in Table ES-1-1. The realization rates were 1.00 for energy savings and 1.00 for peak demand savings.

Table ES-1-1. Overall Evaluation Results

	2017 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	4,735	5,299	5,299	1.00	112%
Demand Savings (MW)	0.963	2.8	2.8	1.00	286%

[1] AEP Ohio Volume 1: 2017 TO 2019 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, September 2, 2016, data for 2017.

---

[1] Draft *State of Ohio Energy Efficiency Technical Reference Manual.* Prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation, August 6, 2010.

ES.3 Key Process Findings and Recommendations

The process evaluation component of the AEP Ohio EfficiencyCrafted^{TM} New Homes Program assessed the effectiveness of the program operations and delivery. Navigant's process evaluation included in-depth interviews with program staff, online survey of participating builders, and a review of program tracking systems, reports, and marketing materials.

Finding 1: Participant Satisfaction. Builders remain highly satisfied with their overall experience with the program. Overall satisfaction with the program and most of the elements increased in 2017, though satisfaction decreased slightly for the training opportunities, and remained the same for the time it takes to receive the incentives. Builders reported an increase in satisfaction for the incentives amounts in 2017.

> **Recommendation 1a.** Consider online webinars and training videos in addition to in-person trainings for the builders and HVAC contractors, to allow distant builders and HVAC contractors to attend the trainings remotely. Additionally, these webinars could be recorded and provided on the program website to allow builders a self-paced training experience.

Finding 2: Marketing and Promotion. The program's marketing strategy and tactics remained largely unchanged in 2017. The program was promoted to homebuilders and homebuyers in 2017 through in-person meetings, outreach at industry meetings, and through TV, print and digital advertisements. Two builders reported low satisfaction with the EfficiencyCrafted^{TM} brand in the home sales process noting that homebuyers are not aware of EfficiencyCrafted^{TM} homes and their benefits.

> **Recommendation 2a.** Help builders create public awareness about the benefits of EfficiencyCrafted^{TM} homes by showing program home energy performance and/or cost savings on the program website. Develop interactive branded graphics to visualize data on the benefits of EfficiencyCrafted^{TM} homes that builders could incorporate into their websites. These graphics could further incentivize builders to display program branding on their websites, to raise awareness among homebuyers.

> **Recommendation 2b.** Recruit and engage realtors or real estate agents who can share the financial benefits of EfficiencyCrafted^{TM} homes with the potential homebuyers compared to the average homes in the neighborhood.

Finding 3: Data Tracking and Reporting. Data tracking and reporting system was modified in 2017 due to the separation of the program from Columbia Gas' program. This modification required several changes to the data tracking and reporting processes. All data needed for evaluation was tracked.

> **Recommendation 3a**. The implementer should keep AEP Ohio informed of any changes in the data tracking and reporting system before implementation**.**

Finding 4: Application and Payment Processing. Navigant completed a review of the incentive processing times entered into the incentive tracking dataset. Incentive application processes and incentive processing cycle time remained largely unchanged in 2017.

1. INTRODUCTION

This section begins with a summary of various aspects of the program implementation strategy and marketing.

1.1 Program Description

The purpose of the EfficiencyCrafted™ New Homes Program is to 1) increase market penetration of energy efficient new homes in AEP Ohio's service territory, and 2) to move builders to even higher levels of energy savings through ENERGY STAR® certification. The program recruits and educates participating builders and their trades on the benefits associated with ENERGY STAR® homes, as well as building practices designed to improve upon baseline efficiency.

Program-enrolled builders are provided with financial incentives to meet energy efficient building standards at two levels under the EfficiencyCrafted™ brand. The first level is branded "EfficiencyCrafted™" and is based on Version 2 of the ENERGY STAR® homes standard[2]. The second level, branded "EfficiencyCraftedT™ plus ENERGY STAR®" is based on Version 3 of the ENERGY STAR® Homes standard[3]. Both performance levels require additional prescriptive requirements designed to boost the program's cost-effectiveness by increasing the energy savings per home.

The program targets all builders in the AEP Ohio service territory. Builders who participate in the program receive cash incentives based on a sliding scale tied to the home's home energy rating system (HERS) score, as determined by program-enrolled HERS raters. In addition, builders are provided with training on marketing ENERGY STAR® homes to customers, ENERGY STAR® building standards, and building practices designed to meet these standards.

1.2 Implementation Strategy

1.2.1 Program Delivery Mechanisms and Marketing Strategy

The delivery strategy for AEP Ohio's EfficiencyCrafted™ New Homes Program focuses on: 1) offering education, financial incentives, and marketing support and materials to participating home builders; 2) offering technical training to home builders and HERS raters; and 3) educating industry professionals and homebuyers on the benefits of energy efficient and ENERGY STAR® construction.

Key elements of the implementation strategy include:

- Builder and rater recruitment, outreach, and orientation, including home builder associations, professional associations, and other trade groups

- Rater or rating company enrollment (raters must show evidence of certification by a Residential Energy Services Network [RESNET]-accredited rating provider)

- Registration and tracking of committed homes, including all pertinent site data and contact information

---

[2] See https://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_v2_guidelines
[3] See https://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_v3_guidelines

- Review, approval, and tracking of incentive applications for completed sites, including all necessary supporting documentation (such as rating files and rater invoices)

- Incentive processing, including fund management, check issuance, reconciliation, and reporting

- Marketing and collaterals development and deployment (consumer and builder targeted)

- Participant communications and update meetings

- Education sessions for builders, raters, and the broader construction community

- A technical and procedural quality assurance (QA) monitoring program for both field and rating activities

- Goal tracking, progress reporting, budgeting, and accrual processes

The program's marketing strategy primarily focuses on builder outreach, recruitment, and orientation. Marketing efforts in 2017 focused on face-to-face meetings with builders through events and one-on-one meetings between program staff and selected building companies.

1.3 Participation Levels and Incentives

Table 1-1 presents a summary of each performance level offered through the program in 2017. Each program level is based on specific technical requirements targeted to advance specific construction practices in the AEP Ohio service territory. Home's performance is measured by the HERS rating process, which is carried out by HERS raters who inspect homes throughout the building process and upon completion.

Table 1-1. Technical Requirement for Program Homes

Technical Requirement	EfficiencyCrafted™	EfficiencyCrafted™ Plus
ENERGY STAR® certified	NA	√
Maximum HERS rating	70	70
High-efficiency heating	√	√
Duct air leakage tested	√	√
HVAC installation compliant with program checklists	√	√
Maximum 5.0 ACH50 building envelope air leakage	√	√
ENERGY STAR® lighting (percent of total)	100%	100%
All ENERGY STAR® appliances if supplied by builder	√	√

In the previous years, incentive amounts were determined based on the HERS score and home type. However, AEP Ohio has switched from HERs based incentive structure to performance based incentive structure going in effect March 2017. Table 1-2 presents performance based incentive amounts.

Table 1-2. AEP Ohio Efficiency Crafted Homes Incentives

Single Family and Multi-Single homes (e.g. townhomes)	
EfficiencyCrafted™	$200 + $0.12/kWh
ENERGY STAR® certified	$300 + $0.12/kWh

1.4 Evaluation Objectives

The three major objectives of the evaluation were to: 1) quantify energy and summer peak demand savings impacts from the program during 2017; 2) determine key process-related program strengths and weaknesses to identify ways in which the program can be improved and; 3) determine program cost-effectiveness.

1.5 Evaluation Methods

Navigant conducted the following activities to collect the information necessary to achieve these evaluation objectives:

1. A program documentation review
2. In-depth interviews with AEP Ohio staff and program implementation contractor staff
3. Tracking system review
4. Online survey of participant builders
5. Building simulation modeling

1.6 Evaluation Questions

1.6.1 Impact Questions

1. What are the annual energy (kWh) and peak demand (kW) savings induced by the program?
2. What are the realization rates? (Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings.)
3. What are the benefits and costs attributable to the program?

1.6.2 Process Questions

1.6.2.1 Program Characteristics and Barriers

1. How do participants perceive the incentives and costs related to this program?

2. Are builders sufficiently satisfied with the program incentives to sustain participation goals?

3. Are there particular program characteristics that could be changed to improve builder satisfaction while maintaining program effectiveness?

4. Do participating builders see any increase in-home value for an ENERGY STAR® or EfficiencyCrafted^{TM} home?

5. What are the key barriers to greater participation in the program for enrolled builders who are not completing many projects, and how can these be addressed by the program?

1.6.2.2 Marketing and Participation

6. Is the program outreach to participating builders effective in increasing awareness of the program opportunities?

7. What is the format of the outreach?

1.6.2.3 Market Characterization

8. What is the program's current progress toward market penetration goals, including the number of EfficiencyCrafted^{TM} Homes certified (and initiated) and the number of builders participating in the program?

9. Has market penetration increased in those high-construction areas within the service territory where program participation has been low?

10. What are key factors contributing to and/or limiting further penetration of the EfficiencyCrafted^{TM} Homes Program?

1.6.2.4 Administration and Delivery

11. Has the program as implemented changed from 2016? If so, what is the impact of these changes?

12. Is the program efficient and well managed? How are problems resolved?

13. What are the opportunities for program improvement?

2. EVALUATION METHODS

This section describes the analytic methods and data collection activities implemented as part of the 2017 evaluation of the EfficiencyCrafted™ New Homes Program, including an overview of data collection activities and analysis.

2.1 Overview of Approach

To meet the objectives of this evaluation, the evaluation team undertook the following activities:

1. **Develop Evaluation Questions**. Key evaluation questions were established from the development of the 2017 evaluation plan with AEP Ohio staff and a review of the key outcomes of the 2016 program evaluation.

2. **Tracking Data Review**. The program tracking data collected by the implementation contractor were reviewed for consistency and accuracy.

3. **Review of New Program Documentation**. Reviewed changes to program documentation and marketing materials.

4. **Primary Data Collection**. Primary data collection was performed through interviews with program staff and implementers, and online surveys with participating builders.

5. **Methods Used to Analyze Impact Data**. Key impact parameters for program homes were extracted from REM/Rate™ files submitted by raters, tracking data, and secondary data sources. These parameters were used to verify building performance requirements and re-calculate energy and demand savings.

6. **Methods Used to Analyze Process Data**. The effectiveness of the program processes was assessed by analyzing program tracking data, in-depth interview data, and participant survey data.

2.2 Data Collection Methods

To determine answers for the key research questions in the evaluation, the evaluation team conducted a series of primary data collection activities. Qualitative and quantitative data were collected through in-depth interviews with program staff and through online surveys with program participant builders who completed homes through the program in 2017.

Program staff members were interviewed by telephone in January 2018. Each interview lasted roughly an hour and covered changes to program design and implementation, marketing and promotion, and perceived barriers to participation. Table 2-1 provides a summary of the data collection activities conducted to support the process evaluation. An online survey of eight program builders was conducted in February 2018. The online survey addressed process related research objectives including marketing and promotion, customer satisfaction and suggestions for program improvement.

Table 2-1. Data Collection Activities

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
In-Depth Telephone Interviews	AEP Ohio Program Staff	Contacts from AEP Ohio	New Homes Program Coordinator	1	January 2018
	Staff of Program Implementer	Contacts from the Program Implementation Contractor	Program Manager, VP Program Development	2	January 2018
Participant Online Surveys	Participating Builders	Tracking Database	Random Sample of Program Participants	8	February 2018

2.3 Tracking Data Review

Navigant conducted a review of program data in the program tracking system to assess their accuracy and effectiveness for use in recording, tracking, and reporting the processes and impacts of the program. This review included an assessment of the incentive processing timeframes, a review of the project data for outliers and missing information, and an assessment of the data collected on incentive applications and recorded in the tracking systems. The tracking review also included additional assessments of the data, including:

- Analysis of the key characteristics (e.g., size, equipment specifications, HERS rating, etc.) of homes participating in the program

- Analysis of REM/Rate™ files submitted by raters for completed homes

The program tracking system and individual project data were closely reviewed to determine discrepancies, outliers and missing values. The evaluator did not address whether the tracking system is adequate for regulatory prudency reviews or corporate requirements.

2.4 Ex Post Savings Evaluation

The Navigant team verified savings reported from participating homes by completing an engineering review of *ex ante* savings calculated for a sample of projects using the REM/Rate™ building simulation model. Navigant assessed savings through the following steps:

1. Reviewed baseline model characteristics against Draft 2010 Ohio Technical Reference Manual[4] specifications and 2009 IECC code requirements to verify that assumptions are appropriate and have been correctly applied.

2. Analyzed REM/Rate™ files and supporting documentation submitted for a sample of participating projects to verify that homes were built to program specifications.

3. Calculated savings for a sample of records in the tracking system per the Draft 2010 Ohio Technical Reference Manual, compared to AEP Ohio's *ex ante* savings.

---

[4] Draft *State of Ohio Energy Efficiency Technical Reference Manual.* Prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation, August 6, 2010.

The annual energy and demand savings associated with each program home was calculated as the difference between the UDRH and program home simulation results within a sample of program homes. The energy and demand realization rates from the sample were applied to the entire program savings to determine program total *ex post* savings.

To determine target sample sizes, the evaluation team calculated the coefficient of variation (CV) from the 2017 impact evaluation sample. Realization rates for this modeling exercise have been consistently at or near 100 percent, yielding a CV of 0.09. Based on this information, attaining +/- 10 percent precision at a 90 percent level of confidence at the program level would result in a sample size of four file reviews. However, Navigant applied a conservative CV of 0.25 to ensure sufficient sample for verification and due diligence purposes, resulting in a target sample of 20 file reviews.

To draw the sample, Navigant calculated the proportion of total homes completed by each builder. Navigant soft stratified the sample by builder volume, ensuring files were reviewed for the top ten builders, which represented more than 80 percent of the program's volume.

Table 2-2 shows the actual population of homes completed in 2017, the number of file reviews completed, and the resulting sampling error. Overall sampling efforts resulted in +/- 8.5 percent precision at a 90 percent level of confidence.

Table 2-2. 2017 File Review Completes and Population-Level Sampling Error

Strata	2017 Strata Population Size (N)	Coefficient of Variation*	Target Completes	Actual Completes (n)	Sampling Error (90% CI)
EfficiencyCrafted™ New Homes	1,762	0.20	15	25	6.8%

*Estimated from the results of the 2017 impact evaluation desk review.

2.5 Program Material Review and Secondary Research

The evaluation team reviewed all program materials provided by the program implementation contractor to date. A summary list of program materials reviewed for this report includes:

- Program tracking data
- Program marketing materials
- Program website

3. DETAILED EVALUATION FINDINGS

This section presents detailed findings from the evaluation of the EfficiencyCrafted™ New Homes Program.

3.1 Impact Evaluation Findings

3.1.1 Summary of Program Activity

Participation in the EfficiencyCrafted™ New Homes Program in 2017 was above Plan[5] forecasts. The program reported 1,762[6] building projects in 2017, submitted by nearly 40 building companies. Table 3-1 shows a summary of key impact evaluation metrics over the past five program years.

Table 3-1. Summary of Key Program Activity Metrics

Program Activity Metric	2017	2016	2015	2014	2013
Participation					
Number of Units	1,762	1,792	1,842	1,723	2,186
Number of Active Builders	39	41	35	32	35
Program Market Penetration*	34%	33%	24%	24%	24%
ENERGY STAR® Level Penetration**	7%	7%	6%	7%	7%
Energy Savings					
Total *Ex Ante* Savings (MWh)	5,299	4,144	4,196	3,815	5,835
Average Savings / Unit (kWh)	3,007	2,313	2,278	2,214	2,669
Average Savings / SF (kWh/SF)	0.83	0.65	0.66	0.59	0.75
Average HERS Score***	60	57	55	55	59
Incentive Spending					
Average Incentive / Home ($)****	$562	$442	$333	$296	$999
Average Incentive / kWh ($)****	$0.19	$0.19	$0.15	$0.13	$0.37
Participant Satisfaction (0-10)	9.5	N/A	8.8	8.6	8.6

* Represents the market penetration of all EfficiencyCrafted™ homes completed in AEP Ohio territory.
** Represents the market penetration of homes completed at the ENERGY STAR® level in AEP Ohio territory.
*** The lower the HERS score, the more energy efficient the home
**** Represents the AEP Ohio portion of the combined incentive.

3.1.2 Summary of Impact Findings

The *ex ante* energy and demand savings for 2017 were 5,298,604 kWh and 2752 kW. These savings exceeded the program goals of reducing energy usage by 4,735 MWh and peak demand by 1 MW.

---

[5] *AEP Ohio Volume 1: 2017 TO 2019 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, September 2, 2016, data for 2017.*

[6] *This number does not include 5 units from the Manufactured Homes program. These units were included in the New Homes evaluation sample. They are not claimed in Ex Post savings.*

3.1.3 Ex Ante Energy Savings

Table 3-2 summarizes total unadjusted energy savings from the tracking system as well as the average energy savings per home.

Table 3-2. Total *Ex Ante* Energy Savings

	EfficiencyCrafted™	EfficiencyCrafted™ Plus	Total or Overall Average
Average Savings/Unit (kWh)	3,100	2,621	3,007
Number of Units	1,420	342	1,762
Total Ex Ante Energy Savings (MWh)	4,402	896	5,299

3.1.4 Ex Post Energy Savings

Table 3-3 shows the results of the modeling procedures discussed in Section 2.4 to compute the energy savings estimates for each participation level. The energy savings realization rate from the impact evaluation sample were applied to the remaining population of projects and aggregated to determine the total *ex post* energy savings.

Table 3-3. *Ex Post* Energy Savings

	EfficiencyCrafted™	EfficiencyCrafted™ Plus	Total or Overall Average
Average Savings/Unit (kWh)	3,100	2,621	3,007
Number of Units	1,420	342	1,762
Total Ex Ante Energy Savings (MWh)	4,402	896	5,299

3.1.5 Ex Ante Demand Savings

Table 3-4 summarizes total *ex ante* demand savings from the tracking system as well as the average demand savings per home.

Table 3-4. *Ex Ante* Coincident Demand Savings

	EfficiencyCrafted™	EfficiencyCrafted™ Plus	Total or Overall Average
Average Savings / Unit (kW)	1.6	1.4	1.6
Number of Units	1,420	342	1,762
Total Ex Ante Demand Savings (MW)	2.3	0.5	2.8

3.1.6 Ex Post Demand Savings

Table 3-5 shows the results of the modeling procedures discussed in Section 2.4 to compute the *ex post* coincident demand savings estimates for each participation level. The demand savings realization rate from the impact evaluation sample were applied to the remaining population of projects and aggregated to determine the total *ex post* demand savings.

Table 3-5. Ex Post Coincident Demand Savings

	EfficiencyCrafted™	EfficiencyCrafted™ Plus	Total or Overall Average
Average Savings / Unit (kW)	1.6	1.4	1.6
Number of Units	1,420	342	1,762
Total Ex Post Demand Savings (MW)	2.3	0.5	2.8

3.1.7 Realization Rates

AEP Ohio's EfficiencyCrafted™ New Homes Program reports *ex ante* values in the tracking data. Table 3-6 shows the realization rates for the 2017. The realization rates were 1.00 for energy and peak demand savings.

Table 3-6. 2017 Realization Rates

2017 *Ex Ante* Savings		2017 *Ex Post* Savings		Realization Rates	
kWh	kW	kWh	kW	kWh	kW
5,298,604	2752	5,298,604	2752	1.00	1.00

3.2 Process Evaluation Findings

This section presents detailed findings of the process evaluation of the EfficiencyCrafted™ New Homes Program. Data sources for the process evaluation included online surveys of participant builders and in-depth interviews with program staff and both the implementation contractor's Program Manager and Operations Manager, and review of program materials and tracking data.

3.2.1 Participant Satisfaction

Navigant conducted an online survey of eight participating EfficiencyCrafted™ New Homes Program builders to determine their satisfaction with various aspects of the program. A census of all program participants was attempted though only eight companies participated in the online survey. Participants were asked to rate their satisfaction on a scale of 0 to 10, where 0 – "Not at all satisfied" and 10 – "Extremely satisfied."

Overall satisfaction with the program and most of the elements of the program increased in 2017, as shown in Table 3-7, though satisfaction decreased slightly for the training opportunities, and remained the same for the time it takes to receive the incentives. One participant reported low satisfaction with the time it takes to receive a rebate and the incentive application process due to lack of notice on the status of the rebate process. The satisfaction score for training was skewed by one builder who reported trainings are mostly offered in Columbus which is too far for travel, and credits cannot be used for the architectural continuing education. AEP Ohio Gas' program separated from the Columbia Gas program in 2017 and therefore the training offerings were split between the two. The feedback for Columbia Gas trainings may have influenced the satisfaction ratings.

Table 3-7. Mean Builder Satisfaction Scores (n=8)[7]

Program Aspect	Satisfaction Rating (Scale of 0 to 10)			
	2017	2015	2014	2013
Overall experience with the ENERGY STAR® Homes program	9.5	8.8	8.6	8.6
Site Submittal and Incentive Application Process	8.5	8.1	9.0	8.0
Time Required to Certify a Home	8.5	8.1	8.6	7.2
Training opportunities offered through the program	7.8	7.9	8.3	8.4
Incentive Amounts for EfficiencyCrafted™ Homes	8.3	7.5	7.4	6.0
Time to Receive Incentive	7.3	7.3	7.9	6.0
Incentive Amounts for ENERGY STAR® Homes	8.7	7.2	7.4	5.6

When asked what could be changed about the program to improve their satisfaction, most builders responded they were happy with the program as it is. Suggestions for improving the program were to increase incentives; offer more online trainings, especially for HVAC contractors; and create public awareness about the benefits of EfficiencyCrafted™ homes by sharing data on the performance of program homes. Builders reported an increase in average satisfaction with incentive amounts in 2017.

---

[7] Builder surveys were not conducted in 2016. Therefore, there are no results for builder satisfaction scores in 2016.

When asked their opinion of barriers to participation for non-participant builders, respondents reported the cost associated with testing; lack of qualified ENERGY STAR® certified HVAC contractors; and lack of awareness of the program among homebuyers.

3.2.2 Program Activity

Most builders who participated in the survey (n=8) indicated their program activity (number of homes completed) increased or remained the same in 2017. Builders were asked to report several building statistics related to all the homes built by their company in 2017. Table 3-8 shows 97 percent of all the homes built by respondents in 2017 received a rebate through the program. Two percent of homes built by respondents did not receive a rebate through the program, due to service territory in-eligibility. One percent of homes did not meet the program standards. This suggests little room for further market penetration among these existing participating builders.

