2016 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs

VOLUME II

APPENDICES E - K

AEP OHIO®

A unit of American Electric Power

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APPENDIX E

In-Home Energy Program

2016 Evaluation Report

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EXECUTIVE SUMMARY

This report presents the results of an evaluation of the 2016 AEP Ohio In-home Energy Program. The Executive Summary provides a high-level description of the program, key impact and process findings, conclusions, and recommendations. Detailed methodology and findings are described in the body of the report following the Executive Summary.

ES.1 Program Summary

The purpose of the In-home Energy Program is to provide energy efficiency information and easy-to-install measures to help customers act to reduce energy use. Energy efficiency products and information are provided to customers in four ways: 1) an *Online Energy Profile*, 2) an *In-home Energy Assessment,* 3) an *In-home Energy Audit,* and 4) a M*ulti-Family Direct Install Service*. During an audit or assessment, contractors install compact fluorescent lamps (CFLs), a light emitting diode (LED) night light, a 7-plug smart strip, an LED bulb and, if using electricity for water heating, low-flow showerheads and low-flow faucet aerators. Contractors install similar measures for multi-family dwellings. The program implementation contractor delivers program services on behalf of AEP Ohio and contracts with local installation contractors. The assessment (#2) and audits (#3) delivery channels were discontinued as of January 1, 2017.

ES.2 Key Impact Evaluation Findings and Recommendations

Navigant used engineering algorithms to verify energy and demand savings for the 2016 In-home Energy Program. The In-home Energy Program reported *ex ante* 6,796 MWh energy savings and 0.58 MW demand savings in 2016. The verified (*ex post*) energy and demand savings for 2016 were 5,708 MWh and 0.50 MW. The realization rates were 85 for energy and 86 percent for peak demand savings. Table ES-1 presents *ex ante* program savings along with Navigant's *ex post* estimates, which include the aggregated value of the verified measure installation rates. Measure installation rates of less than 100 percent were primarily responsible for the differences between *ex ante* and *ex post* savings estimates.

As shown in Table ES-2, the realization rate for each stratum (in this case, delivery channel) is calculated by weighting the installation rates of each measure in that stratum by their ex post savings contribution to total program savings. The kWh realization rate is therefore weighted by kWh savings and the kW realization rate is weighted by kW contributions of the measure in a stratum. The realization rates for these strata are then weighted by their respective savings to calculate the program level realization rates. *Ex post* savings fell short of the program energy savings goal of 13,700 MWh and the demand savings goal of 0.9 MW, as shown in Table ES-1.

Table ES-1. 2016 Overall Evaluation Results

	2016 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate[2] RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	13,720	6,796	5,708	0.85	42%
Demand Savings (MW)	0.90	0.58	0.50	0.86	56%

Source: [1] AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.
[2] The overall realization rate is weighted by the ex post savings contributions.

Table ES-2. Tracking System (*Ex Ante*) and Verified (*Ex Post*) Savings Estimates

Stratum (Delivery channel)	*Ex Ante* Savings (MWh) (a)	*Ex Ante* Savings (MW) (b)	*Ex Post* Savings (MWh) (c)	*Ex Post* Savings (MW) (d)	Energy Savings Realization Rate RR = (c) / (a)	Demand Savings Realization Rates RR = (d) / (b)
SF Direct Install	1,062	0.06	933	0.05	0.88	0.89
MF Direct Install	2,967	0.35	2,298	0.29	0.77	0.82
Retrofit Measures	1,901	0.12	1,901	0.12	1.00	1.00
Online Energy Kit	865	0.05	576	0.03	0.67	0.68
Total Savings / Weighted Average	6,796	0.58	5,708	0.50	0.85	0.86

Note: Total may not sum due to rounding.
The overall realization rate is weighted by the ex post savings contributions.

Program Activity. There were more than 100,000 direct install measures and 3,900 retrofits in 2016. Single-family and multi-family direct install measures accounted for 59 percent of the total *ex ante* program energy saving in 2016, energy kit measures accounted for 13 percent, and retrofit measures accounted for 28 percent of the program's total *ex ante* MWh savings.

Measure Installation Rate. The installation rate for each measure installed through the program was determined through both on-site audits as well as participant online and telephone surveys. Energy kit measure installation rates ranged from 48 percent for night lights and aerators, to 69 percent for showerheads and aerators, as shown in Table ES-3[1]. Installation rates for direct install measures ranged from 18 percent (multi-family smart strips) to 100 percent (multi-family showerheads) as presented in Table ES-4. All retrofit measures were found to have a realization rate of 100 percent as shown in Table ES-5.