Table 3-8. Participating Builders Home Statistics

Builder Participation	Percent of all Homes Built by Company in 2017
Homes meeting Efficiency Crafted**TM** standards and received an incentive through the program	97%
Homes meeting Efficiency Crafted**TM** standards but did not receive an incentive	2%
Homes not meet program standards	1%

3.2.3 Marketing and Promotion

The EfficiencyCrafted^{TM} New Homes Program was promoted to homebuilders in 2017 through in-person meetings with builders, outreach at industry meetings, and through television, print and digital advertisements. The primary target for marketing and outreach activities is homebuilders. Those activities focus on recruiting and maintaining the network of builders and supporting them in advertising EfficiencyCrafted^{TM} homes to potential homebuyers. The secondary target for marketing efforts is potential homebuyers, who were reached through an advertising campaign with messaging focused around efficiency and comfort. AEP Ohio is working with builders to add EfficiencyCrafted^{TM} logos onto participating builder's websites to enhance homebuyers' awareness and demand for the EfficiencyCrafted^{TM} certified homes.

3.2.4 Market Progress

The program implementation contractor tracked market penetration in 2017 by comparing data provided by AEP Ohio on new meters installed in single-family new construction with the number of incentive payments issued. Table 3-9 presents a comparison of program market penetration from 2013 to 2017. The program market penetration in 2017 exceeded the Program's annual goal.

Table 3-9. Market Penetration Based on Projects Completed in 2017

Description	2017	2016	2015	2014	2013
Number of new projects completed	1,762	1,792	1,842	1,723	1,664
Number of new meters installed in new single family homes	5,117	5,365	7,533	7,130	6,865
Market penetration of the EfficiencyCrafted^{TM} New Homes Program	34%	33%	24%	24%	24%

3.2.5 Application and Payment Processing

Navigant completed a review of the incentive processing times entered into the incentive tracking dataset. Table 3-10 breaks down the time period between project completion and incentive payment by showing the cumulative number of days between project completion, application approval, and incentive payment. The average duration between the project completion and incentive application approval was 54 days. Once incentive forms were approved, the average duration for incentive payment was 10 days. Therefore, the total duration between project completion and incentive payment was 64 days on average.

Table 3-10. Incentive Processing Time (Average Days)

Process	2017	2016	2015	2014	2013
Project Completion to Application Approval	54	59	78	69	80
Application Approval to Incentive Payment	10	7	12	4	42
Total Rebate Processing Time	64	65	90	73	122

3.2.6 Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) processes are well established and remain unchanged from 2016. The program has a network of raters with several years of experience working with builders through the program, resulting in a steady decrease in quality control issues. Navigant cross-checked project data from REM/Rate^{TM} files and the tracking system against the program requirements at each participation level and found the tracking system and REM/Rate^{TM} files were in good order.

3.2.7 Tracking and Reporting

The implementation contractor requires all projects to submit incentive application forms and REM/Rate^{TM} files to determine energy savings and verify program compliance. Key tracking data is entered into the implementation contractor's VISION database which stores documentation of building and program specifications, application data and incentive data. The data tracking and reporting system for the EfficiencyCrafted^{TM} New Homes Program was modified in 2017 due to the separation of running the program in tandem with Columbia Gas. This modification caused several changes that had to be worked through with AEP Ohio and the implementer.

A final end-of-year data extract was provided in support of this evaluation by AEP Ohio in January of 2018. The data contained roughly 120 fields and 1,762[8] unique project entries. REM/Rate™ files for a sample of 25 projects were reviewed for missing information, outliers and compliance with program requirements. Despite some initial data issues due to changes in the tracking system, the evaluation tracking system extract was found to be well organized and complete and all data needed for evaluation was tracked. The tracking data were not assessed for prudency, regulatory review or corporate requirements.

Detailed monthly reports are prepared by the implementation contractor, which are clear, comprehensive, and delivered in a timely fashion. The monthly report provides a well-organized summary narrative of program activities conducted during the month. The report contains data required by program staff to monitor program progress and make course corrections, if necessary.

3.3 Cost-Effectiveness Review

This section addresses the cost effectiveness of the EfficiencyCrafted™ New Homes Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-11 summarizes the unique inputs used in the TRC test.

Table 3-11. Inputs to Cost-Effectiveness Model for EfficiencyCrafted™ New Homes Program

Item	Value
Average Measure Life	25
Units	1762
Annual Energy Savings (kWh)	5,298,604
Coincident Peak Savings (kW)	2752
Third-Party Implementation Costs	$974,957
Utility Administration Costs	$246,202
Utility Incentive Costs	$991,680
Participant Contribution to Incremental Measure Costs	$3,173,683

Based on these inputs, the TRC ratio is 1.4. Table 3-12 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant Cost Test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-12. Cost Effectiveness Results for the EfficiencyCrafted™ New Homes Program

Benefit-Cost Test Results	Ratio
Total Resource Cost	1.7
Participant Cost Test	1.8
Ratepayer Impact Measure	0.8
Utility Cost Test	3.4

---

[8] *This number does not include 5 units from the Manufactured Homes program. These units were included in the New Homes evaluation sample. They are not claimed in Ex Post savings.*

4. CONCLUSIONS

This section highlights the findings from the impact and process evaluation of the EfficiencyCrafted^{TM} New Homes Program.

4.1 Key Impact Findings

Navigant used REM/Rate™ building simulation modeling to verify energy and peak demand savings for the EfficiencyCrafted™ New Homes Program as specified by the Draft 2010 Ohio Technical Reference Manual. Navigant reviewed the UDRH baseline inputs to ensure the energy characteristics of the UDRH matched the 2009 IECC, which is the current Ohio energy code for residential new construction. The annual energy and demand savings associated with the program homes were calculated as the difference between the UDRH and program home simulation results for a sample of 25 program homes. The energy and demand realization rates from the sample were applied to the entire program savings to determine program total *ex post* savings.

AEP Ohio reported *ex ante* 5,298,604 kWh of energy savings and 2752 kW of demand savings for the EfficiencyCrafted™ New Homes Program in 2017. The *ex post* energy and demand savings for 2017 were 5,298,604 kWh and 2752 kW. These savings exceeded the program goals as shown in Table 4-1. The realization rates were 1.00 for energy savings and 1.00 for peak demand savings.

Table 4-1. Overall Evaluation Results

	2017 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	4,735	5,299	5,299	1.00	112%
Demand Savings (MW)	0.963	2.8	2.8	1.00	286%

[1] *AEP Ohio Volume 1: 2017 TO 2019 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, September 2, 2016, data for 2017.*

4.2 Key Process Findings and Recommendations

The process evaluation component of the AEP Ohio EfficiencyCrafted™ New Homes Program assessed the effectiveness of the program operations and delivery. Navigant's process evaluation included in-depth interviews with program staff, online surveys, and a review of program tracking systems, reports, and marketing materials.

Finding 1: Participant Satisfaction. Builders remain highly satisfied with their overall experience with the program. Overall satisfaction with the program and most of the elements increased in 2017, though satisfaction decreased slightly for the training opportunities, and remained the same for the time it takes to receive the incentives. Builders reported an increase in satisfaction for the incentives amounts in 2017.

> **Recommendation 1a.** Consider online webinars and training videos in addition to in-person trainings for the builders and HVAC contractors, to allow distant builders and HVAC contractors to attend the trainings remotely. Additionally, these webinars could be recorded and provided on the program website to allow builders a self-paced training experience.

Finding 2: Marketing and Promotion. The program's marketing strategy and tactics remained largely unchanged in 2017. The program was promoted to homebuilders and homebuyers in 2017 through in-person meetings, outreach at industry meetings, and through TV, print and digital advertisements. Two builders reported low satisfaction with the EfficiencyCrafted™ brand in the home sales process noting that homebuyers are not aware of EfficiencyCrafted™ homes and their benefits.

> **Recommendation 2a.** Help builders create public awareness about the benefits of EfficiencyCrafted™ homes by showing program home energy performance and/or cost savings on the program website. Develop interactive branded graphics to visualize data on the benefits of EfficiencyCrafted™ homes that builders could incorporate into their websites. These graphics could further incentivize builders to display program branding on their websites, to raise awareness among homebuyers.

> **Recommendation 2b.** Recruit and engage realtors or real estate agents who can share the financial benefits of EfficiencyCrafted™ homes with the potential homebuyers compared to the average homes in the neighborhood.

Finding 3: Data Tracking and Reporting. Data tracking and reporting system was modified in 2017 due to the separation of the program from Columbia Gas' program. This modification required several changes to the data tracking and reporting processes. All data needed for evaluation was tracked.

> **Recommendation 3a**. The implementer should keep AEP Ohio informed of any changes in the data tracking and reporting system before implementation**.**

Finding 4: Application and Payment Processing. Navigant completed a review of the incentive processing times entered into the incentive tracking dataset. Incentive application processes and incentive processing cycle time remained largely unchanged in 2017.

APPENDIX G

Home Energy Report Program

2017 Evaluation Report

Prepared for:

AEP Ohio

April 30, 2018

Submitted by:
Navigant Consulting, Inc.
30 S. Wacker Drive
Suite 3100
Chicago, IL 60606

312.583.5700
navigant.com

NAVIGANT

Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

Randy Gunn
Managing Director
Navigant Consulting, Inc.
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director   Stu Slote, Director
312.583.5714   802.526.5113
randy.gunn@navigant.com   stu.slote@navigant.com

Prepared by:

Kathleen Ward, Managing Consultant
303.248.4028
kathleen.ward@navigant.com

Rachel Marty, Managing Consultant
303.728.2523
rachel.marty@navigant.com

TABLE OF CONTENTS

LIST OF FIGURES, TABLES AND EQUATIONS

EXECUTIVE SUMMARY

This document summarizes the 2017 evaluation of AEP Ohio's Home Energy Report (HER) Program. The program has been operating since August 2010, making 2017 the seventh full year in which the program has been in operation. This annual evaluation of the program includes estimates of electric energy and demand savings, a process evaluation including a customer survey, as well as recommendations based on the evaluation.

ES.1 Program Overview

The HER Program helps residential participants reduce electricity usage by encouraging them to alter their habits of electricity use by providing positive reinforcement behavior modification. Through 2017, participants are enrolled on an opt-out basis in the energy efficiency service operated and delivered by the program implementation contractor. Program participants were randomly selected for program enrollment from three AEP Ohio customer groups, including:

- Higher-than-average electricity users (abbreviated as HU for high use customers). HU program participants include the original group of customers enrolled in 2010, as well as additional cohorts enrolled in 2011, 2013, 2014, 2016, and 2017.

- Low-income households enrolled in a State of Ohio program called Percentage of Income Payment Plan (PIPP). PIPP program participants include a single group of customers enrolled in 2010.

- Customer residences equipped with Advanced Metering Infrastructure (AMI). AMI program participants include the original group of customers enrolled in 2010, as well as additional cohorts enrolled in 2011, 2013, 2014, 2015, 2016, and 2017.

The program provides participants with a mailed or electronic report that is received separately from their normal utility bills. The mailed report (included in Appendix C) consists of a single page (front and back) containing:

- A bar chart comparing last month's electricity costs for the participant with two groups of similar homes
- A line graph comparing monthly electric use for each of the previous 12 months for the participant, and for two groups of similar homes
- A bar chart showing the participant whether they are using more or less electricity than during the comparable season last year
- Bulleted lists of simple actions the participant can take to reduce electricity usage
- An estimate of savings the customer may see on the electricity bill if a specific action is taken

Access to participant information and more tailored tips is also available through an Internet web portal available to the participant even after opting-out of the mailed reports.[1]

---

[1] https://aepo.opower.com/

ES.2 Evaluation Objectives

This evaluation addresses the following objectives:

- Quantify energy and peak demand savings attributable to the HER Program
- Calculate the energy and peak demand savings attributable to each participant subgroup
- Estimate the increased rate of participation in other AEP Ohio energy efficiency/peak demand reduction (EE/PDR) programs due to participation in the HER Program
- Estimate program cost effectiveness

ES.3 Evaluation Methods

ES.3.1 Impact Evaluation

For the impact evaluation, Navigant used a linear fixed-effects regression (LFER) model to estimate program savings. The LFER model combines both cross-sectional and time series data in a panel dataset. The data consists of electric billing data both before program enrollment and for 2017, for both treatment (program) households receiving the Home Energy Reports and control households that do not receive the reports. The program evaluation utilizes a randomized controlled trial (RCT) experimental design, with households randomly allocated to the control and treatment groups. The RCT design eliminates the issue of selection bias that complicates the evaluation of many behavioral programs. The basic LFER model casts the average daily electricity use as a function of a household-specific constant term, a variable indicating whether the observation is in the pre- or post-program period, and a variable indicating whether the household is a treatment household or a control household. Navigant also utilized a Lagged Dependent Variable (LDV) model as a robustness check on the savings results.

ES.3.2 Process Evaluation

Navigant used in-depth interviews and online customer surveys to complete the HER program process evaluation for program year 2017.

Table ES-1 summarizes the data used during the 2017 evaluation of the HER Program.

Table ES-1. Data Collection Activities for Impact and Process Analysis

Data Collection Type	Targeted Population	Sample Design	Sample Size	Timing
Program Tracking Data	Participant and control customers	NA	Attempted program census	Feb 2018 – Mar 2018
Billing Data	Participant and control customers	NA	Attempted program census	Feb 2018 – Mar 2018
Customer Surveys	Participant customers	90/10[2]	400	November 2017 – January 2018

---

[2] Survey was designed to achieve 90 percent confidence and 10 percent precision on customer satisfaction

| In-depth Telephone Interviews | Program manager and implementer | NA | 2 | Feb 2018 – Mar 2018 |

ES.4 Key Evaluation Findings and Recommendations

ES.4.1 Evaluation Findings

The HER Program reported *ex ante* 76,229 MWh of energy savings and 9,909 kW of demand savings in 2017. The verified *(ex post)* energy and demand savings for 2017 for all HU and PIPP customers combined were 72,958 MWh and 9,512 kW respectively. A comparison of *ex ante* and *ex post* HER Program savings are shown in
Table ES-2.

Table ES-2. 2017 Overall Evaluation Results

	2017 Program Goals (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	75,000	76,229	72,958	0.96	97%
Demand Savings (MW)	3.750	9.909	9.512	0.96	254%

Source: Navigant analysis of customer billing data provided by AEP Ohio.
AEP Ohio EE/PDR 2017 Performance Report 12-31-2017 Final.

Savings from AMI customers are not included in the above *ex ante* and *ex post* calculations because these savings are not counted toward the HER Program savings goals. Navigant estimated AMI customers provided an additional 4,217 MWh of energy savings and 550 kW of peak demand savings.

A summary of the savings from each customer group includes:

- All HU customers accounted for a total of 70,391 MWh of energy savings, corresponding to 9,178 kW of peak demand savings. HU customers represent 91 percent of the total savings.

- Low-income customers accounted for 2,566 MWh of energy savings, corresponding to 335 kW of peak demand savings, and represent approximately 3 percent of total savings.

- AMI customers accounted for 4,217 MWh of energy savings, corresponding to 550 kW of peak demand savings, representing 5 percent of total savings.

Detailed impact results for each customer group participating in the HER Program are provided in Table ES-2 and Table ES-3. In the tables, customers are divided into cohorts based upon when they initially enrolled in the HER Program.

Table ES-3. Estimated Program Savings by Participant Type

	2010 HU	2011 HU	2013 HU	Jan 2014 HU	Aug 2014 HU	2016 HU	Feb 2017 HU	Sept 2017 HU‡	PIPP	TOTAL
Number of Active Participants^ (start of 2017 or cohort)	84,790	14,517	77,675	57,128	28,674	54,696	191,469	31,369	9,114	**549,432**
2017 Move-outs	4,141	787	5,878	4,790	3,709	10,081	31,144	4,172	913	**65,615**
2017 Opt-outs±	32	9	25	15	8	36	59	6	2	**192**
Average Daily Household kWh Used	44.0	57.5	40.0	34.2	35.8	40.3	26.5	36.4	37.1	**N/A**
Estimated Daily kWh Savings per participant	0.87	0.86	0.59	0.41	0.42	0.27	0.13	-0.15	0.80	**N/A**
(standard error)	(0.08)	(0.24)	(0.08)	(0.09)	(0.17)	(0.08)	(0.04)	(0.15)	(0.23)	**N/A**
Estimated Annual kWh Savings per participant	*316*	*314*	*216*	*151*	*153*	*100*	*46*	*-55*	*291*	**N/A**
(standard error)	*(30)*	*(88)*	*(29)*	*(34)*	*(61)*	*(31)*	*(15)*	*(55)*	*(84)*	**N/A**
Estimated Percentage Savings	1.93%	1.48%	1.46%	1.19%	1.16%	0.68%	0.48%	-0.42%	2.10%	**N/A**
Estimated Total MWh Savings* (a)	26,760	4,515	15,631	8,284	4,116	4,929	6,900	-	2,540	**73,675**
Savings Counted in Other Programs (b)	84	49	214	48	-25	73	300	87	-26	**804**
Total Savings (MWh) = (a) – (b)	**26,676**	**4,466**	**15,416**	**8,236**	**4,141**	**4,855**	**6,600**	**-**	**2,566**	**72,958**
Total Savings (kW)†	**3,478**	**582**	**2,010**	**1,074**	**540**	**633**	**861**	**-**	**335**	**9,512**

Source: Navigant analysis of customer billing data provided by AEP Ohio.
Note: All savings values are statistically significant at the 95% confidence level.
* Aggregate savings values have been adjusted to account for customer move-outs throughout the program year.
‡ The analysis of the September 2017 HU cohort of participants produced a negative estimate of savings. Therefore, the total savings from this cohort has been assumed to be zero, since it is unlikely that the program produced an increase in average household energy usage.
† The billing analysis model described in this report cannot be directly utilized for the estimation of demand savings. In order to properly determine demand savings using this method, intraday customer billing data would be needed. In the absence of such data, Navigant applied the ratio of kW to MWh savings from the program plan to the estimate of energy savings produced by the program analysis.
± Opt-outs are not removed from the analysis.
^ AEP Ohio reported 550,209 active participants for the 2017 program year. Navigant removed the duplicate customers split across waves and the opt outs at the start of 2017 and/or cohort start which is the driver of the different participant values for ex ante and ex post.

Table ES-4 presents the estimated savings for the AMI cohorts enrolled in the HER Program. Savings for these customers were also adjusted to account for double counted savings and participants that moved out of their households during 2017.

Table ES-4. Estimated Program Savings by AMI Participant Group Using Equations 1 and 2

	2010/11 AMI	2013 AMI‡	2014 AMI	2015 AMI	2016 AMI	2017 AMI‡	TOTAL
Number of Active Participants (start of 2017 or cohort)	30,144	3,535	6,886	7,921	7,107	2,488	**58,081**
2017 Move-outs	2,519	580	837	1,795	2,013	2	**7,746**
2017 Opt-outs±	10	0	4	3	1	0	**18**
Average Daily Household kWh Used	27.1	26.5	28.7	23.3	25.5	19.4	**N/A**
Estimated Daily kWh Savings per participant	0.25	-0.38	0.36	0.30	0.00	0.05	**N/A**
(standard error)	(0.16)	(0.23)	(0.16)	(0.12)	(0.16)	(0.47)	**N/A**
Estimated Annual kWh Savings per participant	*92*	*-137*	*133*	*109*	*1*	*18*	**N/A**
(standard error)	*(58)*	*(85)*	*(57)*	*(42)*	*(57)*	*(173)*	**N/A**
Estimated Percentage Savings	0.92%	0.00%	1.25%	1.26%	0.01%	0.26%	**N/A**
Estimated Total MWh Savings* (a)	2,688	-	852	748	8	-	**4,297**
Savings Counted in Other Programs (b)	72	-18	28	-29	8	11	**73**
Total Savings (MWh) = (a)	**2,688**	**-**	**852**	**748**	**8**	**-**	**4,297**
Total Savings (kW)†	**351**	**-**	**111**	**98**	**1**	**-**	**560**

Source: Navigant Analysis
Note: All values are statistically significant at the 95% confidence level except for the 2013 cohort.
* Aggregate savings values have been adjusted to account for customer move-outs throughout the program year.
‡ The analysis of the 2013 and 2017 AMI cohorts of participants produced a negative estimate of savings. Therefore, the total savings from these cohorts has been assumed to be zero, since it is unlikely that the program produced an increase in average household energy usage.
† The billing analysis model described in this report cannot be directly utilized for the estimation of demand savings. In order to properly determine demand savings using this method, intraday customer billing data would be needed. In the absence of such data, Navigant applied the ratio of kW to MWh savings from the program plan to the estimate of energy savings produced by the program analysis.
± Opt-outs are not removed from the analysis.

As shown in Table ES-3 and Table ES-4, Navigant found savings varied significantly by customer group: HU participants in the earlier cohorts are estimated to have saved more energy than other customer groups on an absolute basis. This is partly due to their higher average daily energy use as compared to other participant cohorts. On a relative basis, the savings from the earlier cohorts enrolled in 2010 through 2015 all exceed one percent of daily energy usage.

A meaningful result from the cohort-level findings is the relatively low rate of savings from the later cohorts compared to the earlier cohorts. The five cohorts enrolled during 2016 and 2017 are estimated to have generated under one percent savings. Prior experience has shown once customers begin receiving

HERs, it can take up to 18 months for savings to fully materialize after a customer is enrolled in the program. This "ramp-up" phase may be impacting the savings estimate for the 2017 HU both February and September) and AMI cohorts, as well as the 2016 HU and AMI cohorts. However, the 2016 AMI cohort generated almost no savings, despite having been deployed for 17 months by the end of 2017. This cohort may not be savings-generating in the coming program years.

In 2017, overall program savings were reduced by the savings generated by the increase in participation by HER Program customers in other AEP Ohio EE/PDR programs compared to control customers. Navigant used a Post-Only-Difference (POD) calculation to determine if any program savings should be subtracted to account for the HER Program participant energy savings attributable to other AEP Ohio programs. The approach ensures energy savings from another AEP Ohio EE/PDR programs are not double counted in the HER Program. The results of this program uptake analysis are shown in Table ES-5.

Table ES-5. Estimate of Energy Savings Attributable to Participation in Other Programs

	Appliance Recycling	Community Assistance Program	Efficient Products Rebates	In-Home Component of Efficient Products	Total
Average Post-Only Difference (POD) Statistic	0.09%	0.01%	0.03%	0.01%	**N/A**
Change in Program Participation due to HER Program (# of Participants)	509	57	168	48	**783**
Median Savings per Program Participant (kWh)	1,376	1,442	162	168	**N/A**
Total Savings (MWh)	**701**	**77**	**27**	**-1**	**804**

Source: Navigant analysis

Due to increased participation, the analysis determined an estimated 804 MWh of the evaluated savings from the HER Program were double counted in other AEP EE/PDR programs.

ES.4.2 Satisfaction Findings

Navigant measured customers' satisfaction with AEP Ohio by asking customers to rate their satisfaction on a scale of 0 to 10, where 10 is highly satisfied. Navigant categorized "overall satisfaction" as any rating above a 5, while "highly satisfied" is any score above an 8, as shown in Table ES-56.

Table ES-6. Satisfaction with AEP Ohio - Summary

Metric	2017 Result
Average Satisfaction Score	7.9
Overall Satisfied (score 6-10)	86%
Highly Satisfied (score 9-10)	48%

Source: Navigant analysis

ES.4.2 Recommendations

1. Navigant's analysis shows recent participant cohorts have a lower average daily energy usage and, relatedly, a lower average electricity savings. Evidence from this analysis also suggests some of the more recent cohorts may have a lower relative level of electric savings beyond the initial ramp-up period. Navigant suggests AEP Ohio continue the HER Program as long as regularly reported electric savings remain cost-effective, but also monitor the incremental cost and savings of each new cohort introduced to ensure individual cohorts contribute to the cost-effectiveness of the program as a whole.

2. Further investigation into the construction of the 2013 AMI cohort may be warranted to determine if there are customer characteristics that are adversely impacting participant savings. AEP Ohio should also carefully watch the 2016 AMI cohort, as savings were almost non-existent in 2017. If savings continue to lag for this wave, additional investigation may be warranted.

3. The results of the customer survey suggest both satisfaction and engagement with the reports are high. AEP Ohio should continue to track customer satisfaction in subsequent program years as year-over-year comparisons will serve as a benchmark for the efficacy of the reports, and could explain any future changes in electricity savings that may occur.

1. INTRODUCTION

1.1 Program Description

The purpose of the HER Program is to provide feedback to residential participants that will encourage them to change energy use habits to save energy. Customers are encouraged to do this through the use of a personalized report delivered to participating households eitherquarterly or bi-annually via mail. Customers with an email address in the system are delivered an electronic report each month. The information included in the report shows the energy use pattern of the household relative to peers and offers actions a participant can take to reduce their household's metered electricity usage. To implement this program, AEP Ohio contracted with an implementation contractor, Oracle, to develop and distribute the reports.

The HER Program provides recipients with the following items:

- A bar chart comparison of last month's electricity costs for the recipient and for two groups of similar homes.
- A line graph comparing monthly electric use for each of the previous 12 months for the recipient vs. two groups of about 100 similar homes.
- A bar chart showing the recipient whether it is using more or less electricity than during the comparable season last year.
- A short bullet list of simple actions the household could take to reduce electricity usage.
- An estimate of the savings the customer may see on the electricity bill if a specific action is taken.

The goal of the HER Program is to generate electric energy and demand savings by providing customers with information on their energy usage along with methods to manage usage. This is performed through behavioral changes and through influencing household purchasing decisions. Relevant energy habits include turning off appliances and lights when not in use, purchasing and installing low-cost energy efficiency measures, and participating in other AEP Ohio EE/PDR programs.

The program was launched in August 2010 with an initial mailing of the HERs to more than 200,000 residential customers selected as participants. Additional participants (and corresponding control households used for evaluation purposes) were added in 2011, 2013, 2014, 2015, 2016, and 2017 to increase the overall program savings, and/or to compensate for original participants that had opted-out of the program or moved out of AEP Ohio's service territory. The program provides participants with ongoing comparisons, tips, and encouragement that can produce energy savings, lower energy bills, and improve participant satisfaction.

Participants were randomly selected for program enrollment from three AEP Ohio customer groups, including:

- Higher-than-average electricity users (abbreviated as HU for high use customer), living in single-family homes. A total of eight cohorts of HU customers have been enrolled in the program. In 2010, the implementation contractor randomly selected 125,002 households for enrollment among customers that consume more than 21,000 kWh annually. Approximately 21,750 additional households that met the same criterion were enrolled in 2011. In 2013, the annual usage threshold for consideration as a high use customer was lowered to 16,000 kWh annually. Using this new criterion, 125,968 additional households were enrolled in the HER Program in 2013, 143,430 in two cohorts in 2014, 62,338 in 2016, and 223,565 in two cohorts in 2017.

- Lower-income households, enrolled in a State of Ohio program called Percentage of Income Payment Plan (PIPP). To stay enrolled, all households must have a verified annual income at or below 150 percent of the Federal Poverty Level (FPL). The PIPP helps customers arrange affordable long-term payment agreements. The PIPP group enrolled in 2010 was initially 25,000 participants. No additional cohorts of PIPP customers have been added to the HER Program.

- Customers utilizing Advanced Metering Infrastructure (AMI), all of which were located within the footprint of AEP Ohio's Smart Grid Demonstration Project. The AMI group originally contained 62,027 participants enrolled in 2010. AEP Ohio later added additional treatment households to this group, including 9,980 households in 2011, 12,677 in 2013, 15,000 in 2014, 12,278 in 2015, 9,317 in 2016, and 2,488 in 2017.

Additionally, AEP Ohio attempted to expand the program to include an opt-in component. Approximately 250,000 households were provided with marketing material regarding the HER Program and encouraged to opt-in to the program if interested in participating. While this endeavor resulted in 4,088 additional program participants, the result was significantly below the number targeted by AEP Ohio. The majority of the households remaining in the marketing endeavor were subsequently enrolled in the 2013 HU cohort of standard, opt-out participants.

As time passes, the number of active customers in each program cohort declines as a portion of the households opt out of the program, move from the enrolled home, or otherwise discontinue service at the household enrolled in the HER Program. Table 1-1 shows the number of active treatment and control households in each program subgroup and cohort as of the beginning of the 2017 program year, or at the time of enrollment for the 2017 cohorts.

Table 1-1. Number of Program Participants and Non-Participants

Customer Subgroup	Participants	Controls
HU Customers	**544,170**	**153,569**
August 2010 Cohort	86,708	41,718
November 2011 Cohort	14,738	7,000
February 2013 Cohort	78,274	31,270
January 2014 Cohort	57,382	13,598
August 2014 Cohort	28,797	5,754
August 2016 Cohort	54,706	17,238
February 2017 Cohort	191,567	24,993
September 2017 Cohort	31,998	11,998
AMI Customers	**58,495**	**26,645**
August 2010/11 Cohort	30,513	9,274
February 2013 Cohort	3,552	2,861
February 2014 Cohort	6,912	5,171
November 2015 Cohort	7,923	6,570
July 2016 Cohort	7,107	2,417
October 2017 Cohort	2,488	352
Low-income Customers	**9,213**	**8,388**
August 2010 Cohort	9,213	8,388
Total	**611,878**	**188,602**

Source: Navigant Analysis
Note: Participant and control counts in this table to not exclude opt-outs. Control customers cannot opt-out, therefore Participant opt-outs are not excluded from the analysis. Opt-outs are excluded from the "active" participant count.

1.2 Evaluation Overview

This evaluation report presents the findings from the impact evaluation of the AEP Ohio HER Program for 2017. The primary goal of the impact evaluation is to quantify electric energy and demand savings attributable to the HER Program. A secondary goal of the impact analysis is to compare the savings generated among the various participant subgroups and cohorts. The primary goal for the process evaluation is to understand customer opinions of and experience with the HER Program.

2. EVALUATION METHODOLOGY

The following section provides a detailed description of the evaluation methodologies and data used in the impact and process evaluations of AEP Ohio's HER Program.
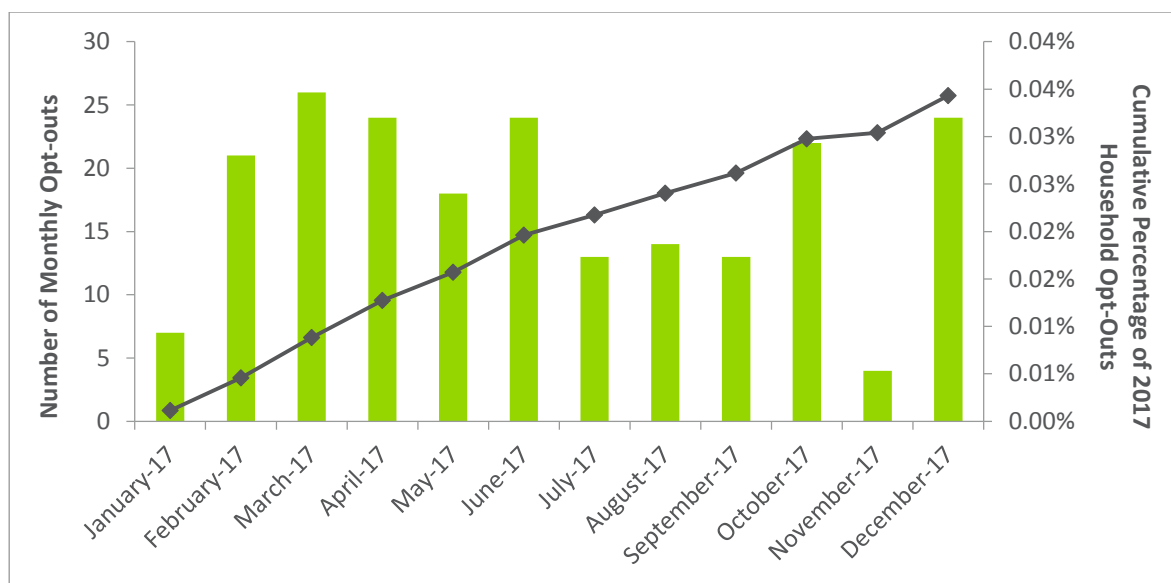
2.1 Description of the Data

2.1.1 Data Used in the Impact Evaluation

The impact analysis follows an attempted census approach, using data from all treatment and control households to estimate program savings. Navigant used monthly billing data from AEP Ohio's customer information system, spanning the period from December 2008 to December 2017. The billing data included a unique customer account ID, the start and end dates of each bill cycle, and the quantity of energy consumed during the bill cycle. Navigant also received participant data from AEP Ohio, including information about when the customer first received an HER, the participant group the customer is in, and a list of customers participating in other AEP Ohio energy efficiency programs to account for double counted savings.

Participants choosing to opt-out of the HER Program during 2017 were included in the analysis, as recipients of HER reports continue to generate savings even after opting out. Figure 2-1 shows the number of program participants that opted-out in each month of the 2017 program year. By the end of December 2017, 210 households had opted-out of the HER Program during the program year, including some households that also moved out of AEP Ohio service territory during the year. Opt-outs represents 0.03 percent of 2017 participant households, which is low relative to what behavioral programs usually experience, and what AEP Ohio's HER Program has experienced in prior program years. For example, the opt-out rate was 0.34 percent in 2014 and 0.12 percent in 2015. The downward trend in opt-outs is likely due to the maturity of AEP Ohio's HER program.

Figure 2-1. Frequency Distribution of Opt-Out Households, by Month and Cumulative Percentage

Source: Navigant Analysis

Navigant also included households that moved out of the premise enrolled in the HER program during 2017 as shown in Figure 2-2. These households were included in the analysis up to the date participants' accounts at the enrolled premise became inactive. In total, these participants represent over 73,000 AEP Ohio customers, or around 12 percent of the number of program participants at the start of 2017. This move out rate is higher compared to 2016 (7.6 percent), but comparable the move out rate in 2015 and 2014 (11 percent and 12 percent, respectively). AEP Ohio's move out rate is almost double that of other Midwest utilities[3].

3

http://ilsagfiles.org/SAG_files/Evaluation_Documents/ComEd/Final_ComEd_Studies/ComEd_HER_Year_Three_Persistence_and_Decay_Study_2017-11-14.pdf

Figure 2-2. Frequency Distribution of Participant Move-outs, by Month and Cumulative Percentage

Source: Navigant Analysis

2.2 Comparability of Treatment and Control Group

When customers are enrolled in the HER Program, a randomized control trial (RCT) is utilized to assign perspective participants into treatment and control groups. In principle, this methodology of assignment results in comparable control and treatment groups, where the energy use of the control group can be used as a counterfactual to estimate the program savings of the participant group.

Navigant analyzed characteristics of treatment and control households within each customer group and cohort to determine whether they are balanced in the factors affecting energy use. For this comparison, two primary characteristics were reviewed to ascertain the comparability of the control households:

- The geographic distribution of customers within AEP Ohio service territory as indicated by the weather station assigned to each customer.
- Distribution of energy use within each month in the 12-month period prior to the enrollment of the participant households in the HER Program. Monthly levels of energy use were compared using the mean, 5th percentile, 25th percentile, Mean, 75th percentile, and 95th percentile.

Navigant's position is that a comparison on the last item – the distribution of past energy use – subsumes all other relevant comparisons, because structural differences between a treatment and control group will be revealed by past energy use. Still, comparisons in other dimensions can be a useful check on the balance of the samples. Navigant performed this analysis on all cohorts included in the 2017 evaluation during prior years. Graphs referencing the results of these prior analyses are provided in Appendix A. The analysis of the AMI and HU cohorts enrolled during 2017 is summarized in Section 3.1.3.

2.3 Analytical Methods

This section describes the analytical methods used as part of the impact and process evaluations. In general, the methodologies utilized are in accordance with recommendations from the SEE Action

Network Working Group for evaluating behavior-based energy efficiency programs.[4] Two different models are utilized in the impact evaluation to confirm the robustness of the estimated savings impacts.

2.3.1 Impact Evaluation Methods

The main methodological issue for the impact evaluation is to estimate the *counterfactual* energy use by households participating in the HER Program – that is, the energy that households *would have used in the absence of the program.* The program utilized a RCT experimental design, meaning households were randomly allocated to the control and treatment groups. This eliminates the issue of selection bias that complicates the evaluation of many behavioral programs. The random assignment of households to the treatment and control groups means the control group should serve as a robust baseline against which the energy use of the treatment households can be compared to estimate savings from enrollment in the HER Program.

Navigant estimated the HER program impacts using two approaches applied to monthly billing data: (1) a lagged dependent variable (LDV) regression analysis with lagged controls, and (2) a linear fixed-effects regression (LFER) analysis. Navigant uses the LDV results for reporting total program savings, but runs both models as a robustness check. Although the two models are structurally very different, assuming the randomized controlled trial (RCT) is well balanced with respect to the drivers of energy use, in a single sample the two approaches generate very similar estimates of program savings.

Navigant prefers to report out the LDV model for two reasons. One, the implementer is also using a post-only model for evaluation. Two, although both the LFER and LDV models generate unbiased estimates of program savings, as an empirical matter—based on our past analyses and those in the academic literature—estimated savings from the LDV model tend to have lower standard errors than those from the LFER model, though the differences are usually very small.

The LDV model combines both cross-sectional and time-series data in a panel format. It controls for non-treatment differences in energy use between treatment and control customers using lagged energy use as an explanatory variable. In particular, the model frames energy use in calendar month t of the post-program period as a function of both the treatment variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between control and treatment customers will be reflected in differences in their past energy use, which is highly correlated with their current energy use. The lagged energy use term is similar to the customer fixed effect included in the LFER model explained below. Formally, the model is shown in Equation 1.

---

[4] "Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations" published by the State and Local Energy Efficiency Action Network in May 2012.

<div align="center">

Equation 1. Lagged Dependent Variable Model

</div>

$$ADU_{kt} = \beta_1 Treatment_k + \sum_J \beta_{2j} Month_{jt} + \sum_J \beta_{3j} Month_{jt} \cdot ADUlag_{kt} + \varepsilon_{kt}$$

Where:

ADU_{kt}	is average daily consumption of kWh by household k in bill period t
$Treatment_k$	is a binary variable taking a value of 0 if household k is assigned to the control group, and 1 if assigned to the treatment group
$Month_{jt}$	is a binary variable taking a value of 1 when j = t and 0 otherwise[5]
$ADUlag_{kt}$	is household k's energy use in the same calendar month of the pre-program year as the calendar month of month t
ε_{kt}	is the cluster-robust error term for household k during billing cycle t; cluster-robust errors account for heteroskedasticity and autocorrelation at the household level.[6]

The coefficient β1 is the estimate of average daily kWh energy savings due to the program.

As with the LDV model, the LFER model combines both cross-sectional and time-series data in a panel format. The regression essentially compares pre- and post-program billing data for participants and controls to identify the program's effect. The customer-specific fixed effect is a key feature of the LFER analysis and captures all customer-specific factors affecting electricity usage that do not change over time, including those that are unobservable. Examples include the square footage of a residence or the home's physical location. The fixed effect represents an attempt to control for small, systematic differences between treatment and control customers that might occur due to chance.

The LFER model used by Navigant is one in which average daily consumption of kWh by household k in bill period t, denoted by ADU_{kt}, is a function of the following three terms:

1. The binary variable $Treatment_k$.
2. The binary variable $Post_t$, taking a value of 0 if month t is in the pre-treatment period, and 1 if in the post-treatment period.
3. The interaction between these variables, $Treatment_k \cdot Post_t$.

Formally, the LFER model is shown in Equation 2.

<div align="center">

Equation 2. Linear Fixed Effects Regression Model

</div>

$$ADU_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Treatment_k \cdot Post_t + \varepsilon_{kt}$$

Three observations about this specification deserve comment. First, the coefficient α0k captures all household-specific effects on energy use that do not change over time, including those that are

---

[5] In other words, if there are T post-program months, there are T monthly dummy variables in the model, with the dummy variable $Month_{tt}$ the only one to take a value of 1 at time t. These are, in other words, monthly fixed effects.
[6] Ordinary Least Squares (OLS) regression models assume that the data are homoskedastic and not autocorrelated. If either of these assumptions is violated, the resulting standard errors of the parameter estimates are incorrect (usually underestimated). A random variable is heteroskedastic 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.

unobservable. Second, α1 captures the average effect across all households of being in the post-treatment period. Third, the effect of being both in the treatment group and in the post period, i.e., the effect directly attributable to the program, is captured by the coefficient α2. In other words, whereas the coefficient α1 captures the change in average daily kWh use across the pre- and post-treatment for the *control* group, the sum $\alpha_1 + \alpha_2$ captures this change for the treatment group, and so α_2 is the estimate of average daily kWh energy savings due to the program.

In prior evaluation years, Navigant found the 2010 AMI treatment group is not statistically comparable to the corresponding control group. Navigant found statistically significant differences in the energy use of control and treatment households in seven out of the 12 months preceding the enrollment of AMI participants. The months where differences were found were all during the heating season, from October 2009 until April of 2010 (as shown in Figure A-4 in Appendix A). After consultation with the program implementer, Navigant determined these deviations are due to different proportions of customers with electric heat in the treatment and control groups. As a result, data regarding the heating type of customers in the AMI treatment and control groups was provided by the program implementer and incorporated into the analysis. After controlling for customers with electric heat, there is no month in the 12 months before the program begins in which the average energy use for the two groups is statistically significant different at the 90 percent confidence level.

The finding of differences in the rate of customers with electric heat in the 2010-11 AMI treatment and control groups requires a modification to the impact evaluation methodology for this cohort. Navigant incorporated two additional terms into the regression equation to account for the differing prevalence of electric heat. Equation 3 formally presents the equation for this model.

Equation 3. Lagged Dependent Variable Model (2010-11 AMI Customer Group)

$$ADU_{kt} = \beta_1 ElectricHeat_k + \beta_2 Treatment_k + \beta_3 Treatment_k \cdot ElectricHeat_k +$$
$$\sum_J \beta_{4j} Month_{jt} + \sum_J \beta_{5j} Month_{jt} \cdot ADUlag_{kt} + \varepsilon_{kt}$$

Where,

$ElectricHeat_k$ = 	A binary variable indicating whether household *k* utilizes electric heat (taking a value of 1) or non-electric heat (taking a value of 0).

The LFER model is also augmented to account for customer heating type, and presented in Equation 4.
.
Equation 4. Linear Fixed Effects Regression Model (2010-11 AMI Customer Group)

$$ADC_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Participant_k \cdot Post_t + \alpha_3 ElectricHeat_k \cdot Post_t$$
$$+ \alpha_4 Participant_k \cdot ElectricHeat_k \cdot Post_t + \varepsilon_{kt}$$

All participants and non-participants that moved out of the program household during 2016 were included in the analysis up to the bill month preceding their departure. Move-out dates were provided to Navigant by AEP Ohio.

One of the ways in which the HER Program encourage participants to reduce energy consumption is by channeling them into other energy efficiency programs offered by AEP Ohio, notably the Appliance Recycling, Community Assistance, and Efficient Products Rebate Programs. Navigant investigated the

effect of the HER Program on increasing participation in these three programs in order to account for the possibility of double counted savings. For each customer group and cohort, Navigant compared the difference in the rate of participation between the treatment group and the control group in the 2017program year via the Post-Only-Differences (POD) statistic:

POD = (Treatment: # of participants as % of total HER participants) –
(Control: # of participants as % of total control households)

Navigant then multiplied the POD statistic by the number of treatment households to get the change in uptake for each of the three other AEP Ohio programs due to the HER Program. The change in participation in the other programs was then multiplied by the average participant savings for each program to estimate the total savings already accounted for in the savings estimates for the other AEP Ohio programs.

2.3.2 Customer Surveys

To understand customer perspectives and experiences with the program, Navigant completed surveys with HER Program participants. The survey goal was to complete 400 surveys, with 100 in each of the four customer segments: AMI 2010-2014, AMI 2015+, EE 2010-2014, and EE 2015+. Navigant reached out to a sample of customers in November 2017 through January 2018 with an invitation to take an online survey. The survey took approximately 10 minutes to complete.

The process evaluation sought to investigate the following primary research questions:

1. Are customers aware of receiving HERs in the mail or by email? If so, have they read the report and are they aware of its contents?

2. Are customers aware they can get HERs electronically? Are they aware they can view their usage history online?

3. What aspects of the HERs do the participants find memorable and/or meaningful for their household?

4. For participant and control households, how many light bulbs are present in the room in which residents spend the majority of their evening hours (family room)? How many of these bulbs are CFLs or LEDs? How many lights are currently turned on?