[1] There is no installation rate for kit LED bulbs due to limited sample size and their late introduction into the kit in November 2016.

Table ES-3. Energy Kit Installation Rates

Energy Kit Measures		
	2016 Percent Installed	2016 Number of Online Survey Responses
CFL	55%	55
LED Nightlight	48%	56
Showerhead	69%	22
Aerator	69%	45

Table ES-4. In-Home Energy Program Direct Install Measure Installation Rates

Direct Install Measures	Single-Family		Multi-Family	
	Percent Installed	Number of Telephone Survey Respondents	Percent Installed	Number of On-site Participants
Aerator	88%	16	91%	6
CFL	90%	51	87%	65
LED	96%	25	91%	35
LED nightlight	83%	23	28%	36
Showerhead	76%	16	100%	7
Smart Strip	83%	23	19%	27

Table ES-5. Retrofit In-Service Rates

Retrofit Measures	Telephone Survey	
	2016 Percent Installed	2016 Number of Respondents
Air Conditioner	100%	23
Air Sealing	100%	3
Air Source Heat Pump	100%	5
Insulation	100%	3
Ground Source / Ductless Mini Split Heat Pump	100%	6
Thermostat	100%	19

1. **Impact Finding 1: Overall Energy Savings Realization Rate**. Although the energy realization rates of the individual delivery channels were higher compared to 2015, the overall realization rate remained like the 2015 value, as shown in Table ES-6. This is primarily because of the shift in the contribution of savings from the delivery channels. Retrofit measures had a realization rate of 100 percent both in 2015 and 2016, but these contributed 28 percent of the total savings in 2016 compared to 44 percent in 2015. So, retrofit measures influenced the overall realization rate more in 2015. Multi-family Direct Install measures had the highest contribution to savings and thus influenced the realization rate most in 2016.

Table ES-6. Energy Savings Contribution by Delivery Channel

Stratum Delivery Channel	Percent Savings (2016)	Percent Savings (2015)
Single-family Direct Install	16%	17%
Multi-family Direct Install	44%	29%
Retrofit Measures	28%	44%
Online Energy Kit	13%	9%
Total	100%	100%
Overall Realization Rate	85%	83%

Note: Totals may not sum due to rounding.

Impact Recommendation 1: The percentage of savings contributed by an individual delivery channel, along with the installation rates of the measures delivered through the channel, are key to realizing a high realization rate. Retrofit measures historically have a 100 percent installation rate. Increasing the contribution of savings from these measures is key to a high program realization rate. Rebate measures have a much higher per unit savings as compared to the direct install and kit measures, and a 100 percent realization rate. Navigant recommends allocating more funds to implementation of rebate measures as that will directly translate to a higher program realization rate.

Impact Recommendation 2: Navigant recommends separating the on-line delivery channel into a standalone program (as the online energy audit program), as it has historically had a lower realization rate. Without the on-line kits portion, the realization rate of the program would be 88 percent for energy and 87 percent for demand respectively. This number would be even higher if there were greater contributions from the rebate measures, which typically have a realization rate of 100 percent. The on-line energy audit can still serve as a participation channel for this program. There are utilities in nearby states that have separated out the online aspect of their in-home programs, which has improved the program realization rate.

2. **Impact Finding 2: *Ex Post* Savings Evaluation.** Navigant conducted a review of measure savings recorded in the tracking system to verify the energy savings algorithms matched those in the Draft 2010 Ohio Technical Reference Manual (Draft 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 Draft TRM. Navigant's algorithm review found the energy and demand savings algorithms have been constructed and applied properly per the Draft TRM

specifications. Following are two additional findings based on the review of updated Federal standards and LED interactive effects.

Codes and Standards: Heat Pump Measure

Navigant reviewed the in-situ baselines of the measures in consideration of applicable federal standards. Per the Federal Regional Standards for cooling equipment[2] that went it to effect on Jan 1, 2015, the baseline efficiencies for heat pumps were increased. According to this standard, the allowable baseline values for a heat pump measure were a SEER value of 14 and HSPF value of 8.2. AEP Ohio gave contractors a grace period of 12 months to exhaust their existing inventory and implemented the new baselines in 2016. Navigant determined AEP Ohio had updated the savings algorithm for this measure to be compliant with the standard.