5. For participant and control households, what temperature is the thermostat set at currently? During the winter? During the summer?

6. Is the level of household engagement related to their confidence in the information presented in the Home Energy Report?

7. Is the level of household engagement related to other household characteristics, such as average energy use, customer group, or their tenure in the HER Program?

8. Has the household participated in any other AEP Ohio EE/PDR programs?

9. Are there key barriers to understanding and/or responding to the information in the reports?

10. How satisfied is the respondent with AEP Ohio and the efforts of their utility to reduce their customers' energy costs?

2.3.3 In-Depth Staff Interviews

Navigant conducted in-depth interviews in February - March 2018, as summarized in Table 2-1. The purpose of these interviews was to understand changes in program design and implementation, collect feedback on research priorities, and understand stakeholders' experiences with the program.

Table 2-1. Summary of In-Depth Interviews

Data Collection Type	Targeted Population	Sample Frame	Sample Target	Sample Size	Timing
In-depth Telephone Interviews	AEP Ohio Program Staff	Contacts from AEP Ohio	HER Program Coordinator	1	February 2018
	Implementation Contractor Program Staff	Contacts from AEP Ohio	AEP Ohio Client Success Manager	1	March 2018

3. DETAILED EVALUATION RESULTS

3.1 Impact Evaluation Results

The HER Program reported *ex ante* 76,229 MWh of energy savings and 9,909 kW of demand savings in 2017. The verified *(ex post)* energy and demand savings for 2017 for all HU and PIPP customers combined were 72,958 MWh and 9,512 kW respectively. A comparison of *ex ante* and *ex post* HER Program savings are shown in Table 3-1.

Table 3-1. 2017 Overall Evaluation Results

	2017 Program Goals (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	75,000	76,229	72,958	0.96	97%
Demand Savings (MW)	3.750	9.909	9.512	0.96	254%

Source: Navigant analysis of customer billing data provided by AEP Ohio.
AEP Ohio EE-PDR 2017 Performance Report 12-31-2017 Final.

Savings from AMI customers are not included in the above *ex ante* and *ex post* calculations because these savings are not claimed by AEP Ohio as part of meeting annual EE/PDR portfolio goals. Navigant estimated these customer groups provided an additional 4,217 MWh of energy savings and 550 kW of peak demand savings.

The total savings estimate pro-rates savings for customers who moved out or otherwise became inactive during the program year. This adjustment is performed using a participant-day metric that estimates the total numbers of days each household participates in the HER Program in 2017.

3.1.1 Results by Participant Type

Table 3-2 presents the estimated program savings using the fixed effects model described in Equation 1 for each of the participant cohorts for which AEP Ohio claimed savings. The number of participants at the beginning of the program year is shown along with the savings estimates and average daily energy use for customers in each wave. Final savings estimates for each wave are adjusted to account for double counted savings and participants that moved out of their households during 2017.

Table 3-2. Estimated Program Savings by HU and PIPP Participant Group Using Equation 1

	2010 HU	2011 HU	2013 HU	Jan 2014 HU	Aug 2014 HU	2016 HU	Feb 2017 HU	Sept 2017 HU‡	PIPP	TOTAL
Number of Active Participants (start of 2017 or cohort)	84,790	14,517	77,675	57,128	28,674	54,696	191,469	31,369	9,114	**549,432**
2017 Move-outs	4,141	787	5,878	4,790	3,709	10,081	31,144	4,172	913	**65,615**
2017 Opt-outs±	32	9	25	15	8	36	59	6	2	**192**
Average Daily Household kWh Used	44.0	57.5	40.0	34.2	35.8	40.3	26.5	36.4	37.1	**N/A**
Estimated Daily kWh Savings per participant	0.87	0.86	0.59	0.41	0.42	0.27	0.13	-0.15	0.80	**N/A**
(standard error)	(0.08)	(0.24)	(0.08)	(0.09)	(0.17)	(0.08)	(0.04)	(0.15)	(0.23)	**N/A**
Estimated Annual kWh Savings per participant	*316*	*314*	*216*	*151*	*153*	*100*	*46*	*-55*	*291*	**N/A**
(standard error)	*(30)*	*(88)*	*(29)*	*(34)*	*(61)*	*(31)*	*(15)*	*(55)*	*(84)*	**N/A**
Estimated Percentage Savings	1.93%	1.48%	1.46%	1.19%	1.16%	0.68%	0.48%	-0.42%	2.10%	**N/A**
Estimated Total MWh Savings* (a)	26,760	4,515	15,631	8,284	4,116	4,929	6,900	-	2,540	**73,675**
Savings Counted in Other Programs (b)	84	49	214	48	-25	73	300	87	-26	**804**
Total Savings (MWh) = (a) – (b)	**26,676**	**4,466**	**15,416**	**8,236**	**4,141**	**4,855**	**6,600**	**-**	**2,566**	**72,958**
Total Savings (kW)†	**3,478**	**582**	**2,010**	**1,074**	**540**	**633**	**861**	**-**	**335**	**9,512**

Source: Navigant Analysis
* Aggregate savings values have been adjusted to account for customer move-outs throughout the program year.
Note: All values are statistically significant at the 95% confidence level.
‡ The analysis of the September 2017 HU cohort of participants produced a negative estimate of savings. Therefore, the total savings from this cohort has been assumed to be zero, since it is unlikely that the program produced an increase in average household energy usage.
† The billing analysis model described in this report cannot be directly utilized for the estimation of demand savings. In order to properly determine demand savings using this method, intraday customer billing data would be needed. In the absence of such data, Navigant applied the ratio of kW to MWh savings from the program plan to the estimate of energy savings produced by the program analysis.
± Opt-outs are not removed from the analysis.

Table 3-3 presents the estimated savings for the AMI cohorts enrolled in the HER Program. Savings for these customers were also adjusted to account for double counted savings and participants moved out of their households during 2017.

Table 3-3. Estimated Program Savings by AMI Participant Group Using Equations 1 and 2

	2010/11 AMI	2013 AMI‡	2014 AMI	2015 AMI	2016 AMI	2017 AMI‡	TOTAL
Number of Active Participants (start of 2017 or cohort)	30,144	3,535	6,886	7,921	7,107	2,488	**58,081**
2017 Move-outs	2,519	580	837	1,795	2,013	2	**7,746**
2017 Opt-outs±	10	0	4	3	1	0	**18**
Average Daily Household kWh Used	27.1	26.5	28.7	23.3	25.5	19.4	**N/A**
Estimated Daily kWh Savings per participant	0.25	-0.38	0.36	0.30	0.00	0.05	**N/A**
(standard error)	(0.16)	(0.23)	(0.16)	(0.12)	(0.16)	(0.47)	**N/A**
Estimated Annual kWh Savings per participant	*92*	*-137*	*133*	*109*	*1*	*18*	**N/A**
(standard error)	*(58)*	*(85)*	*(57)*	*(42)*	*(57)*	*(173)*	**N/A**
Estimated Percentage Savings	0.92%	0.00%	1.25%	1.26%	0.01%	0.26%	**N/A**
Estimated Total MWh Savings* (a)	2,688	-	852	748	8	-	**4,297**
Savings Counted in Other Programs (b)	72	-18	28	-29	8	11	**73**
Total Savings (MWh) = (a)	**2,688**	**-**	**852**	**748**	**8**	**-**	**4,297**
Total Savings (kW)†	**351**	**-**	**111**	**98**	**1**	**-**	**560**

Source: Navigant Analysis
Note: All values are statistically significant at the 95% confidence level except for the 2013 cohort.
* Aggregate savings values have been adjusted to account for customer move-outs throughout the program year.
‡ The analysis of the 2013 and 2017 AMI cohorts of participants produced a negative estimate of savings. Therefore, the total savings from these cohorts has been assumed to be zero, since it is unlikely that the program produced an increase in average household energy usage.
† The billing analysis model described in this report cannot be directly utilized for the estimation of demand savings. In order to properly determine demand savings using this method, intraday customer billing data would be needed. In the absence of such data, Navigant applied the ratio of kW to MWh savings from the program plan to the estimate of energy savings produced by the program analysis.
± Opt-outs are not removed from the analysis.

As shown in Table 3-2 and Table 3-3, Navigant found savings varied significantly by customer group: HU participants in the earlier cohorts are estimated to have saved more energy than other customer groups on an absolute basis. This is partly due to their higher average daily energy use as compared to other participant cohorts. On a relative basis, the savings from the earlier cohorts enrolled in 2010 through 2015 all exceed one percent of daily energy usage.

A meaningful result from the cohort-level findings is the relatively low rate of savings from the later cohorts compared to the earlier cohorts. The five cohorts enrolled during 2016 and 2017 are estimated to have generated under one percent savings. Prior experience has shown once customers begin receiving

HERs, it can take up to 18 months for savings to fully materialize after a customer is enrolled in the program. This "ramp-up" phase may be impacting the savings estimate for the 2017 HU and AMI cohorts, as well as the 2016 HU and AMI cohorts. However, the 2016 AMI cohort generated almost no savings, despite having been deployed for 17 months by the end of 2017. This cohort may not be savings-generating in the coming program years.

Additionally, the 2013 AMI cohort has been in the HER Program for up to 47 months by the beginning of the 2017 program year. This cohort has demonstrated little to no savings relative to what would normally be expected by this point in time. Further investigation into the construction of the 2013 AMI cohort may be warranted to determine if there are customer characteristics that are adversely impacting participant savings.

It is important to note savings differences among the groups are not necessarily due to the identifiers defining group membership. For instance, it cannot be concluded that receipt of an AMI meter causes HER Program savings to be low; factors correlated with group membership, such as levels of pre-enrollment energy use or other household characteristics, might explain the relationship.

3.1.2 Enrollment in Other AEP Ohio Programs

Navigant utilized the POD statistic to estimate the savings captured in the billing analysis for the HER Program that is already accounted for in the savings estimate for four other AEP Ohio programs: Appliance Recycling, Community Assistance Program, and Efficient Products. In essence, the POD statistic represents the change in participation in other EE programs beyond that would have occurred in the absence of the HER Program (as measured by control households). This calculation was performed separately for each of these three programs and for each cohort of participant households in the HER Program. The resulting change in program participation due to the HER Program is multiplied by the average claimed savings per HER Household participating in the Appliance Recycling, Community Assistance, and Efficient Products Programs to estimate the total amount of savings that is double counted. Table 3-4 shows the results of this calculation across all HER Program cohorts combined for each AEP Ohio EE/PDR program.

Due to increased participation, the analysis determined an estimated 804 MWh of the evaluated savings for HU and PIPP cohorts from the HER Program was double counted in other AEP EE/PDR programs.

Table 3-4. Estimate of Energy Savings Attributable to Participation in Other Programs

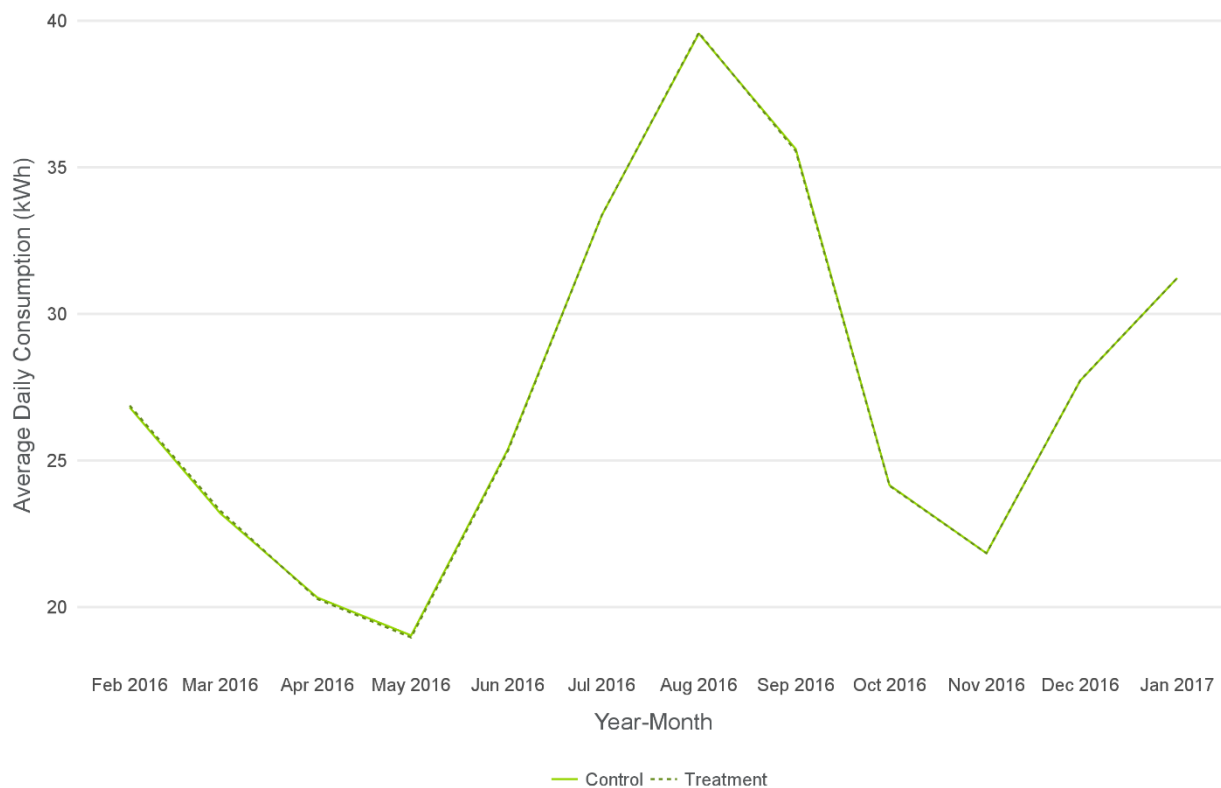|	Appliance Recycling	Community Assistance Program	Efficient Products Rebates	In-Home Component of Efficient Products	Total
Average Post-Only Difference (POD) Statistic	0.09%	0.01%	0.03%	0.01%	**N/A**
Change in Program Participation due to HER Program (# of Participants)	509	57	168	48	**783**
Median Savings per Program Participant (kWh)	1,376	1,442	162	168	**N/A**
Total Savings (MWh)	**701**	**77**	**27**	**-1**	**804**

Source: Navigant Analysis

3.1.3 Comparability of Treatment and Control Groups

Navigant compared characteristics of treatment and control households in the AMI and HU cohorts initiated during the 2017 program year to confirm the control households were randomly selected and are suitable for the purposes of the estimating program savings. Figure 3-1 through Figure 3-3 below depict the average energy usage for treatment and control households for the 12 months prior to the start of the program. The solid green line indicates the average energy usage for the control group and the grey dashed line indicates the average energy usage for the treatment group. The two lines are essentially identical for the February 2017 and September 2017 HU cohorts, indicating no difference in average usage patterns for the treatment and control groups. The visual difference in group usage for the October 2017 cohort is likely attributable to the small sample size.

The primary comparison Navigant performed to assess the reasonableness of the control groups is to compare the energy used by households in the 12 months preceding enrollment of participating households in the HER Program. Navigant conducted a statistical test on the difference in the mean energy usage for the two groups in each of the 12 pre-treatment months being tested and found the difference to be statistically insignificant at the 90% confidence level for all 12 months. Navigant also conducted a standard ordinary least squares (OLS) regression analysis for the same 12-month period comparing the average energy usage of treatment and control households, with a dummy variable included to indicate which households were classified as treatment. If the energy usage of the treatment and control households were comparable, the coefficient on the treatment dummy variable should not be statistically different from zero. Navigant's analysis found that the treatment dummy was, in fact, not statistically different from zero at the 90% confidence level for all three 2017 cohorts. Therefore, Navigant concludes that the allocation of program households across the treatment and control groups is consistent with an RCT design. In prior years, Navigant compared the distribution of energy use in each month for treatment and control households. Graphs showing the results of this comparison for 2016 and older cohorts performed in previous evaluation years are presented in Appendix A.

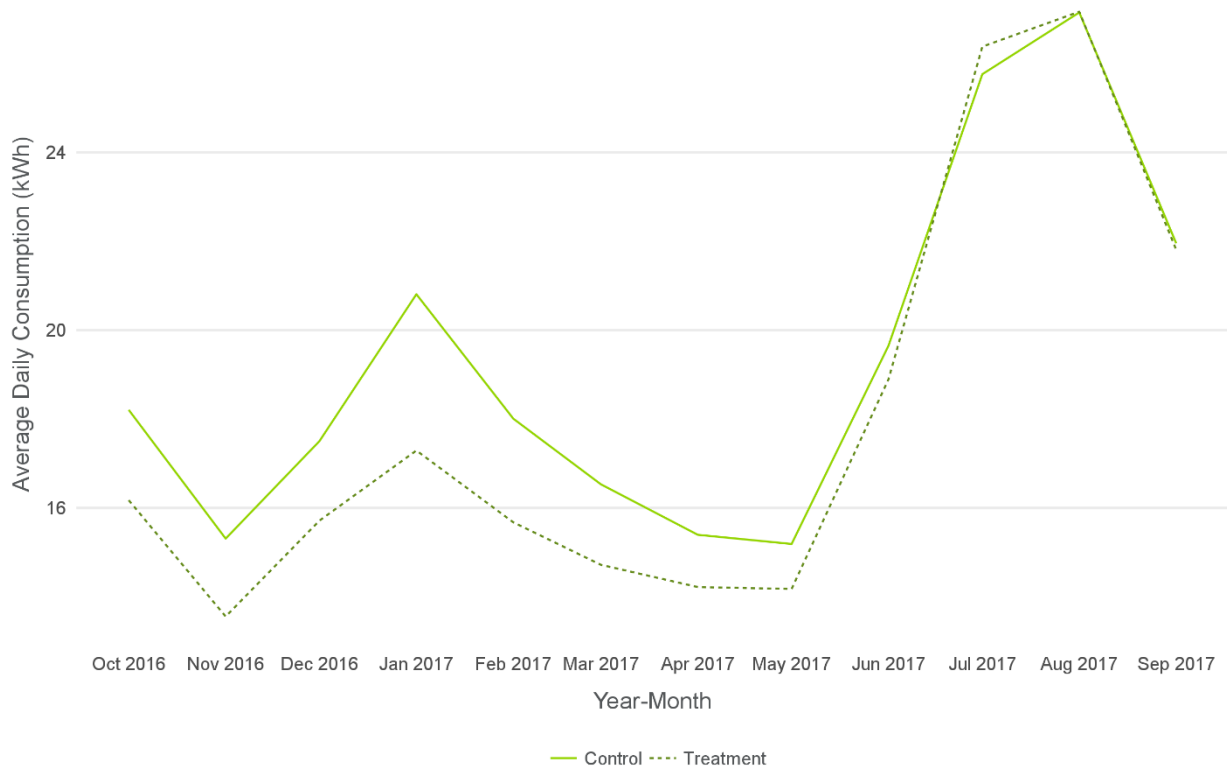**Figure 3-1. Average Daily Treatment/Control Household Energy Use by Month in February 2017 HU Cohort**

Source: Navigant Analysis

Figure 3-2. Average Daily Treatment/Control Household Energy Use by Month in September 2017 HU Cohort

Source: Navigant Analysis

Figure 3-3. Average Daily Treatment/Control Household Energy Use by Month in October 2017 AMI Cohort

As the preceding graphs and the graphs in Appendix A demonstrate, Navigant found the average energy use and the distribution of energy use by month for control households in the pre-treatment period to be comparable to treatment households for all customer groups and cohorts, except the initial 2010 AMI cohort, as described previously, and the 2017 AMI cohort, launched in October 2017. However, due to the rolling nature of this latter cohort, the initial treatment and control groups are quite small. This small sample size is likely the primary cause of the imbalance seen in Figure 3-3. Navigant will test this cohort again during the 2018 evaluation once more customers are enrolled.

Navigant also performed t-tests on the difference in mean energy usage between treatment and control households in each month during the year preceding enrollment of participating households for the 2017 cohorts. For all t-tests performed on these monthly comparisons for the 2017 HU cohorts, Navigant determined the treatment and control households were not statistically different at the 90 percent confidence level. This further corroborates the conclusion that the control groups were constructed appropriately.

3.2 Customer Surveys

Navigant fielded two rounds of the online HER customer survey in November 2017 through January 2018. 530 respondents started the survey, and 443 customers completed the survey. The target was 400 completed surveys. The following section presents the results of this survey analysis.