Interactive Effects: LED Measure

While calculating the *ex pos*t savings, Navigant updated the interactive effects for LED bulbs. The Ohio TRM currently has a waste heat factor for energy of 1.07, and a waste heat factor for demand of 1.21. These values were replaced with interactive factors (IF) for LEDs of 0.93 for energy and 1.34 for demand, based on the AEP Ohio Residential Lighting Interactive Effects Modeling Results memo. The implementation of this change led to a slight decrease in the energy *ex post* savings and a slight increase in the demand *ex post* savings,

ES.3 Key Process Evaluation Findings and Recommendations

The process evaluation component of the In-home Energy Program assessed the effectiveness of the program operations, delivery for the energy audits/assessments, and rebates for retrofit measures. Navigant's process evaluation methods included in-depth interviews with program staff, participating customers and installation contractors, and a review of program tracking systems, reports and marketing materials. Findings follow along with recommendations.

1. **Process Finding 1:** Many participants are using technology, such as emails, websites and social media, to learn about AEP Ohio's programs. In 2015, the percent of customers who found out about the program through AEP Ohio's website was nine percent. This number increased to 16 percent in 2016. Also, in 2016, 20 percent of respondents said an email was how they found out about the program, compared to three percent in 2015.
    - **Process Recommendation 1:** As customers are becoming more technologically savvy, AEP Ohio should use technology more in its program promotions, channels to increase the use of email, website, online advertising via social media.
2. **Process Finding 2:** Seventy-five percent of the Online Energy Profile customers ranked themselves as knowledgeable or very knowledgeable regarding energy efficiency; yet they still chose to participate in the Online survey to ensure their knowledge was current.
    - **Process Recommendation 2:** Given the Online Energy Profile program appeals to people who are interested in staying current about energy efficiency and its implementation, these

[2] http://www.sgtorrice.com/files/Pages/News/2015-Regional-Standards-Cooling-Heating%20Products-rev1.pdf

participants should be considered the customer base for any AEP Ohio residential pilot programs as their interest is high.

3. **Process Finding 3:** Participants from the Online Energy Profile did not install the measures recommended primarily because they believed the costs of implementing these recommendations were too high. Many customers do not understand the significant savings they can realize by installing energy efficient equipment.
    - **Process Recommendation 3a:** Include the rebate amounts of equipment recommended to be installed so customers have a full understanding of the net costs.
    - **Process Recommendation 3b:** A comparison of the approximate energy savings a new unit could have over an older one will help customers better understand the value of energy efficiency.
    - **Process Recommendation 3c:** To help cross promote the residential energy efficiency programs and encourage increased participation – The Online Energy Profile should link the recommended rebate measures to the corresponding, other AEP Ohio program websites.

4. **Process Finding 4:** Overall, trade allies are satisfied with the program. However, 30 percent of trade allies found the rebate process complicated and cumbersome. Compared to other utilities, trade allies indicated the paper work involved with AEP Ohio was more work for them.
    - **Process Recommendation 4:** Work with the implementation contractor to develop a more streamlined rebate fulfillment process by benchmarking the paperwork requirements of neighboring utilities.

5. **Process Finding 5:** Some trade allies want to understand how to engage customers who are not aware of the opportunity to install energy efficiency equipment through the program. Many customers were not aware rebates were available for the equipment they were purchasing. Trade allies believe this can be established by more targeted advertising of the program.
    - **Process Recommendation 5:** Develop a joint advertising effort with trade allies, including brochures or flyers that could be given to customers.

6. **Process Finding 6:** Some customers received high energy use reports from AEP Ohio through the Home Energy Report Program. These customers participated in the program through audits and assessments to determine the cause of their high-energy use. The audits and assessments did not help these customers in identifying actionable items for reducing their energy use, as their homes were already energy-efficient. There is no recommendation based on this finding as the audits and assessments have been discontinued as a part of the IHE Program.

1. PROGRAM DESCRIPTION

This section provides an overview of the AEP Ohio In-home Energy Program, including a brief program description, followed by a summary of various aspects of the implementation strategy and marketing approach.

1.1 Program Description

The purpose of the In-home Energy Program is to provide energy efficiency information and easy-to-install measures to help customers reduce electric energy use. Energy efficiency products and information are provided to customers in four ways: 1) an *Online Energy Profile*, 2) an *In-home Energy Assessment,* 3) an *In-home Energy Audit,* and 4) a *Multi-Family Direct Install Service*. The program implementation contractor delivered program services on behalf of AEP Ohio and contracts with local installation contractors.