3.2.1 Demographics

Navigant targeted four customer segments, aiming to reach a minimum of 100 customers per stratum. The response rate for each stratum is show below in Figure 3-4. Cohorts were segmented into early (2010-2014) vs. late (2015+) and AMI vs. EE, as surveying each cohort would have been cost prohibitive.
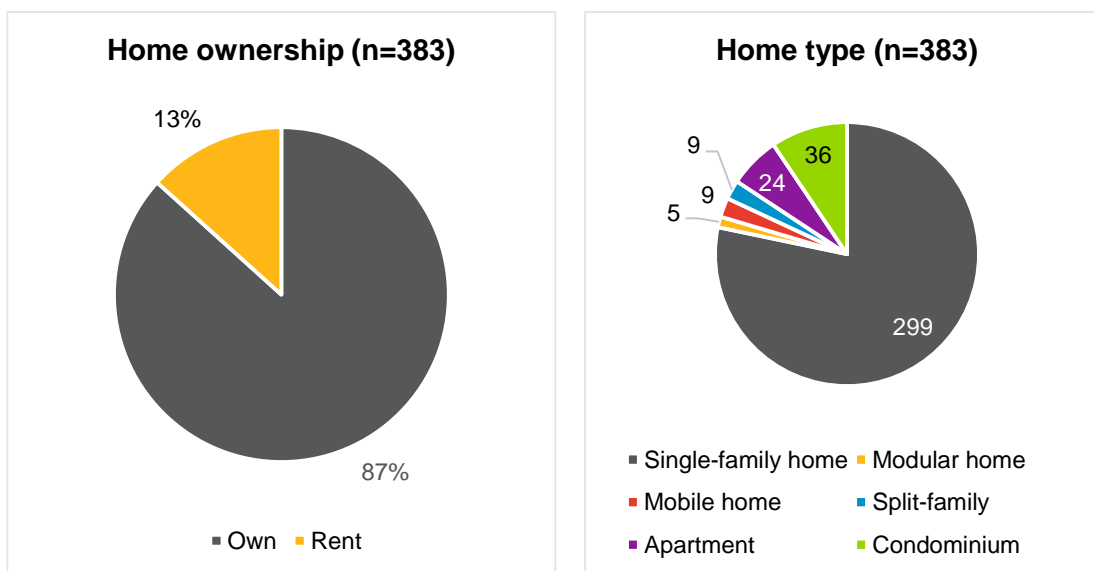
Figure 3-4. Customer Survey Completes by Strata

Strata	Number of Completes
AMI - 2010-2014	139
EE - 2010-2014	133
AMI - 2015+	135
EE - 2015+	123
Total	**530**

Source: Navigant analysis

Of the customers who completed the surveys, the majority are homeowners and reside in a single-family house, as shown in Figure 3-5.
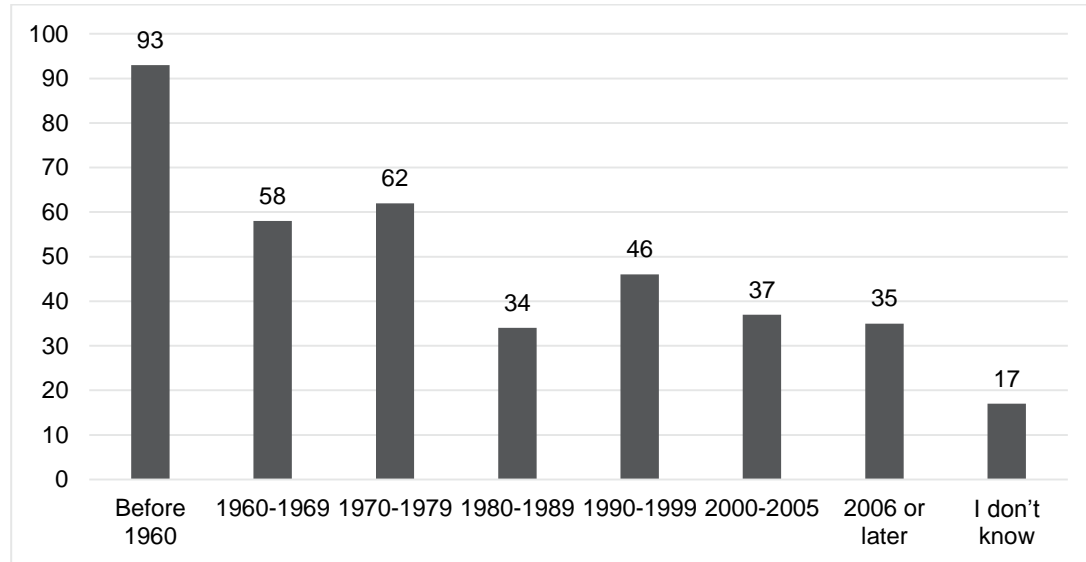
Figure 3-5. Home Characteristics

Source: Navigant analysis

Survey respondents' home ages ranged from less than 10 years old, to over 100. More than half of the homes were built pre-1980, as shown in Figure 3-6.

Figure 3-6. Home Age (n=382)

Source: Navigant analysis

3.2.2 AEP Ohio Satisfaction

Navigant measured customers' satisfaction with AEP Ohio by asking customers to rate their satisfaction on a scale of 0 to 10, where 10 is highly satisfied. Navigant categorized "overall satisfaction" as any rating above a 5, while "highly satisfied" is any score above an 8, as shown in Table 3-5
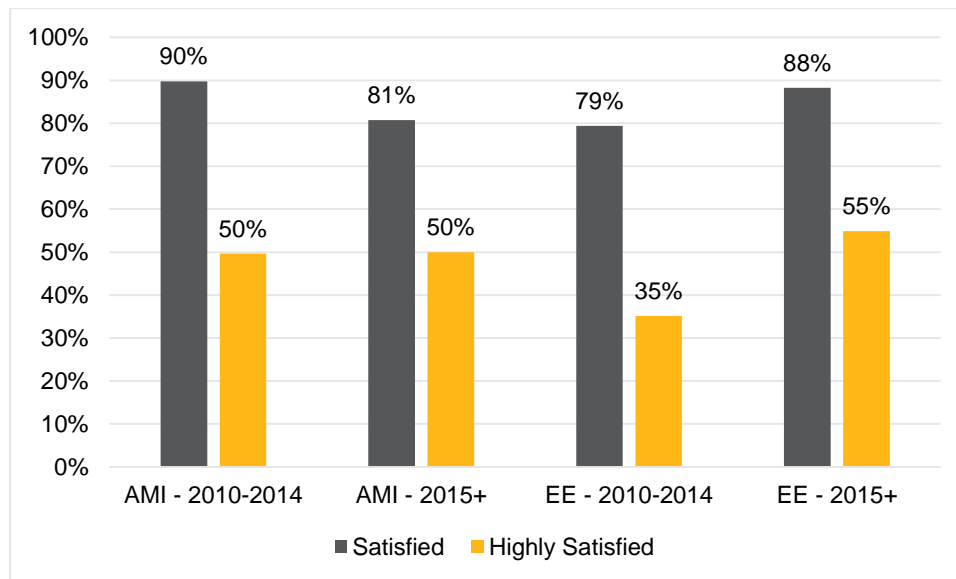
Table 3-5. Satisfaction with AEP Ohio - Summary

Metric	2017 Result
Average Satisfaction Score	7.9
Overall Satisfied (score 6-10)	86%
Highly Satisfied (score 9-10)	48%

Source: Navigant analysis

Satisfaction with AEP Ohio was statistically different between strata, with the EE 2010-2014 group showing lower satisfaction, as shown in Figure 3-7.

Figure 3-7. Satisfaction with AEP Ohio, by Strata (n=500)

Source: Navigant analysis

3.2.3 HER Engagement

The customer survey asks HER recipients a range of questions to capture their experience with and opinions of the report. The following section presents the results from that survey section.

The vast majority of customers read their HER, as shown in Figure 3-8, but most people read the report for fewer than 6 minutes (Figure 3-9).
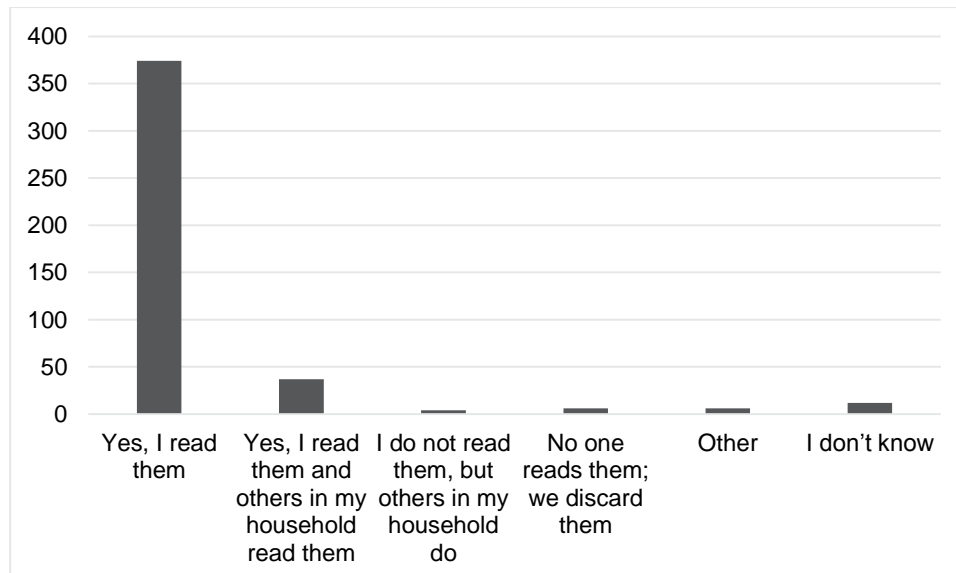
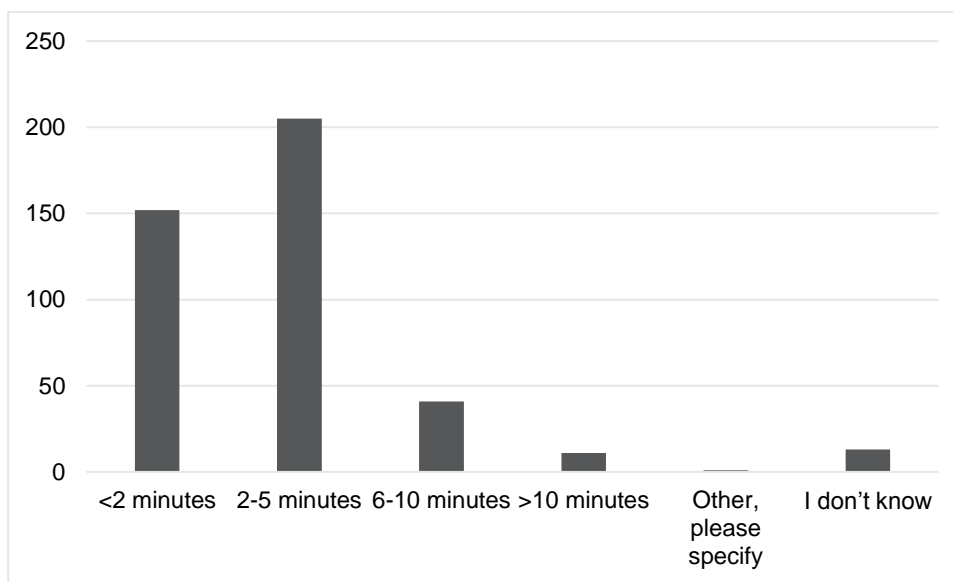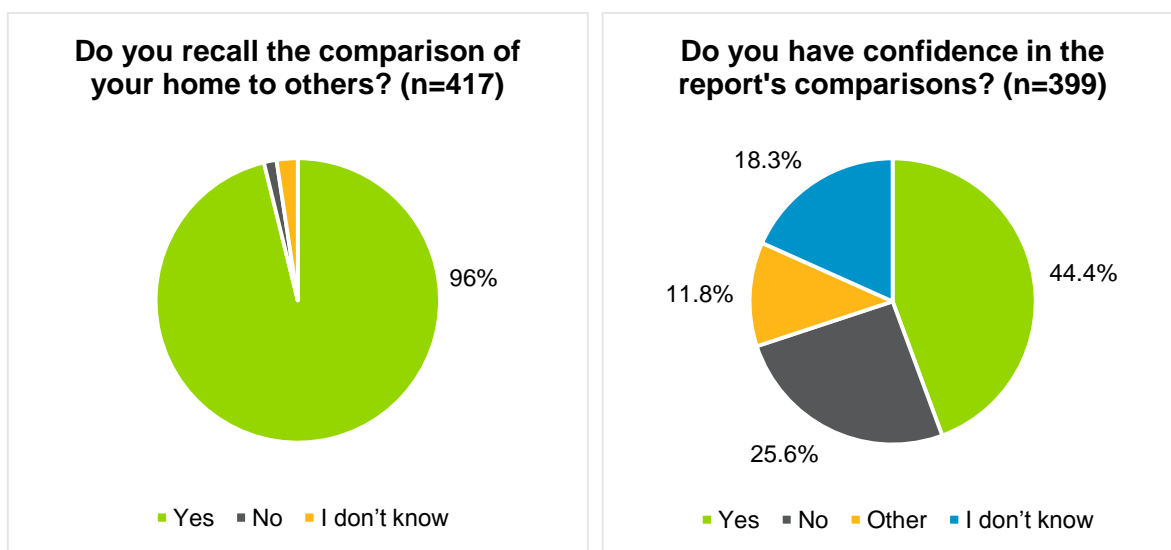**Figure 3-8. Who Reads Report (n=439)**

Source: Navigant analysis

Figure 3-9. Report Review Time (n=423)

Source: Navigant analysis

The core component of the HER is the comparison of the recipient's home to other similar nearby homes. Nearly all of survey respondents (96%) recall seeing the comparison of their home to others, as shown in Appendix A. However, this feature of the report is also somewhat contentious. Less than half of survey respondents reported having confidence in the report's comparisons.

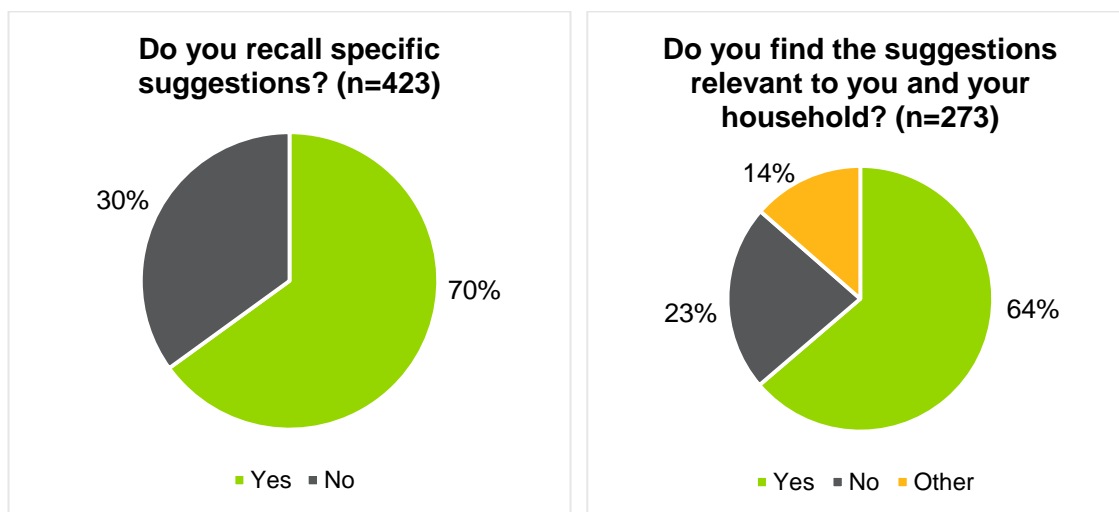**Figure 3-10. Comparison Recall and Confidence**

Source: Navigant analysis

When asked why they have low confidence in the report's comparison, customers often cite specific end uses or details about the occupancy of their home that makes them different from their neighbors.

The HERs also feature specific energy-saving suggestions for the customer. These suggestions are intended to help customers identify energy-saving actions to implement in their homes. Seventy percent of customers recall the report's suggestions, while nearly a third of customers do not (Figure 3-11). Of those who do recall the suggestions, 64 percent find the suggestions relevant to their household.
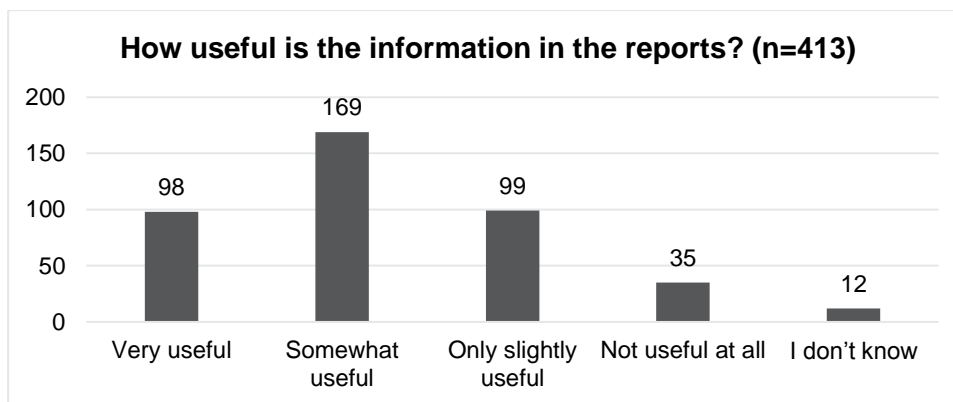
Figure 3-11. Suggestion Recall and Relevance

Do you recall specific suggestions? (n=423)

30%
70%

■ Yes ■ No

Do you find the suggestions relevant to you and your household? (n=273)

14%
23%
64%

■ Yes ■ No ■ Other

Source: Navigant analysis

Survey respondents do find the reports useful, with more than two thirds of respondents stating they find the information very or somewhat useful (Figure 3-12).
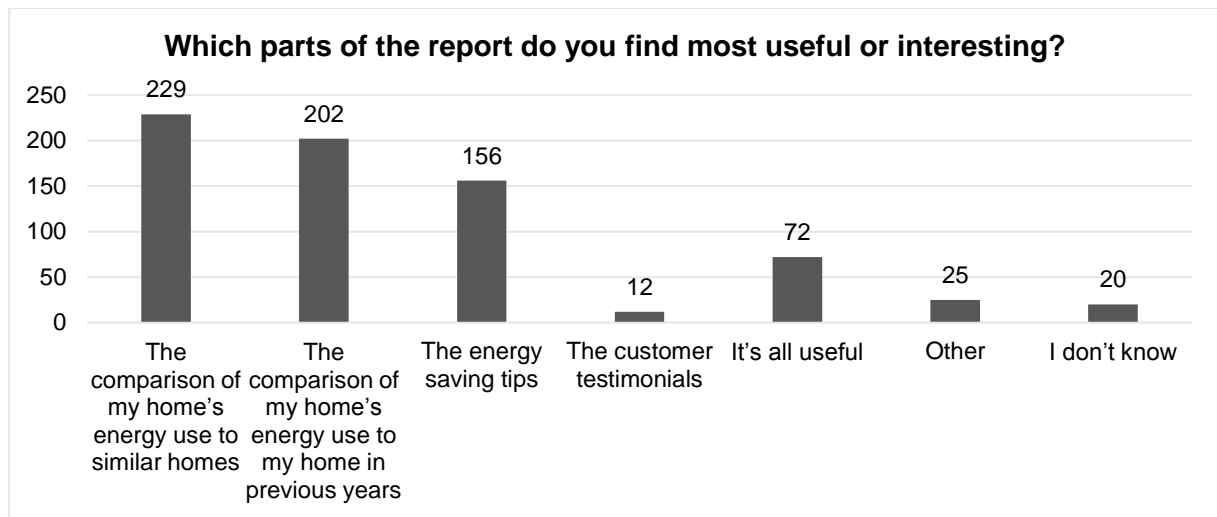
Figure 3-12. Usefulness of Report

How useful is the information in the reports? (n=413)

98	169	99	35	12
Very useful	Somewhat useful	Only slightly useful	Not useful at all	I don't know

Source: Navigant analysis

Customers also report finding the comparisons to other homes and to their own home's historical use to be useful and interesting, as shown in Figure 3-13. This result is surprising given the low confidence respondents said they had in the report's comparisons.
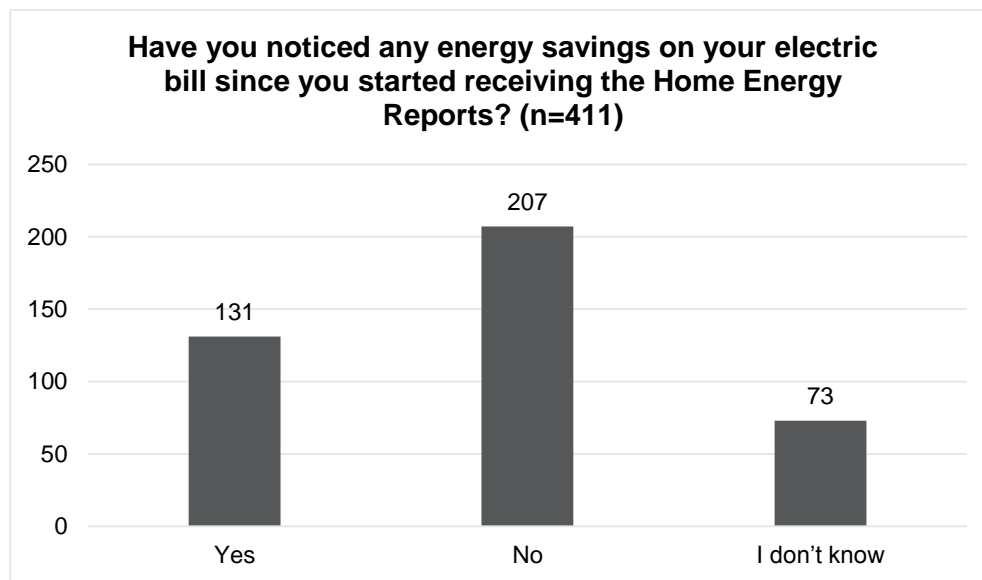
Figure 3-13. Most Interesting Feature

Which parts of the report do you find most useful or interesting?

- The comparison of my home's energy use to similar homes: 229
- The comparison of my home's energy use to my home in previous years: 202
- The energy saving tips: 156
- The customer testimonials: 12
- It's all useful: 72
- Other: 25
- I don't know: 20

Source: Navigant analysis

Figure 3-14 shows that less than half of customers have noticed any energy savings on their electric bills since they started receiving the HERs. This is to be expected, since the percent savings are so low, they are likely not noticeable to most customers.
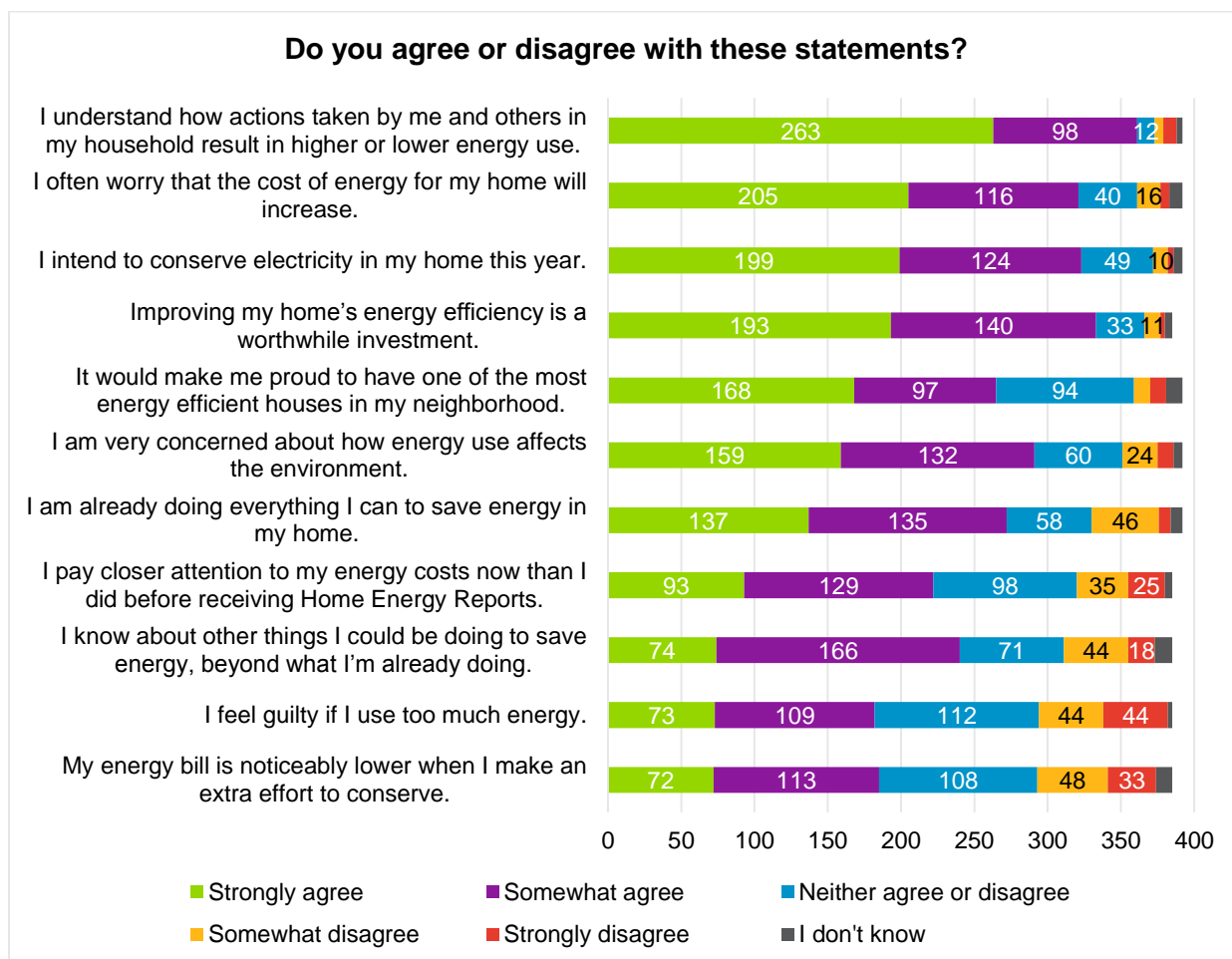
Figure 3-14. Impacts on Energy Bill

Have you noticed any energy savings on your electric bill since you started receiving the Home Energy Reports? (n=411)

- Yes: 131
- No: 207
- I don't know: 73

Source: Navigant analysis

3.2.4 Energy Awareness

The Navigant customer survey asks HER recipients a series of questions about their thoughts and feelings about energy use. This section of the survey is intended to measure trends in customer opinions, and allow AEP Ohio to tailor messaging and marketing to customers. Figure 3-15 displays the

results of this survey section. It is interesting to note that customers most strongly agree with the statement "I understand how actions taken by me and others in my household result in higher or lower energy use," and yet the statement that the fewest customers strongly agree with is "my energy bill is noticeably lower when I make an extra effort to conserve." This may indicate customers have a general understanding of how to conserve energy, but aren't sure of the exact steps to take to really impact their monthly bills.

Figure 3-15. HER Customer Energy Awareness

Source: Navigant analysis

3.3 Staff and Contractor Interviews

This section presents findings resulting from in-depth interviews with program staff and implementation contractors affiliated with the program. With the help of interview guides, the evaluation team completed conversations with program stakeholders to assess program benefits and barriers, and understand satisfaction with program administration, delivery, and marketing.

3.3.1 Program Coordinator Interview

The AEP Ohio Program Coordinator manages the HER program and is responsible for maintaining effective communication between AEP Ohio and the implementation contractor. In-person meetings with the implementation contractor occur on a quarterly basis. The Program Coordinator also regularly reviews savings reports, decides the cadence of reports, aids in the design of promotional modules, and facilitates customer opt-outs. The current Program Coordinator took over management of the HER program in early 2017.

Since the program inception in 2010, the program has shifted towards email reports due to their lower per-participant cost. Email click-through metrics are provided on a monthly basis by the implementation contractor. Program participants without email addresses are still sent paper reports, the cadence of which depends on the average usage of the participants. High users can receive up to four reports a year, while low users may receive only one.

3.3.2 Implementation Contractor Interview

The HER implementation contractor client success manager (CSM) was interviewed in March 2017. The current CSM took over the AEP Ohio HER account in early 2017. The CSM's responsibilities include ensuring smooth implementation of the program, creating promotional modules, designing refills and expansions. Goals include achieving reliable and cost-effective savings, increasing digital engagement and program promotion, and increasing customer satisfaction.

The HER CSM noted that while the HER program targets high energy users, the definition of high user is different for each HER wave. Earlier waves targeted the highest energy users in the AEP Ohio customer base. Subsequent waves still targeted high users, but the metric for high users was lower.

3.4 Cost Effectiveness Review

This section addresses the cost effectiveness of the 2017 HER Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. The cost-effectiveness analysis does not include the impacts of the AMI participants. The AMI component is administered and charged to another internal organization. Table 3-6 summarizes the unique inputs used in the TRC test.

Table 3-6. Inputs to Cost-Effectiveness Model for AEP HER Program

Item	Value
Measure Life	1
Participants	553,383
Annual Energy Savings (kWh)	72,957,517
Coincident Peak Savings (kW)	9,512
Third Party Implementation Costs	$1,177,781
Utility Administration Costs	$178,053
Utility Incentive Costs	$0
Participant Contribution to Incremental Measure Costs	$0

Based on these inputs, the TRC ratio for the AEP Ohio HER Program is 2.1, and the program is cost-effective. 7 summarizes the results of the cost-effectiveness tests. Results are presented for the Participant test, the TRC test, the Ratepayer Impact Measure test, and the Utility Cost test.

Table 3-7. Cost-Effectiveness Results for the HER Program

Benefit-Cost Test	Cost Test Ratio
Total Resource Cost	2.1
Participant Cost Test	N/A
Ratepayer Impact Measure	0.3
Utility Cost Test	2.1

At this time, additional benefits related to reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Impact Evaluation

Navigant utilized methodologies in accordance with recommendations from the SEE Action Network Working Group for evaluating behavior-based energy efficiency programs in order to estimates HER Program savings.[7] Two different models were utilized in the impact evaluation to confirm the robustness of the estimated savings impacts.

4.1.1 Key Impact Evaluation Findings

The HER Program reported *ex ante* 76,229 MWh of energy savings and 9,909 kW of demand savings in 2017. The verified *(ex post)* energy and demand savings for 2017 for all HU and PIPP customers combined were 72,958 MWh and 9,512 kW respectively, for a realization rate of 96 percent on energy savings and 96 percent on peak demand savings. Savings from AMI customers are not included in the above *ex ante* and *ex post* calculations because these savings are not counted toward the HER Program savings goals. Navigant estimated these customer groups provided an additional 4,217 MWh of energy savings and 550 kW of peak demand savings. Across all customer groups, Navigant estimates the HER Program saved 77,175 MWh and 10,062 kW during the 2017 program year.

Navigant found savings varied significantly by customer group. HU participants in the earlier cohorts are estimated to have saved more energy than other customer groups on an absolute basis. This is partly due to their higher average daily energy use as compared to other participant cohorts. On a relative basis, the savings from the earlier cohorts enrolled in 2010 through 2015 all exceed one percent of daily energy usage.

A meaningful result from the cohort-level findings is the relatively low rate of savings from the later cohorts compared to the earlier cohorts. The five cohorts enrolled during 2016 and 2017 are estimated to have generated under one percent savings. Prior experience has shown once customers begin receiving HERs, it can take up to 18 months for savings to fully materialize after a customer is enrolled in the program. This "ramp-up" phase may be impacting the savings estimate for the 2017 HU and AMI cohorts, as well as the 2016 HU and AMI cohorts. However, the 2016 AMI cohort generated almost no savings, despite having been deployed for 17 months by the end of 2017. This cohort may not be savings-generating in the coming program years.

Navigant's estimates of verified program savings were reduced from double counted savings, as Navigant found an increase in participation among HER Program customers in other AEP Ohio EE/PDR programs as compared to control customers. Navigant used a Post-Only-Difference (POD) analysis to determine 804 MWh of estimated savings are likely already counted in other AEP Ohio programs. The total savings estimate pro-rated savings for customers that moved-out during the program year.

Navigant measured customers' satisfaction with AEP Ohio by asking customers to rate their satisfaction on a scale of 0 to 10, where 10 is highly satisfied. Navigant categorized "overall satisfaction" as any rating above a 5, while "highly satisfied" is any score above an 8. The average satisfaction score from

---

[7] "Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations" published by the State and Local Energy Efficiency Action Network in May 2012.

respondents was 7.9, with 86 percent of respondents falling within the "overall satisfaction" category and 48 percent of respondents in the "highly satisfied" category.
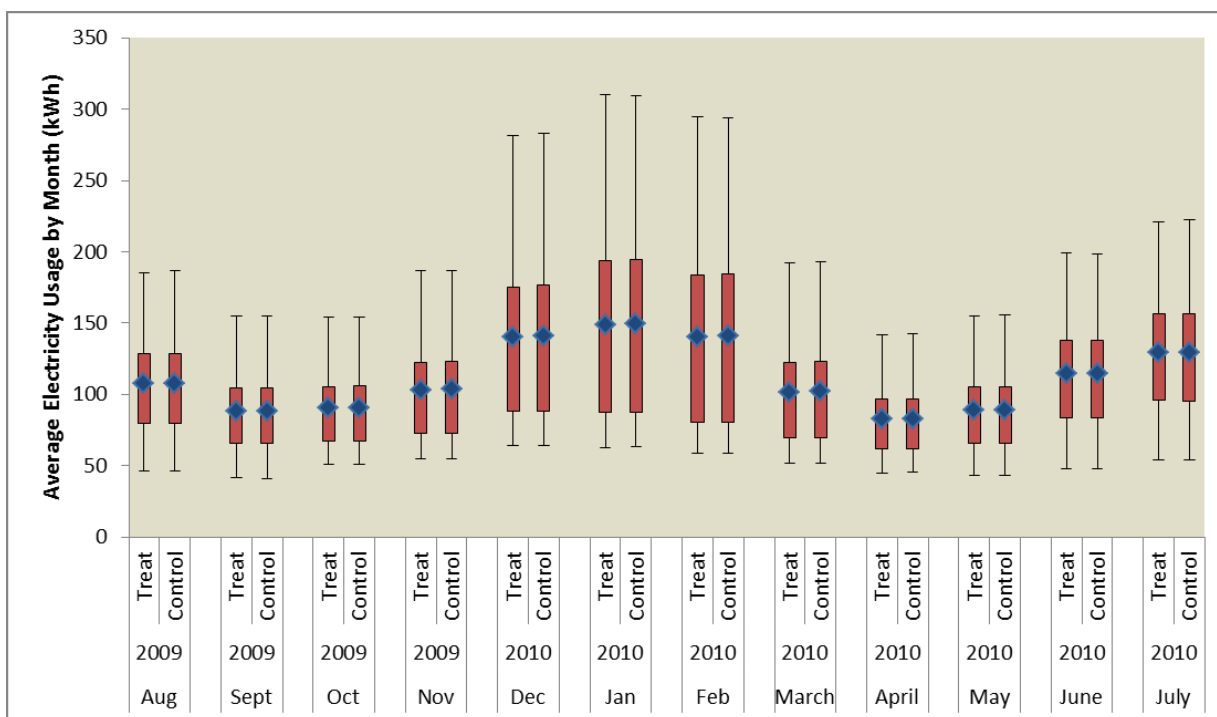
4.1.2 Recommendations

1. Navigant's analysis shows recent participant cohorts have a lower average daily energy usage and, relatedly, a lower average electricity savings. Evidence from this analysis also suggests some of the more recent cohorts may have a lower relative level of electric savings beyond the initial ramp-up period. Navigant suggests AEP Ohio continue the HER Program as long as regularly reported electric savings remain cost-effective, but also monitor the incremental cost and savings of each new cohort introduced to ensure individual cohorts contribute to the cost-effectiveness of the program as a whole.

2. Further investigation into the construction of the 2013 AMI cohort may be warranted to determine if there are customer characteristics that are adversely impacting participant savings. AEP Ohio should also carefully watch the 2016 AMI cohort, as savings were almost non-existent in 2017. If savings continue to lag for this wave, additional investigation may be warranted.

3. The results of the customer survey suggest both satisfaction and engagement with the reports are high. AEP Ohio should continue to track customer satisfaction in subsequent program years as year-over-year comparisons will serve as a benchmark for the efficacy of the reports, and could explain any future changes in electricity savings that may occur.

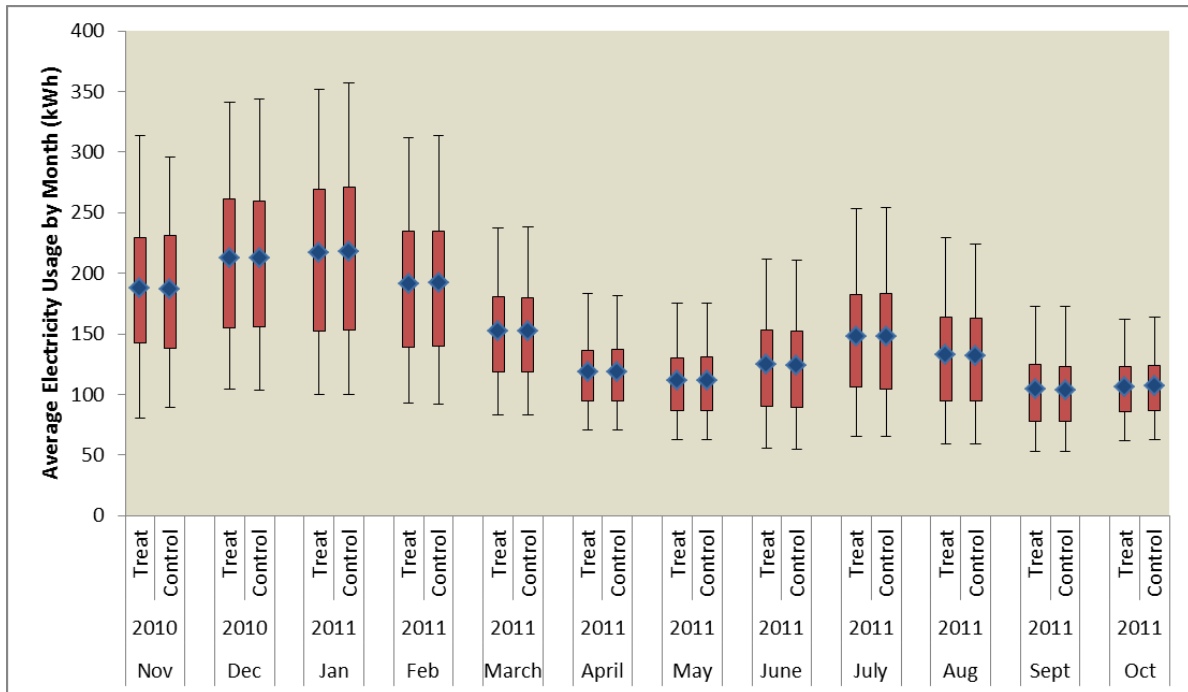# APPENDIX A. VERIFICATION OF CONTROL GROUPS

The following graphs present the distribution of energy use in the pre-program period for treatment and control households in each customer group and cohort. In the graphs, the diamonds represent the average monthly electricity use of households in each customer group, the bars represent the range of energy use between the 25th and 75th percentile of households, and the lines (whiskers) show the range between the 5th and 95th percentile of households.

Figure A-4-1. Average Daily Treatment/Control Household Energy Use by Month in 2010 HU Cohort
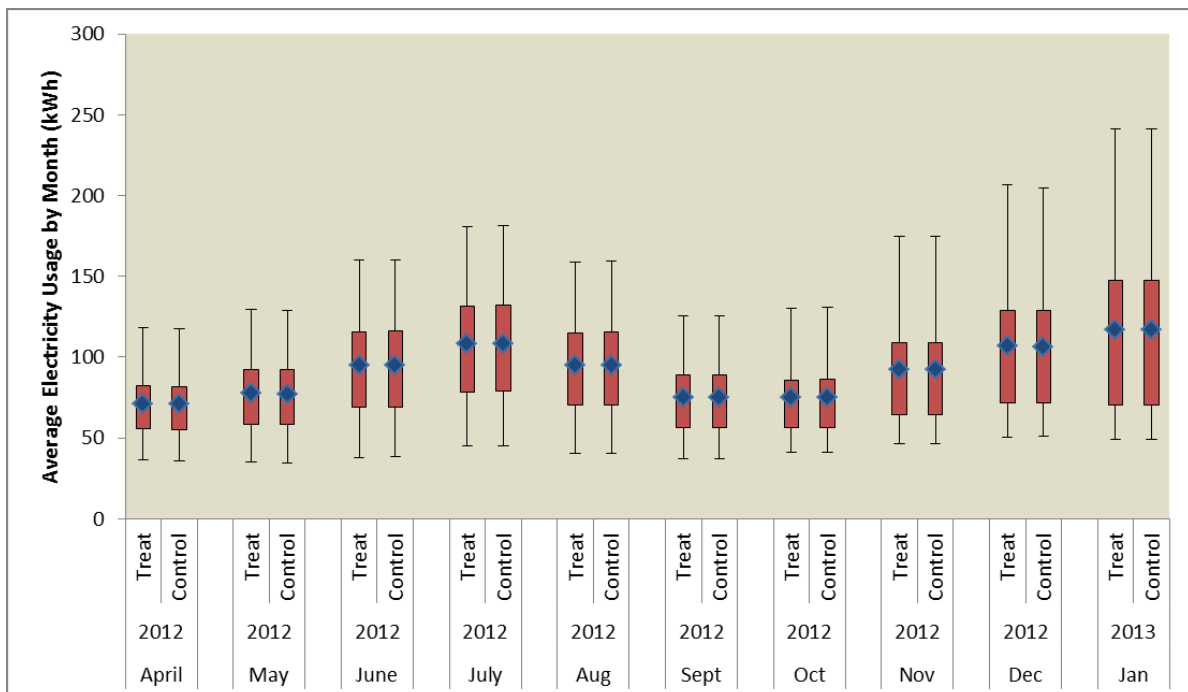

Source: Navigant Analysis

Figure A-4-2. Average Daily Treatment/Control Household Energy Use by Month in 2011 HU Cohort
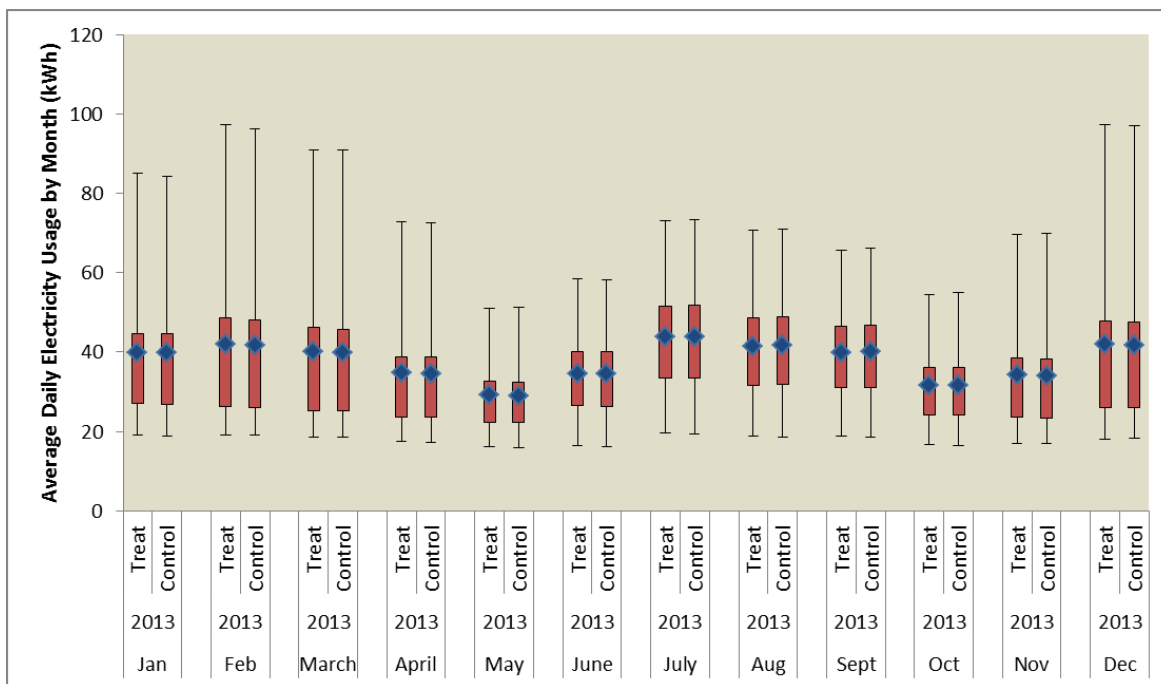

Source: Navigant Analysis

Figure A-4-3. Average Daily Treatment/Control Household Energy Use by Month in 2013 HU Cohort
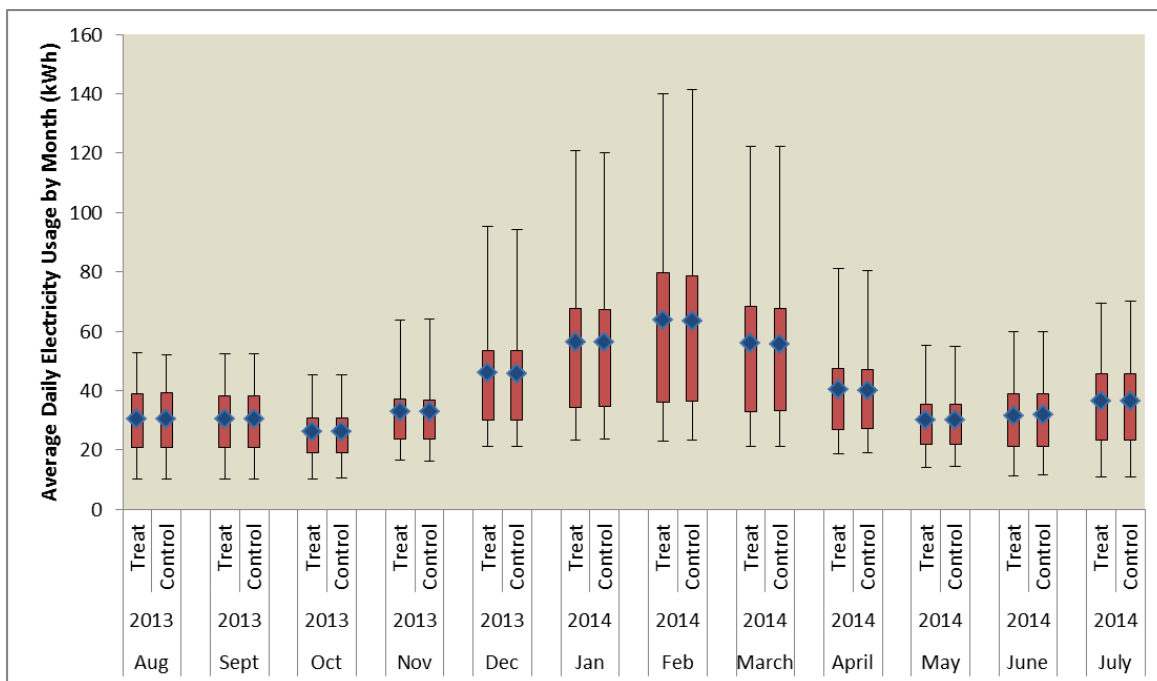