The **Online Energy Profile** is a free web tool that enables AEP Ohio customers to quickly and easily calculate home energy costs and identify opportunities for savings. EnergySavvy is the platform used for the online tool. The Profile includes a report with customized energy savings recommendations. Each customer can opt to receive a free energy efficiency kit. Kit contents are adjusted in accordance with the domestic hot water (DHW) fuel a customer lists during the Online Energy Profile process. If the water heating fuel is electricity, water savings measures, such as low-flow showerheads and faucet aerators, are included in the kit; otherwise, no water savings measures are included. After completing the online profile, participants are also eligible for rebates for completing retrofit measures. Customer information can be provided to a contractor if the customer indicates it wants to receive an assessment. If the participant resides in an all-electric home, the application will display a checkbox for the audit option.

The **In-home Energy Assessment** includes a visual inspection of the home and an interview with the homeowner about his or her lifestyle and energy use by a contractor. The assessor attempts to identify energy-saving opportunities (especially quick to install measures) available in the home and can recommend retrofit measures to reduce energy use. While in the home, the contractor may install CFLs, LED bulbs, an LED night light; and if electricity is used for water heating, low-flow showerheads, low-flow faucet aerators and smart strips. This mix of measures also now includes LED bulbs and a smart strip. There is a $25 fee for the one-hour In-home Energy Assessment, which the customer pays directly to the assessor. The program discontinued these assessments as of January 1, 2017.

The **In-home Energy Audit** is only available to all-electric customers and targets high electricity use customers. It is patterned after a Building Performance Institute (BPI) audit. The audit includes a thorough inspection of the home, an interview with the homeowner, and diagnostic testing for air leakage and combustion safety by a contractor. The auditor utilizes a computer software program to generate a prioritized list of energy-saving measures that includes the calculated energy savings, estimated installed costs, and simple payback for each measure. While in the home, the contractor installs CFLs or LEDs, an LED night light, smart strip; and, if electricity is used for water heating, low-flow showerheads and low-flow faucet aerators. This mix of measures was updated in 2016 to include LED bulbs and a smart strip. There is a $50 fee for an In-home Energy Audit. The program discontinued these audits as of January 1, 2017.

The **Multi-Family Direct Install** component achieves energy savings by installing energy efficiency measures in apartment units at no cost to the tenant or building owner. AEP Ohio's direct installation team conducts a walk-through energy assessment and direct installation of efficient equipment, including CFLs, showerheads, faucet aerators and LED nightlights. CFL specialty bulbs were added in 2016, and all CFL options were supplanted by LEDs in late 2016.A smart strip measure was also added to the measure mix in 2016. Multi-family units were not eligible for additional equipment rebates in 2016.

1.2 Implementation Strategy

1.2.1 Program Marketing Strategy

The program marketing strategy focuses on residential customers in single family housing and multi-family housing. To maximize savings impacts and the percentage of customers who implement improvements, the program targets promotion to customers with above average consumption.

1.2.2 Role of AEP Ohio Staff

The AEP Ohio staff member most involved in the administration of In-home Energy Program is the Consumer Programs Coordinator. The AEP Ohio Consumer Programs Coordinator is responsible for day-to-day program management responsibilities for the utility, including weekly communication with the program implementer, program tracking and reporting, and assisting with development of program marketing materials.

1.2.3 Roles of the Implementation Contractor

The program is delivered and managed primarily by the staff of an implementation contractor. The implementation contractor works on marketing jointly with AEP Ohio and is directly responsible for communicating with customers, scheduling appointments with participants, and coordinating auditors and contractors responsible for assessing participant homes, installing measures, and providing participants with energy surveys including recommendations for further energy saving actions. The implementation contractor also provides AEP Ohio with reporting, which includes progress toward goals, and participant and measure-level databases.

1.2.4 Measures and Incentives

The In-Home Energy program has two channels – the 1) online channel and 2) in-home channel.

Customers participating in the Online channel can request a kit with the following measures:

- three 13 Watt compact fluorescent lamps (CFLs)
- three 23 Watt compact fluorescent lamps (CFLs) or
- four 10 Watt LED bulbs (the lighting measures in the kit were changed from CFLs to LEDs completely in the last two months of 2016)
- one LED nightlight
- one low-flow showerhead, for homes with electric water heating

- two faucet aerators (kitchen and bathroom), for homes with electric water heating

The In-home Energy Program provides direct installation services for the following measures:

- Compact fluorescent lamps (CFLs) or LED bulb[3]
- Low-flow showerheads, for homes with electric water heating
- Faucet aerators (kitchen and bathrooms), for homes with electric water heating
- LED nightlight
- 7-plug smart strip[1]

In addition to the direct installation service, the program offers two levels of the in-home energy service: an "Assessment" and an "Audit." Both services provided single-family residents with recommendations for equipment upgrades eligible for rebates through AEP Ohio. The audits and assessments were discontinued in January 1, 2017. Table 1-1 shows the incentives offered through the In-home Energy Program in 2016.

Table 1-1. AEP Ohio In-home Energy Measures and Incentives

In-home Energy Program Measure Incentives	All Electric or Electric Heat Only	Central Air Conditioning with Natural Gas or Other Fuel
Air Sealing	$200	NA
Attic Insulation	$225	NA
Duct Sealing[4]	$50	$50
Duct Insulation[2]	$20	20
Heat Pump Programmable Thermostat	$50	25
Programmable Thermostat (non-line voltage) - 2016[2]	$70	$35
Smart Thermostats[5]	$100	$50
ENERGY STAR® Central Air Conditioning Replacement	$150	same
ENERGY STAR® Central Air Conditioning - Early Retirement	$275	same
ENERGY STAR® Air Source Heat Pump Replacement	$200	same
ENERGY STAR® Air Source Heat Pump - Early Retirement	$450	same
ENERGY STAR® Ground Source Heat Pump Replacement	$1200	Same
Ductless Heat Pump	$200	Same

[3] LED lamp and smart strip added in March 2016.

[4] Measures discontinued post June 2016.

[5] Smart Thermostat added in April 2016.

1.3 Program Theory

The program theory for the AEP Ohio In-home Energy Program is to produce long-term electric energy savings in the consumer sector by helping customers analyze their energy use, and to provide incentives for the installation of high-efficiency HVAC, lighting and shell measures. Since the program theory and logic have not changed since 2012, a new logic model was not created for 2016. Instead, the reader is referred to the 2012 evaluation report[6].

1.4 Evaluation Questions

Each of the following questions is addressed in the remainder of the evaluation report.

1.4.1 Impact Questions

1. What is the level of annual energy (kWh) and peak demand (kW) savings induced by the program?
2. What were the realization rates for each participation path and for the program overall? (Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings.)
3. What are the benefits and costs, and cost effectiveness of the program?

1.4.2 Process Questions

1.4.2.1 Program Characteristics and Barriers

1. Is the marketing effort sufficient to meet current and future program participation goals?
2. How do participating customers and contractors become aware of the program? What marketing strategies could be used to boost program awareness?
3. Is the program outreach to customers and contractors effective in increasing awareness of the program opportunities?

1.4.2.2 Marketing and Participation

1. How do participating customers and contractors perceive the incentives and costs related to the program?
    a. Are customers and contractors sufficiently satisfied with the program incentives to sustain participation goals?
    b. Are there particular program characteristics that could be changed to improve customer and/or contractor satisfaction while maintaining program effectiveness?
2. What are current and past audit-to-rebate conversion rates for the program?

[6] Appendix E Docket 13-1182 AEP Ohio Portfolio Status Report for 2012.

   a. Can we identify contractors with high/low conversion rates to determine why the rates were what they were?

3. What are key barriers to participation in the program for eligible customers and contractors who do not participate, and how can these be addressed by the program?
4. Are there significant numbers of retrofits occurring through program contractors that do not participate in the program?
   a. Are these because of program-induced barriers (such as paperwork)?
   b. Do customers complete the rebate form or does the contractor?
   c. Can we determine conversion rates with program tracking data?

1.4.2.3 Program Administration and Delivery

1. How has program administration and delivery changed over the course of 2016?
2. Is program administration being documented and program tracking being conducted in a way that makes the program evaluable?
3. Is the program efficient and well managed? How are problems resolved?
4. Have there been any changes to the verification procedures for the program in 2016?
5. What are the opportunities for program improvement?