Source: Navigant Analysis

Figure A-4-4. Average Daily Treatment/Control Household Energy Use by Month in January 2014 HU Cohort

Source: Navigant Analysis

Figure A-4-5. Average Daily Treatment/Control Household Energy Use by Month in August 2014 HU Cohort

Source: Navigant Analysis

Figure A-4-6. Average Daily Treatment/Control Household Energy Use by Month in 2010 PIPP Cohort

Source: Navigant Analysis

Figure A-4-7. Average Daily Treatment/Control Household Energy Use by Month in 2010 AMI Cohort
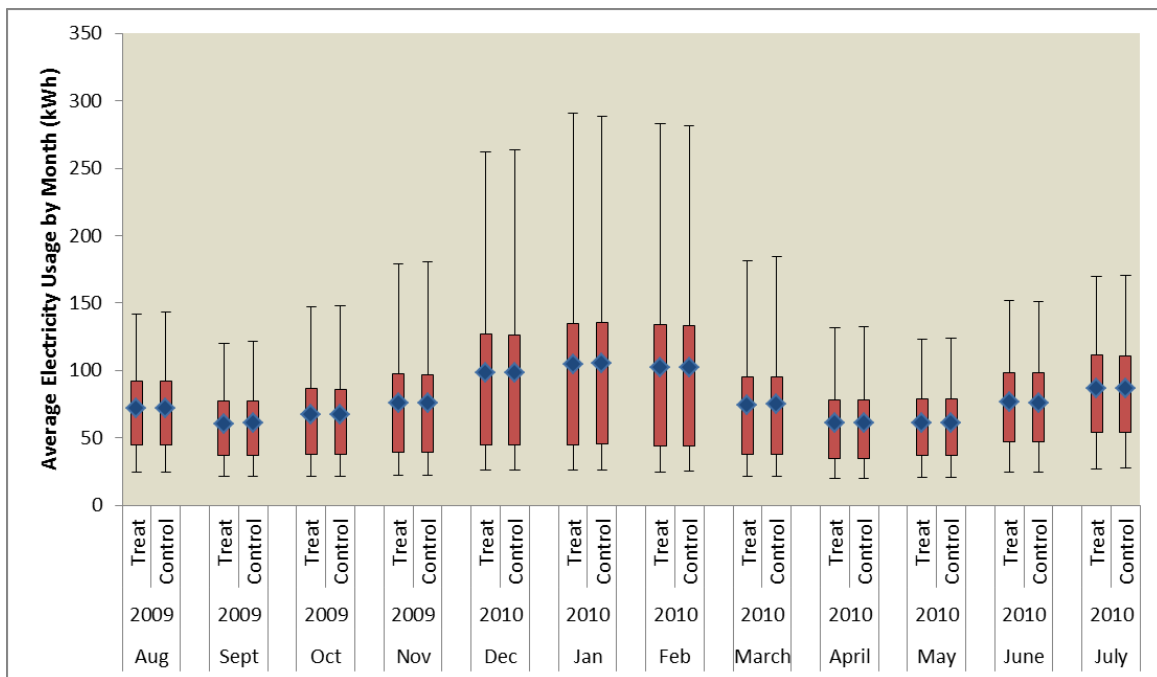

Source: Navigant Analysis

Figure A-4-8. Average Daily Treatment/Control Household Energy Use by Month in 2014 AMI Cohort
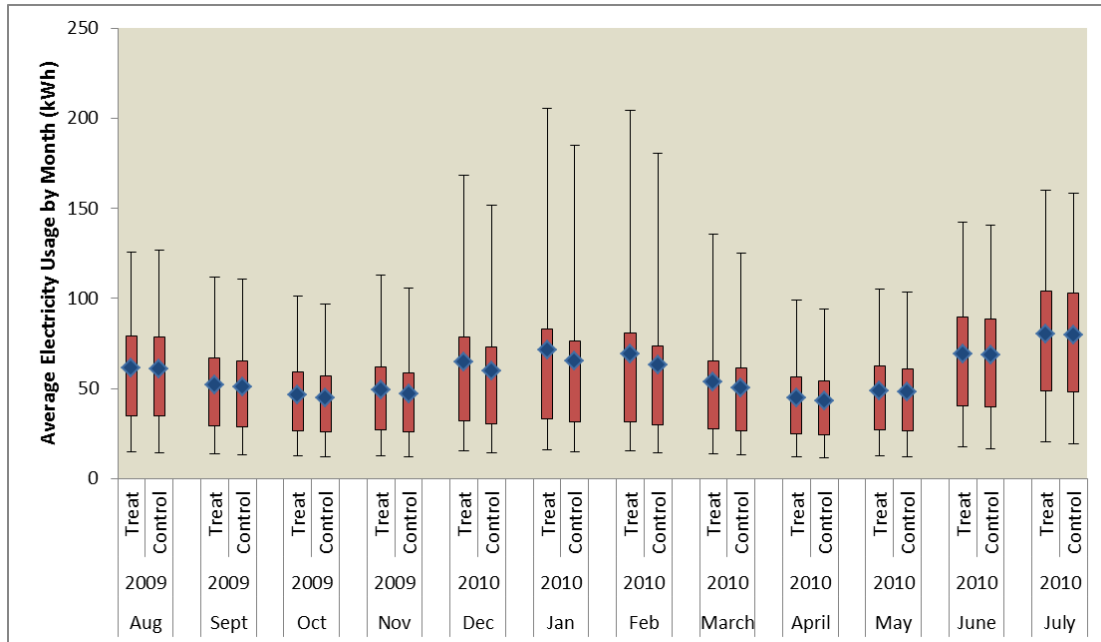

Source: Navigant Analysis

Figure A-4-9. Average Daily Treatment/Control Household Energy Use by Month in 2015 AMI Cohort
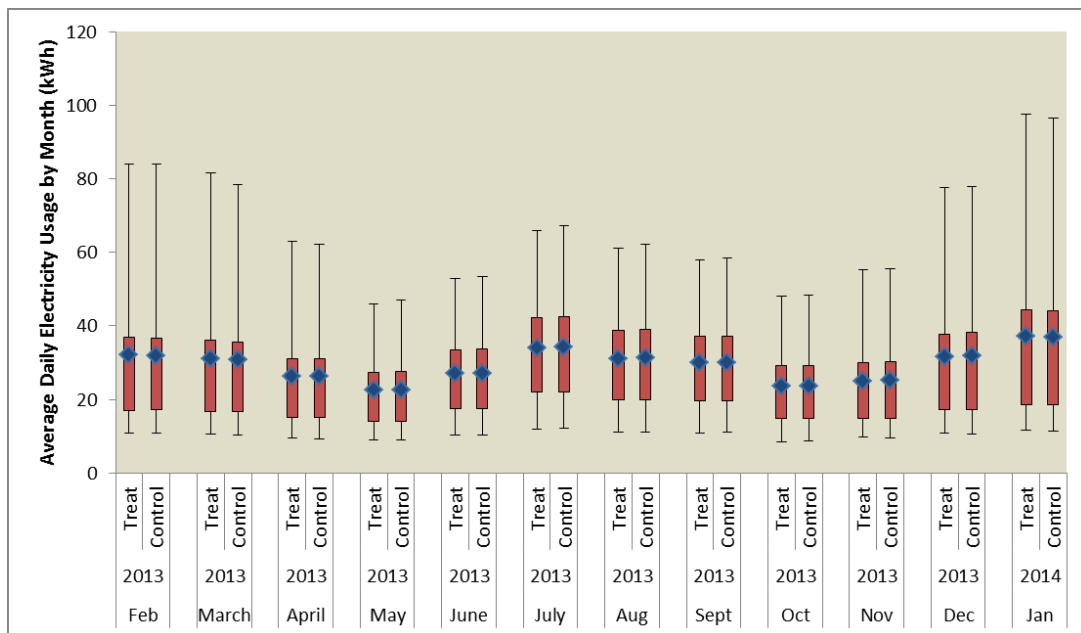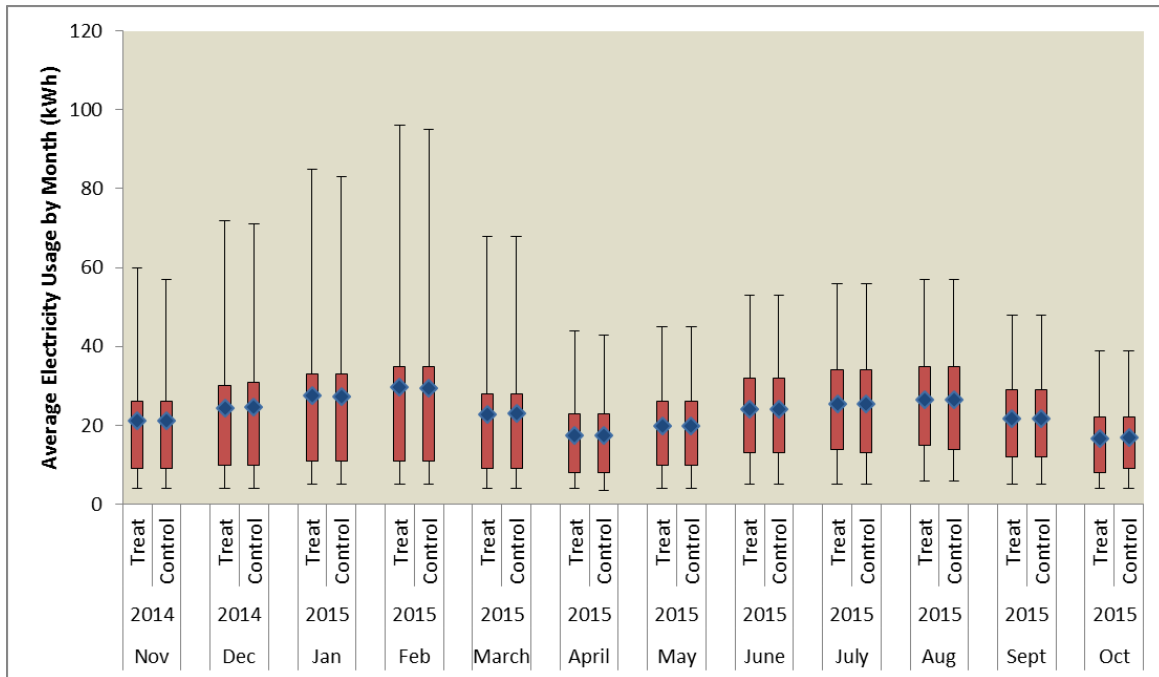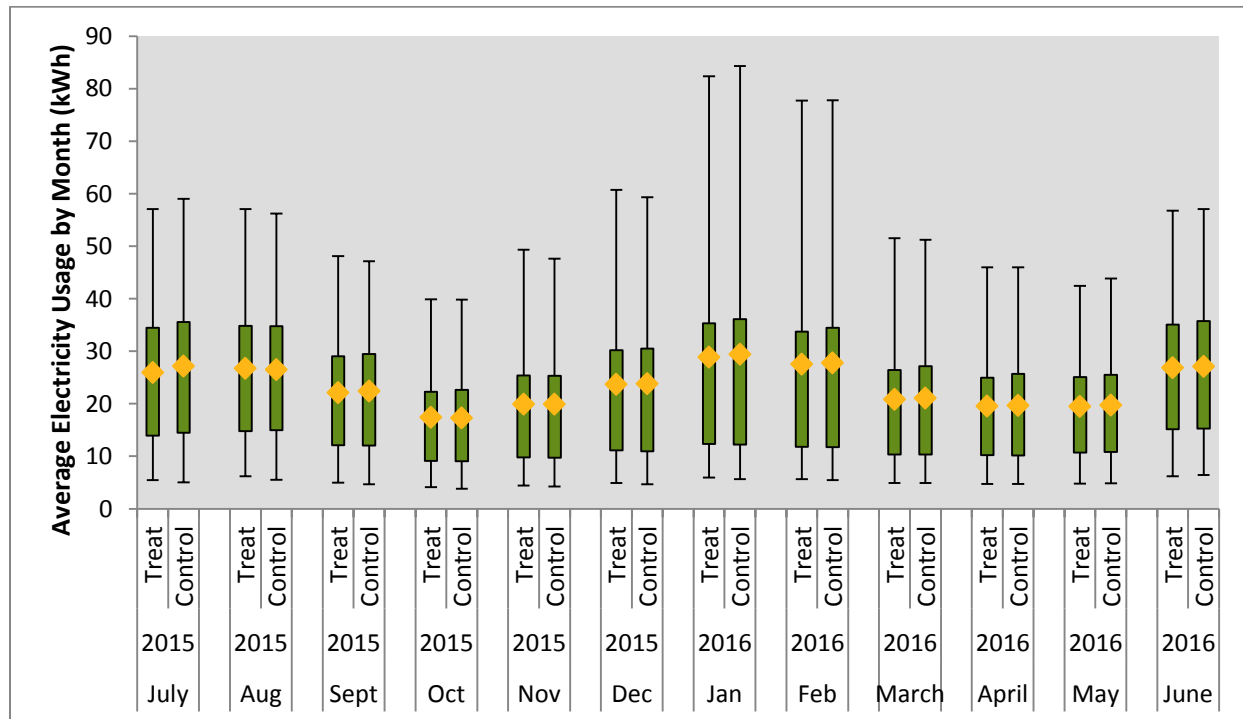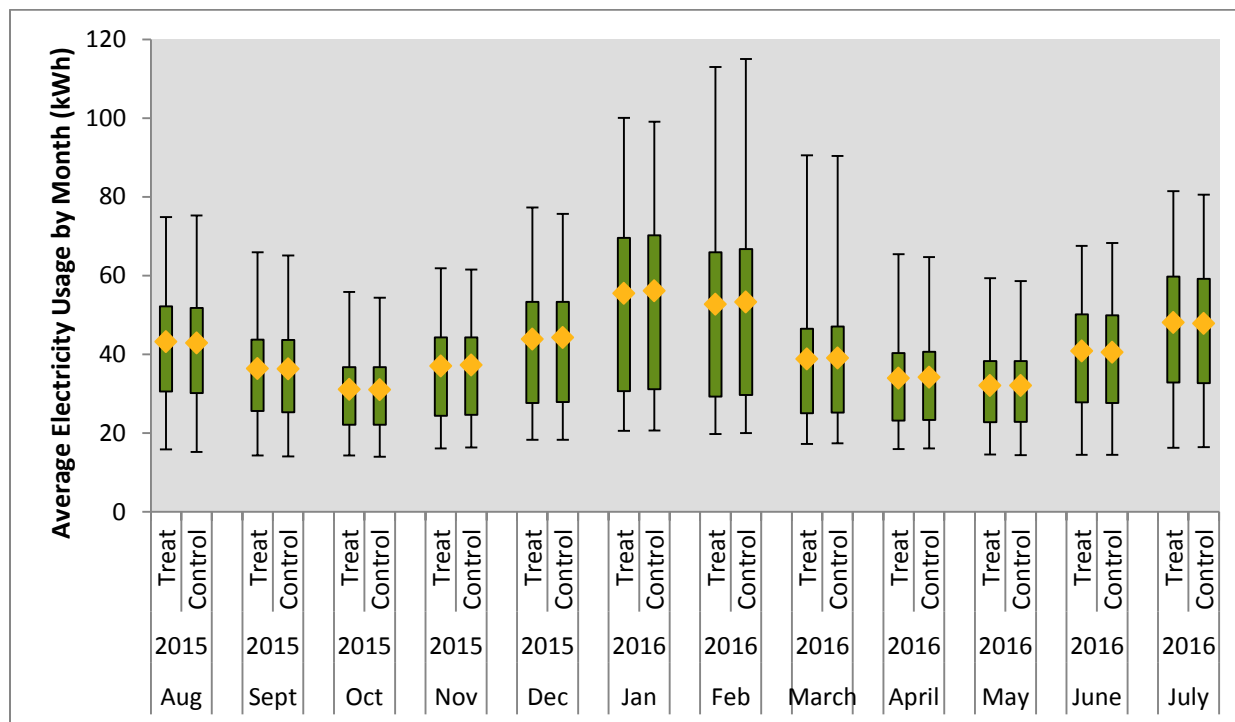

Source: Navigant Analysis

Figure A-4-10. Average Daily Treatment/Control Household Energy Use by Month in July 2016 AMI Cohort

Source: Navigant Analysis

Figure A-4-11. Average Daily Treatment/Control Household Energy Use by Month in August 2016 HU Cohort

Source: Navigant Analysis

APPENDIX B. PER PARTICIPANT REGRESSION RESULTS

Table B-4-1 presents the key outputs of the post program regression and fixed-effects analyses. These values are per participant daily savings estimates in terms of kWh.

Table B-4-1. Per Participant Coefficients and Standard Errors by Program Cohort

Program Cohort	LDV Coefficient	LDV Clustered Standard Error	FE Coefficient	FE Clustered Standard Error
2010 HU	-0.8660	0.0810	-0.8329	0.0867
2011 HU	-0.8616	0.2402	-0.8319	0.2501
2013 HU	-0.5925	0.0803	-0.5795	0.0796
Jan 2014 HU	-0.4133	0.0935	-0.3782	0.0974
Aug 2014 HU	-0.4199	0.1671	-0.3805	0.1810
2016 HU	-0.2747	0.0847	-0.2322	0.0823
Feb 2017 HU	-0.1268	0.0403	-0.1273	0.0371
Sept 2017 HU	0.1511	0.1520	-0.0250	0.1024
PIPP	-0.7959	0.2300	-0.5329	0.2354
2010/11 AMI	-0.2522	0.1590	-0.3518	0.1786
2013 AMI	0.3766	0.2335	0.5334	0.2435
2014 AMI	-0.3638	0.1571	-0.4138	0.1664
2015 AMI	-0.2979	0.1164	-0.2281	0.1244
2016 AMI	-0.0037	0.1572	-0.1938	0.1624
2017 AMI	-0.0500	0.4737	-0.2423	0.3713

Source: Navigant Analysis

NAVIGANT

APPENDIX C. SAMPLE HOME ENERGY REPORT

gridSMART™
From AEP OHIO®

Home Energy Report
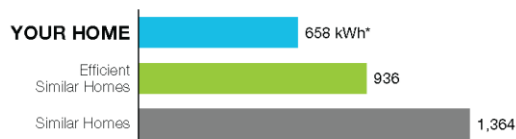Account number:
Report period: 04/01/11 - 05/31/11

We are pleased to provide you periodic, personalized Home Energy Reports as part of an AEP Ohio gridSMART® initiative. These reports are designed to provide you more information to make informed energy choices to help you save energy and money.

If you have any questions about these reports or would like to no longer receive them, you can contact us at (800) 277-2177 or gridSMARTOhioReports@aep.com.

Update your home information at:
gridSMARTOhio.com/go/reports

Last 2 Months Household Comparison | You used **30% LESS** electricity than efficient similar homes.

YOUR HOME — 658 kWh*
Efficient Similar Homes — 936
Similar Homes — 1,364

How you're doing:

▶ **GREAT** ☺ ☺
Good ☺
More than average

* kWh: A 100-Watt bulb burning for 10 hours uses 1 kilowatt-hour.

Similar Homes: Approximately 100 occupied, nearby homes (avg 0.09 miles away)

Efficient Similar Homes: The most efficient 20 percent of similar homes

Is your home compared correctly?
Tell us more about your home:
gridSMARTOhio.com/go/reports

Last 12 Months Household Comparison

You used **50% LESS** electricity than similar homes.
This saves you about **$591** per year.

< 2010 | 2011 >

kWh axis: 1,200 / 900 / 600 / 300

Months: JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY

Key: ▬ Your Home ▬ Similar Homes ▬ Efficient Similar Homes

Turn over for savings ➝

An Average Day Last Month

On average, you used the most from 10 pm – 12 am.
Think about what uses electricity during this time.

Do you use more on weekdays or weekends? Visit **gridSMARTOhio.com/go/reports** to find out.

Action Steps | **Personalized tips chosen for you based on your energy use and housing profile**

Quick Fix
Something you can do right now

☐ **Raise your thermostat setting**
By setting your thermostat appropriately in the summer, you can stay cool and save energy. You can save 3-5% on cooling costs for each degree you increase the temperature.

Set the thermostat to 78°F or higher when you are awake and home, and use fans to stay comfortable.

When you leave home, change the thermostat to an energy saving level — a 10°F adjustment is a good rule of thumb.

SAVE UP TO
$120 PER YEAR

Great Investment
A big idea for big savings

☐ **Choose an efficient room air conditioner**
In the summer, air conditioning can account for a significant portion of your home's energy bill.

When you decide to replace your old room air conditioner, invest in an efficient, ENERGY STAR® qualified unit to lower your cooling costs.

We're offering a $25 mail-in rebate when you recycle your old, working room air conditioner and purchase an ENERGY STAR qualified model May 1, 2011 through August 31, 2011.

SAVE UP TO
$20 PER YEAR

Quick Fix
Something you can do right now

☐ **Keep out the sun's heat**
Sunlight passing through windows can heat up your home and make your air conditioner work extra hard.

Keep blinds or draperies closed on sunny days to block this heat. You can also purchase and install shade screens, which are another affordable and effective way to keep out the sun's heat.

Blocking sunlight from entering your home will help you stay comfortable and save on cooling costs.