2. EVALUATION METHODS

2.1 Overview of Approach

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

1. **Development of Evaluation Questions.** Key evaluation questions were established from the development of the 2016 Evaluation Plan with AEP Ohio staff and a review of the key outcomes of the 2015 Program Evaluation.
2. **Tracking Data Review.** The program tracking data collected by the implementation contractor were reviewed.
3. **New Program Documentation Review**. Reviewed any program documentation that differed from 2015 (e.g. new marketing materials).
4. **Primary Data Collection.** Four primary data collection efforts were conducted in support of this evaluation: 1) in-depth interviews with program staff, 2) a participant telephone survey, 3) on-site field verification surveys, and 4) installation contractor telephone surveys.
5. **Methods Used to Analyze Impact Data.** Reviewed algorithms and tracking system to verify measure eligibility and correct application of energy and demand savings. Calculated installation rates to measure savings achieved by program in alignment with program targets.
6. **Methods Used to Analyze Process Data.** Analyzed program tracking data, in-depth interview data, and participant survey data to assess the effectiveness of program process.

2.2 Impact Evaluation Sample

Primary data collection activities for the impact evaluation consisted of online surveys for online single family participants, telephone surveys for in-home single-family participants, and onsite surveys for the multi-family participants. The primary purpose of both surveys was to gather data to verify measure installation. Sufficient data was collected on single-family installation rates through telephone and online surveys. However, onsite surveys were conducted for multi-family units because participant data is not collected in the program tracking system to enable telephone verification.

To derive target sample sizes, the evaluation team first estimated the number of participants for the year, using a mid-year data extract provided by AEP Ohio. Based on this information, to attain +/- 10% precision at a 90% level of confidence at the program level for the impact sample, a minimum sample size of 50 completed online surveys, 50 completed telephone surveys, and 35 onsite surveys were determined to be appropriate.

Table 2-1 shows the actual population of participants in 2016, and the number of telephone and on-site surveys completed. Overall sampling efforts resulted in +/- 8.3% precision at a 90% level of confidence. Survey participants were drawn from a stratified random sample from the population of program participants in the 2016 tracking database at the site-level.

Table 2-1. 2016 Impact Evaluation and Population-Level Sample

Strata	Survey Method	2016 Strata Population Size (N)	Survey Target Completes	Survey Completes (n)
All In Home	Telephone	4,250	50	50
All Online	Telephone	3,010	50	50
Multi-Family Direct Install	On Site	7,016	35	39
Total		14,276	135	139

2.3 Tracking System Review

Navigant reviewed program data extracted from the AEP Ohio In-home Energy Audit tracking system to assess its accuracy and effectiveness for use in recording, tracking, and reporting the processes and impacts of the program. This data review included an assessment of the rebate processing timeframes, a review of the project data for outliers and missing information. However, the evaluator did not address whether the tracking system is adequate for regulatory prudency reviews or corporate requirements.

2.4 *Ex Post* Savings Evaluation

Navigant reviewed measure savings algorithms and the underlying assumptions for each measure compared to the Draft TRM algorithms. Navigant also recalculated energy and demand savings for each measure in the tracking database to ensure the algorithms were applied correctly.

2.5 Process Evaluation Sample

Primary data collection for the process evaluation focused primarily on a telephone survey of 71 in-home program participants and an online survey of 71 online program participants, which were conducted during February and March of 2017. A telephone survey was conducted with participants who received an energy audit/assessment and rebates for retrofit measures. An online survey was conducted with participants of the Online Energy Profile who received a free energy kit. The surveys served several purposes in both the impact and process evaluation:

- To verify and/or update the assumptions that feed into engineering algorithms of measure level savings.
- To determine participant satisfaction with the program design and implementation.
- To identify any steps in the participation process that customers found difficult or confusing.
- To gain insight into customer motivations and the effectiveness of existing and potential communication channels.
- To elicit customer suggestions on opportunities for program improvement.

To derive target sample sizes, the evaluation team first estimated the number of participants for the year using a mid-year data extract provided by AEP Ohio. Based on this information, to attain 90/10 statistical confidence and precision at the program level, a minimum sample size of 100 completed participant surveys (50 online and 50 telephone) was determined to be appropriate.

Table 2-2 shows the actual population of energy kit and retrofit rebate recipients in 2016, the number of participant surveyed. Overall, at the program level, sampling efforts resulted in +/- 5.2% precision at a 90% level of confidence.

Table 2-2. 2016 Surveys Completed and Population-Level Sample

Strata	2016 Strata Population Size (N)	Survey Target Completes	Survey Actual Completes (n)
Direct Install	2,998	33	33
Online Energy Kits	2,810	64	71
Retrofit	2,691	38	38
Total	8,499	135	142

2.6 Program Staff Interviews

To understand the structure of program administration and implementation, Navigant spoke with the following staff in November 2016.

- AEP Ohio In-Home Energy Program Coordinator
- Implementation contractor program director for Ohio service territories
- Implementation contractor program coordinator for AEP Ohio In-Home Energy Program

In-depth interviews were conducted by telephone in November 2016. Each interview lasted between one and two hours and covered program design and implementation, marketing and promotion, and perceived barriers to participation.

Interview guides were developed based on the research issues and metrics identified in the background review for the program. The purpose of the guides was to solicit the most important information from those who work closely with program. The questions in the guides were primarily focused on these broad topics:

- Program Manager Roles and Responsibilities
- Program Goals and Implementation
- Marketing and Outreach
- Program Tracking and Quality Assurance/Quality Control (QA/QC) Practices

Separate interviews were conducted with AEP Ohio staff and the implementation contractor to encourage candor and help identify any potential issues regarding the relationships between the two parties. Consistent with standard market research procedure, the confidentiality of each person interviewed was guaranteed, and comments are not attributed to any one individual; rather, the evaluation focuses on trends and issues that arose from each stakeholder's perspectives.

2.7 Installation Contractor Interviews

In-depth interviews were conducted with ten participating contractors to engage in conversation with those firms most involved with the delivery of the In-home Energy Program. The final list of interview candidates was developed based on a review of total savings tracked in the program database. Key objectives of the interview were to develop an understanding of contractor perspectives on the market in which the program operates and to gather feedback on the program structure and processes. Interviews were conducted via telephone surveys, with in-depth interview instruments guiding the discussions. Most questions were open-ended to allow a broad discussion, but some information was captured as discrete values to facilitate analysis and comparison.

2.8 Program Material Review

Navigant reviewed all program materials provided by AEP Ohio to date and conducted a review of best practices for implementing residential energy audit programs. A summary list of program materials reviewed to date for this report follows.

- Program tracking data
- Program impact algorithms and assumptions
- Program marketing materials/collateral

3. PROGRAM LEVEL RESULTS

This section details findings of the 2016 In-Home Energy Program evaluation.

3.1 Impact Evaluation Findings

3.1.1 Program Activity

Table 3-1 shows the number of audits, assessments and online audits conducted in 2016. Most single-family participants chose the Online Assessment as their channel of participation. Compared to 2016 participants, total audits and assessments almost decreased by half in 2016, which can be explained by the discontinuation of this channel from the program post May 2016.

Table 3-1. Number of Audits and Assessments

Single-Family Audit Type	2015 Number of SF Customers	2016 Number of SF Customers
SF In-home Audit	1,311	743
SF In-home Assessment	4,525	2,793
SF Online Energy Assessment	2,851	3,062
Total	8,687	6,598

Table 3-2 summarizes *ex ante* program activity tracked across three measure types: direct install, online energy kit, and retrofit. Single-family and multi-family direct install measures provided the majority of installations and savings.

Table 3-2. *Ex Ante* Measure Activity Summary

Measure	Number of Units	Energy Savings (MWh)	Demand Savings (MW)
SF and MF Direct Install Measures	109,952	4,029	0.41
Online Energy Kit Measures	21,751	865	0.05
Retrofit Measures	3,967	1,901	0.12
Total	135,670	6,796	0.58

Note: Totals may not sum due to rounding.

Table 3-3 shows the distribution of single-family and multi-family direct install measures installed in 2016. Direct install measures accounted for 59 percent of the total *ex ante* program energy savings.

Table 3-3. *Ex Ante* Direct Install (DI) Measure Activity

Measure	Number of Units	Energy Savings (MWh)	Demand Savings (MW)
Single-Family (SF)			
SF DI CFL	16,636	504	0.030
SF DI LED Night Light	2,253	46	0.003
SF DI Faucet Aerator	493	15	0.001
SF DI Shower Heads	640	146	0.010
SF DI LEDs	4,449	158	0.010
SF DI Smart Strips	1,904	192	0.010
Multi-Family (MF)			
MF DI CFL	58,655	1,427	0.170
MF DI LED Night Light	6,905	145	0.020
MF DI Shower Heads	2,460	582	0.070
MF DI Faucet Aerator	3,093	95	0.010
MF DI LEDs	8,450	309	0.040
MF DI Smart Strips	4,014	408	0.040
Direct Install Total	109,952	4,029	0.414

Note: Totals may not sum due to rounding.