SAVE UP TO
$10 PER YEAR

---

gridSMART *From* **AEP OHIO**

Questions? Want to opt-out of reports? | (800) 277-2177 | gridSMARTOhioReports@aep.com

runs on OPOWER®

APPENDIX D. AEP OHIO HER CUSTOMER SURVEY

AEP Ohio
Home Energy Report Participant Survey 2017

D.1 Program Overview

The Home Energy Report program provides residential customers with Home Energy Reports (HERs). The reports provide selected households with helpful information about the ways they use energy. HERs also use social norms to compare the customer's energy use to the average energy use of other households similar to them so customers have a better sense of whether their energy use patterns fall above or below the norm. Finally, these reports provide targeted recommendations or tips to customers that suggest actions they can take to reduce consumption. The reports are sent to a targeted subset of customers on an opt-out basis. Currently the reports are being provided to more than 512,000 AEP Ohio customers. The purpose of the reports is to enhance customers understanding of their energy use, encourage them to reduce their consumption through the use of targeted tips and social norms, and to enhance customer engagement and satisfaction.

Section	Description
Statement of purpose	To assess customer satisfaction with the HERs, email reports, web portal and AEP Ohio, as well as to assess the effectiveness of the reports on customers' understanding of their energy usage and their behaviors.
Qualified respondent	Residential sector participant in the program treatment group who is familiar with the reports.
Target number of completes	400 participants
Estimated survey length	5 – 10 minutes
Survey timeline	November 15 to December 20, 2017

Survey Variables	Description	Source
HER Participant in the treatment group w/email	Participates in the treatment group of the residential Home Energy Report Program	Implementer Data
Wave of participation (Wave_Part)	The participant cohort or wave during which the participant joined the program, including which type of home energy report the customer receives (Email, Paper, or Both)	Implementer Data

D.2 Sample

This table outlines Navigant's sampling techniques.

Topic	Description	Population
Sample size	How many completes will you need to reach a relative precision of [±10% at the 90%] confidence level	400 completed surveys from HER report participants in the treatment group
Stratification	How complex is the sample? Do you need to stratify?	We will stratify based on participant wave/cohort
Unique attributes	What is the ability level of the population? Are there language barriers? Do you need to consider literacy rates? Do you need to specialize the training of your surveyors?	None known
Incentives	Any incentives or persuasion techniques?	None planned

D.3 Survey Overview

Research Objective	Survey Questions
Assess participants' satisfaction with AEP Ohio	SAT1-SAT1a
Assess participants' engagement with the home energy reports and collect feedback on their usefulness	HER1-HER24
Assess participants' awareness and opinions on energy efficiency	EA1-EA4
Identify participants' energy efficiency actions and purchases	EA5-EA6a
Collect demographic information on the participants	D1-D6

D.4 Initial Email Invitation

Subject Line: Tell Us What You Think about AEP Ohio's Home Energy Reports
Sender: AEP Ohio

Dear [CUSTOMER_NAME]:

Thank you for your participation in AEP Ohio's Home Energy Report program!

We value your candid feedback so that we can continue to improve our energy programs to better serve our customers. We invite you to share your experience and feedback through a brief on-line survey.

Please click on the link below to take this short survey:

[SURVEY LINK, IN BUTTON FORM]

The survey will take approximately 5 to 10 minutes to complete. If you cannot complete the survey all at one time or you accidentally exit the survey mid-course, you can resume the survey where you left off by clicking on the link from this email or hitting the back button.

Thank you in advance for completing the survey and for participating in AEP Ohio's energy efficiency programs!

Sincerely,

[AEP OHIO EE PROGRAM STAFF]

D.5 Landing Page

Thank you in advance for taking a few minutes to answer these questions about AEP Ohio's Home Energy Report program. Your feedback is important and will help us improve the program to better serve customers like you. We expect the survey to take no longer than 10 minutes to complete. Your responses will be kept confidential, shared only with the research team. In reporting results, no comments will be attributed to specific individuals. Thank you for participating in this important survey!

D.6 AEP Ohio Satisfaction

SAT1. On a scale from 1-10, how would you rate your overall satisfaction with AEP Ohio, your electric utility?

Extremely Dissatisfied									Extremely Satisfied	Don't Know
1	2	3	4	5	6	7	8	9	10	[ ]

SAT1a. Why did you give that rating?
   [LARGE OPEN END BOX]

D.7 Home Energy Report Engagement

HER1. Do you recall whether your household receives a report by email from AEP Ohio that describes your home's energy use?
(The reports are different from your utility bill and include charts and graphs about your energy use.)
   1. Yes
   2. No, we do not receive the reports
   98. I don't know

[IF HER1=2, TERMINATE SURVEY]
Thank you for taking this survey.

HER2. Does anyone in your household read the reports?
   1. Yes, I read them
   2. Yes, I read them *and* others in my household read them
   3. I do not read them, but others in my household do
   4. No one reads them; we discard them
   97. Other **[SPECIFY AND SKIP TO HER4]**
   98. I don't know **[TERMINATE SURVEY]**

[IF HER2=3]
Thank you for taking this survey. Please forward the survey link to the person in your household who reads the Home Energy Reports. We would like to hear their opinions.

[IF HER2=98]
Thank you for taking this survey.

[IF HER2 = 4]
HER3. Could you explain why no one in your household reads the reports?
    [OPEN END]

[IF HER2=4, TERMINATE]
Thank you for taking this survey.

HER4. On average, roughly how much time do you spend reviewing the report?
        1   <2 minutes
        2   2-5 minutes
        3   6-10 minutes
        4   >10 minutes
        97. Other **[OPEN END]**
        98. I don't know

HER5. The Home Energy Reports suggest actions you can take to save energy. Do you recall any specific suggestions from your reports?
        1.   Yes
        2.   No **[SKIP TO HER8]**

[ONLY SHOW IF HER5=1]
HER5a. What suggestions do you remember seeing?
[LARGE OPEN END BOX]

HER6. On average, do you find the suggestions relevant to you and your household?
        1.   Yes
        2.   No
        97. Other **[OPEN ENDED BOX]**

[ASK IF HER6 = 2/No]
HER7. Why do you feel the suggestions are not relevant to you and your household? **[OPEN ENDED BOX]**

HER8. The Home Energy Report provides information about how your home's electricity use compared to a group of homes similar in size and energy usage to yours. Do you recall this section of the Home Energy Report?
   1. Yes
   2. No
   3. I don't know

[IF HER8 = 1/YES]
HER9. Do you have confidence in the report's comparisons—in other words, do you believe that your household is being accurately compared with similar homes?
   1. Yes
   2. No
   97. Other **[OPEN ENDED BOX]**
   98. I don't know

[IF HER9 = No/2]
HER10. Why do you think your household is not being accurately compared with similar homes?
   [LARGE OPEN END BOX]

HER11. Are you aware the information used in the household comparison can be updated to give you a more accurate comparison?
   1. Yes
   2. No
   98. I don't know

HER12. How useful have you found the information provided in the reports to be?
   1. Very useful
   2. Somewhat useful
   3. Only slightly useful
   4. Not useful at all
   98. I don't know

[IF HER12=4]
HER13. Why do you not find the information provided in the reports useful?
[OPEN END]

HER14. What part of the Home Energy Report do you find most useful or interesting? (Select all that apply)

1	The comparison of my home's energy use to similar homes
2	The comparison of my home's energy use to my home in previous years
3	The customer testimonials (i.e. success stories about other people saving energy by acting on the tips provided in the reports)
4	The energy saving tips
5	It's all useful
97	Other **[SPECIFY]**
98.	I don't know

HER15. Have you noticed any energy savings on your electric bill since you started receiving the Home Energy Reports?
1 Yes
2 No
98 I don't know

HER16. AEP Ohio offers a website that gives more details on your personalized Home Energy Report. This website is not the same as AEP Ohio's general website. It offers you online tools to complement the Home Energy Reports. Were you aware of this energy report website before this survey?
1. Yes
2. No **[SKIP TO D1]**
98. I don't know **[SKIP TO D1]**

HER17. How did you first learn about the Home Energy Report website?
[OPEN END]

HER18. Have you or someone else in your household visited the Home Energy Report website?
1. Yes
2. No **[SKIP TO EA1]**
98. I don't know **[SKIP TO EA1]**

HER19. On a scale of 1-10, how satisfied are you with the Home Energy Report website?

Extremely Dissatisfied									Extremely Satisfied	Don't Know
1	2	3	4	5	6	7	8	9	10	[ ]

[IF HER19 < 7]
HER20. Why did you give that rating?

[OPEN END]

[ASK IF Wave_Part=Both, ELSE SKIP TO EA1]

HER21. Since you receive both online and paper versions of the Home Energy Reports, which type do you prefer? **{SINGLE CHOICE}**

1	Online
2	Paper
3	I like getting both
4	Neither
98	I don't know

D.8 Energy Awareness

EA1. Are you familiar with the ENERGY STAR label for appliances, such as televisions, dishwashers, and clothes washers and dryers that meet federal energy efficiency standards?

1	Yes
2	No
98	Don't know
99	Refused

EA2. Please select how much you agree or disagree with these statements.

EA2a.   I am very concerned about how energy use affects the environment.
EA2b.   I often worry that the cost of energy for my home will increase.
EA2c. I intend to conserve electricity in my home this year.
EA2d.   I am already doing everything I can to save energy in my home.
EA2e.   I understand how actions taken by me and others in my household result in higher or lower energy use.
EA2f.   It would make me proud to have one of the most energy efficient houses in my neighborhood.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Don't know
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

EA3. Please select how much you agree or disagree with these statements.

EA3a. I pay closer attention to my energy costs now than I did before receiving Home Energy Reports.
EA3b. I feel guilty if I use too much energy.
ER3c. I know about other things I could be doing to save energy, beyond what I'm already doing.
EA3d. Improving my home's energy efficiency is a worthwhile investment.
EA3e. My energy bill is noticeably lower when I make an extra effort to conserve.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Don't know
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

D.9 Demographics

D1. How many people live in your household year-round?
[NUMERIC, 1-50]

D2. Which of the following best describes your home/residence?
1. Single-family home
2. Factory-built modular home (that is put together at the home site)
3. Mobile home (delivered via truck and has a chassis)
4. Row house
5. Two or three family attached residence
6. Apartment (4+ residences)
7. Condominium
97. Other **(Specify)**

D3. Do you own or rent your home?
1. Own **[SKIP TO D5]**
2. Rent

[ASK IF D3=1, ELSE SKIP TO D5]
D4. Do you pay your own electric bill or is it included in your rent?
1. I pay the electric bills
2. Included in rent

D5.   Approximately when was your home constructed?
1. Before 1960
2. 1960-1969
3. 1970-1979
4. 1980-1989
5. 1990-1999
6. 2000-2005
7. 2006 or later
98. I don't know

D6.   How many years have you lived at your current residence?
[**NUMERIC 1-100]**

D.10 Closing Page

Thank you for completing the survey. Your responses will help AEP Ohio make improvements to its energy programs to better serve customers like you.

D.11 First Follow Up Reminder

Subject Line: REMINDER: Feedback on AEP Ohio's Home Energy Reports
Sender: AEP Ohio

Dear [CUSTOMER_NAME]:

Thank you for participating in AEP Ohio's Home Energy Report program!

Recently, we invited you to share your experience with the Home Energy Report program through a brief online survey. Your feedback is very important and will help AEP Ohio improve its programs to better serve customers like you. **Don't miss out on this chance to share your experience!**

Please click on the link below to take this short survey:

[SURVEY LINK, IN BUTTON FORM]

The survey will take approximately 5 to 10 minutes to complete. If you cannot complete the survey all at one time or you accidentally exit the survey mid-course, you can resume the survey where you left off by clicking on the link from this email or hitting the back button.

Thank you in advance for completing the survey and for participating in AEP Ohio's energy efficiency programs!

Sincerely,

[AEP OHIO EE PROGRAM STAFF]

D.12 Final Follow Up Reminder

Subject Line: REMINDER: Feedback on AEP Ohio's Home Energy Reports
Sender: AEP Ohio

Dear [CUSTOMER_NAME]:

Thank you for participating in AEP Ohio's Home Energy Report program!

Within the last couple weeks, we invited you to share your experience with the Home Energy Report program through a brief online survey. **This survey is closing soon**. **Don't miss out on this chance to share your experience!**
I hope you will take a few minutes to complete the survey as your participation is of great importance.
Your feedback will guide program changes that will enable the program to better serve the needs of customers like you.
Please click on the link below to take this short survey:

[SURVEY LINK]

Thank you in advance for completing the survey and for your participation in AEP Ohio's energy efficiency programs!

Sincerely,

[AEP OHIO EE PROGRAM STAFF]

APPENDIX E. AEP OHIO PROGRAM MANAGER INTERVIEW GUIDE

AEP Ohio: HER PY2017 Evaluation
Program Staff In-Depth Interview Guide

Name of Interviewee: _____   Date: _____

Title: _____   Company: _____

[Note to Reviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff. The guide helps to ensure the interviews include questions concerning the most important issues being investigated in this study. Follow-up questions are a normal part of these types of interviews. Therefore, there will be sets of questions that will be more fully explored with some individuals than with others. The depth of the exploration with any particular respondent will be guided by the role that individual played in the program's design and operation, i.e., where they have significant experiences for meaningful responses.

Topic Area	*Topic Objective*
Roles and Responsibilities	Understand internal staff structure and identify key staff
Program Goals, Objectives, and Structure	Understand the program goals, detailed objectives and operational structure; identify any changes the program has implemented since the pilot phase; identify details about program for incorporation into the program theory and logic model
Data Tracking	Understand data QA/QC procedures
Other	Miscellaneous and wrap-up questions

Roles and Responsibilities
Objective: Understand staff structure and identify key staff.

1. Please briefly summarize your role in the program.
   [Probe for main responsibilities, length of time with program, and percent of time dedicated to program.]

2. Who are the key staff involved in the program's implementation?
   [Probe for an understanding of each person's role.]

3. What activities does each individual complete on a day-to-day basis?

4. Who is your main contact at the implementation contractor firm (Opower)?
   [Probe for an understanding of this person's role.]

5. Besides funding and staff resources, are there other resources invested in the program? (Including in-kind marketing, volunteer time, etc.)

Program Goals, Objectives & Structure
Objective: Understand the program goals, detailed objectives and operational structure. Identify any changes to the program since the pilot phase to increase the likelihood of achieving goals.

6. Please describe the main components of the program.

   [Confirm current understanding of the program components. Probe for as many details as possible regarding mailed reports, email reports and online web portal as necessary.]

7. What is the status of each of the program components?

   [Confirm current understanding of status. Is each component up and running, in development, or upcoming?]

8. What are the overall goals of the program?

   [Confirm current understanding of the program goals. Probe for details about specific energy savings, number of participants, impact on other programs, etc.]

9. What are the goals for each specific component of the program?

   [Confirm current understanding of each program component's goals. Probe for details about mailed reports, email reports, and online web portal as necessary.]

10. What type of customer does the program target (i.e., high energy users, low income customers)?

    [Confirm current understanding of program target customer.]

11. What market barriers does the program address (i.e., why aren't people already doing what the program intends to accomplish)?

12. What specific actions are you hoping to encourage with the program; what do you want participants to do?

    [Within the program (i.e., recall the reports, read the reports, etc.), and as a result of the program (i.e., make changes to energy use behavior, sign up for other programs, etc.).]

13. When are you expecting these actions to be taken, and for how long?

14. How successful is the program so far in achieving these goals (ask about each individual goal)?

    [Probe for details about mailed reports, email reports, and online web portal as necessary.]

15. Do you emphasize any specific tips or other AEP Ohio programs in the HERs?

    [Probe for details about specific tips or programs.]

16. Are there any external factors beyond your control that affect the program or the program's expected results?

17. Are there changes in program design, structure, and/or operations that might make the program more effective in reaching these goals?

    [Probe for things the program is missing, current challenges in implementation, participation, etc.]

18. What is working well?

    [Probe for why they think these things are working well.]

19. What are the future plans for the program?

    [Probe for details about specific components of the program, changes to implementation, or goals.]

Data Tracking

Objective: understand data QA/QC procedures (both on the utility side and the implementer side).

20. What data do you provide to the implementer?

    [i.e., customer data for treatment and control group customers]

21. How often do you provide this data to the implementer?

    [e.g., weekly, monthly, quarterly]

22. How does this data flow from AEP Ohio to the implementer?
    [Probe for an understanding of how the data gets from the utility to the implementer.]

23. What data quality assurance and control procedures do you implement prior to sending data to the implementer to ensure the data is accurate?
    [Probe for whether these are consistently implemented.]

24. What sort of performance metrics do you track for each component of the program?

    [Probe for details about specific components of the program, and how the information is used to manage the program.]

25. How often do you receive this performance data from the implementer?

    [Probe for whether the format is actionable, effective, or needs improvement.]

Other
Miscellaneous and wrap-up questions.

26. What questions are most important for you to answer through our evaluation?

27. Is there anything I didn't ask about that you would like to add?

Thank you very much for taking the time to talk with me. Your contribution is a very important part of the process.

Do you mind if we follow-up with you by phone later, if additional questions arise?

APPENDIX F. AEP OHIO IMPLEMENTER INTERVIEW GUIDE

AEP Ohio: HER PY2017 Evaluation
Implementer In-Depth Interview Guide

Name of Interviewee: _____   Date: _____

Title: _____   Company: _____

[Note to Reviewer] The Interview Guide is a tool to guide process evaluation interviews with the program implementer. The guide helps to ensure the interviews include questions concerning the most important issues being investigated in this study. Follow-up questions are a normal part of these types of interviews. Therefore, there will be sets of questions that will be more fully explored with some individuals than with others. The depth of the exploration with any particular respondent will be guided by the role that individual played in the program's design and operation, i.e., where they have significant experiences for meaningful responses.

Topic Area	Topic Objective
Roles and Responsibilities	Understand internal staff structure and identify key staff
Program Goals, Objectives, and Structure	Understand the program goals, detailed objectives and operational structure; identify any changes the program has implemented since the pilot phase; identify details about program for incorporation into the program theory and logic model
Data Tracking	Understand data QA/QC procedures
Other	Miscellaneous and wrap-up questions

Roles and Responsibilities
Objective: Understand staff structure and identify key staff.

28. Please briefly summarize your role in the program.
    [Probe for main responsibilities, length of time with program, and percent of time dedicated to program.]

29. Who are the key staff involved in the program's implementation?
    [Probe for an understanding of each person's role.]

30. What activities does each individual complete on a day-to-day basis?

    [Probe for an understanding of this person's role.]

31. Who is your main contact at the utility?
    [Probe for an understanding of this person's role.]

Program Goals, Objectives & Structure
Objective: Understand the program goals, detailed objectives and operational structure. Identify any changes to the program since the pilot phase to increase the likelihood of achieving goals.

32. Please describe the main components of the program.

    [Confirm current understanding of the program components. Probe for as many details as possible regarding mailed reports, email reports and online web portal as necessary.]

33. What is the status of each of the program components?

    [Confirm current understanding of status. Is each component up and running, in development, or upcoming?]

34. What are the overall goals of the program?

    [Confirm current understanding of the program goals. Probe for details about specific energy savings, number of participants, impact on other programs, etc.]

35. What are the goals for each specific component of the program?

    [Confirm current understanding of each program component's goals. Probe for details about mailed reports, email reports, and online web portal as necessary.]

36. What type of customer does the program target (i.e., high energy users, low income customers)?

    [Confirm current understanding of program target customer.]

37. What market barriers does the program address (i.e., why aren't people already doing what the program intends to accomplish)?

38. What specific actions are you hoping to encourage with the program; what do you want participants to do?

    [Within the program (i.e., recall the reports, read the reports, etc.), and as a result of the program (i.e., make changes to energy use behavior, sign up for other programs, etc.).]

39. When are you expecting these actions to be taken, and for how long?

40. How successful is the program so far in achieving these goals (ask about each individual goal)?

    [Probe for details about mailed reports, email reports, and online web portal as necessary.]

41. Do you emphasize any specific tips or other AEP Ohio programs in the HERs?

    [Probe for details about specific tips or programs.]

42. Are there any external factors beyond your control that affect the program or the program's expected results?

43. Are there changes in program design, structure, and/or operations that might make the program more effective in reaching these goals?

    [Probe for things the program is missing, current challenges in implementation, participation, etc.]

44. What is working well?

    [Probe for why they think these things are working well.]

45. What are the future plans for the program?

    [Probe for details about specific components of the program, changes to implementation, or goals.]

46. In your opinion, how successful is the program so far, compared to similar programs delivered around the country?

    [Probe for details about specific components of the program, goals, or approaches to implementation.]

47. How is this program different from other programs delivered around the country?

    [Probe for why they are different or causes of the differences.]

48. In your opinion, what are the most innovative programs currently operating?

    [Probe for why they think these are innovative, including goals, implementation differences, or accomplishments.]

Data Tracking
Objective: understand data QA/QC procedures (both on the utility side and the implementer side).

49. What data do you receive from AEP Ohio?

    [i.e., customer data for treatment and control group customers]

50. How often do you receive this data from AEP Ohio?

    [e.g., weekly, monthly, quarterly]

51. How does this data flow from AEP Ohio to your team?
    [Probe for an understanding of how the data gets from the utility to the implementer, and how the implementer handles the data when they receive it.]

52. What data quality assurance and control procedures do you implement upon receipt of the data to ensure the data is accurate?
    [Probe for whether these are consistently implemented.]

53. What sort of performance metrics do you track for each component of the program?

    [Probe for details about specific components of the program, and how the information is used to manage the program.]

54. How often do you provide this data to AEP Ohio?

    [Probe for whether the format is actionable, effective, or needs improvement.]

Other
Miscellaneous and wrap-up questions.

55. What questions are most important for you to answer through our evaluation?

56. Is there anything I didn't ask about that you would like to add?

Thank you very much for taking the time to talk with me. Your contribution is a very important part of the process.

Do you mind if we follow-up with you by phone later, if additional questions arise?

This foregoing document was electronically filed with the Public Utilities

Commission of Ohio Docketing Information System on

5/15/2018 2:06:02 PM

in

Case No(s). 18-0835-EL-EEC

Summary: Annual Report - Ohio Power Company submits the 2017 Portfolio Status Report pursuant to Rule 4901:1-39-05(C), Ohio Administrative Code
(Part 2 of 6) electronically filed by Mr. Steven T Nourse on behalf of Ohio Power Company