Table 3-4 shows the distribution of online energy kit measures sent to customers in 2016. Energy Kit measure savings accounted for approximately 13 percent of total *ex ante* program energy savings in 2016.

Table 3-4. *Ex Ante* Energy Kit Measure Activity

Measure	Number of Units	Energy Savings (MWh)	Demand Savings (MW)
Energy Kit CFLs	11,100	387	0.02
Energy Kit LED Night Light	2,856	59	0.00
Energy Kit LED bulbs	4,024	146	0.01
Energy Kit Low Flow fixtures	3,771	273	0.02
Energy Kit Total	21,751	865	0.05

Note: Totals may not sum due to rounding.

Table 3-5 shows the distribution of retrofit measures installed in 2016. Retrofit measures accounted for 28 percent of the total *ex ante* program MWh savings, with the majority of energy savings from HVAC measures.

Table 3-5. *Ex Ante* Retrofit Measure Activity

Measure	Number of Units	Energy Savings (MWh)	Demand Savings (MW)
Air Conditioner	2,095	988	0.060
Air Sealing	102	56	0.000
Air source Heat Pumps	371	474	0.030
Insulation	130	68	0.004
Ground Source/ Ductless Mini Split Heat Pumps	96	190	0.030
Thermostat	1,173	125	0.010
Retrofit Measure Total	3,967	1,901	0.120

Note: Totals may not sum due to rounding.

3.1.2 Measure Installation Rates

The installation rate for each measure installed through the program was determined through both on-site audits, as well as participant telephone and on-line surveys. During the on-site audits (multi-family participants only), Navigant verified the number of measures installed in the home matched the number listed in the program database. Individuals who were surveyed by telephone and online (single-family participants only) responded to several questions about the number and types of measures installed through the program. The on-site audits and telephone surveys revealed discrepancies between the number of measures reported in the database and the observed number of measures installed. The ratio of the number of measures still installed (as reported or verified) was compared to the number of measures in the program database to determine installation rates.

Table 3-6 shows installation rates for direct install measures ranged from 19 percent (multi-family smart strips) to 100 percent (multi-family showerheads).

Table 3-6. In-home Energy Program Direct Install Measure In-Service Rates

Direct Install Measures	Single-Family		Multi-Family	
	Percent Installed	Number of Telephone Survey Respondents	Percent Installed	Number of On-site Participants
Aerator	88%	16	91%	6
CFL	90%	51	87%	65
LED	96%	25	91%	35
LED nightlight	83%	23	28%	36
Showerhead	76%	16	100%	7
Smart Strips	83%	23	19%	27

Overall, the direct install installation rate improved significantly compared to last year. The installation rate (19%) calculated for multi-family smart strips was much lower than for other measures, especially considering high realization rates found for single-family nightlights (83%). The installation rate for multi-family nightlights is also low at 28 percent. This result may be due to some tenants taking the smart strips and LED nightlights with them when they move out of the apartment. The installation rates for the Single-Family Direct Install measures increased as compared to last year's results. This shows that the direct install component of the program has been performing well. The most common reason for these direct install measures having low installation rates as recorded from participants' responses was the auditor left these behind without installing these, followed by participants removing the measures because they did not like the measure. For the Multi-family LED Direct Install measure, the installation rate is 96 percent, more than double the 40 percent 2015 installation rate. Navigant's online survey of Online Energy Profile participants collected data on installation rates for energy kit measures mailed to participants, as shown in Table 3-7.

Table 3-7. Online Energy Kit Installation

Energy Kit Measures		
	2016 Percent Installed	2016 Number of Online Survey Responses
CFL	55%	55
LED Nightlight	48%	56
Showerhead	69%	22
Aerator	69%	45

The survey participants for the online survey were from the first half of the year. LED bulbs were introduced in the last two months of the year; hence, no data was collected for LED bulbs through the surveys due to the late introduction and limited sample.

The installation rate of CFLs decreased in 2016 as compared to the 2015 value. Participants were asked the reason for not installing or removing an energy kit measure. Their answers varied depending on the measure, as shown in Figure 3-1. For showerheads, CFLs and faucet aerators, the most common reason for not installing a measure was already having that measure, or just have not gotten around to installing it yet. The reasons for not installing between 2015 and 2016 mostly stayed the same.

Figure 3-1. Participant Reasons for Not Installing Energy Kit Measures

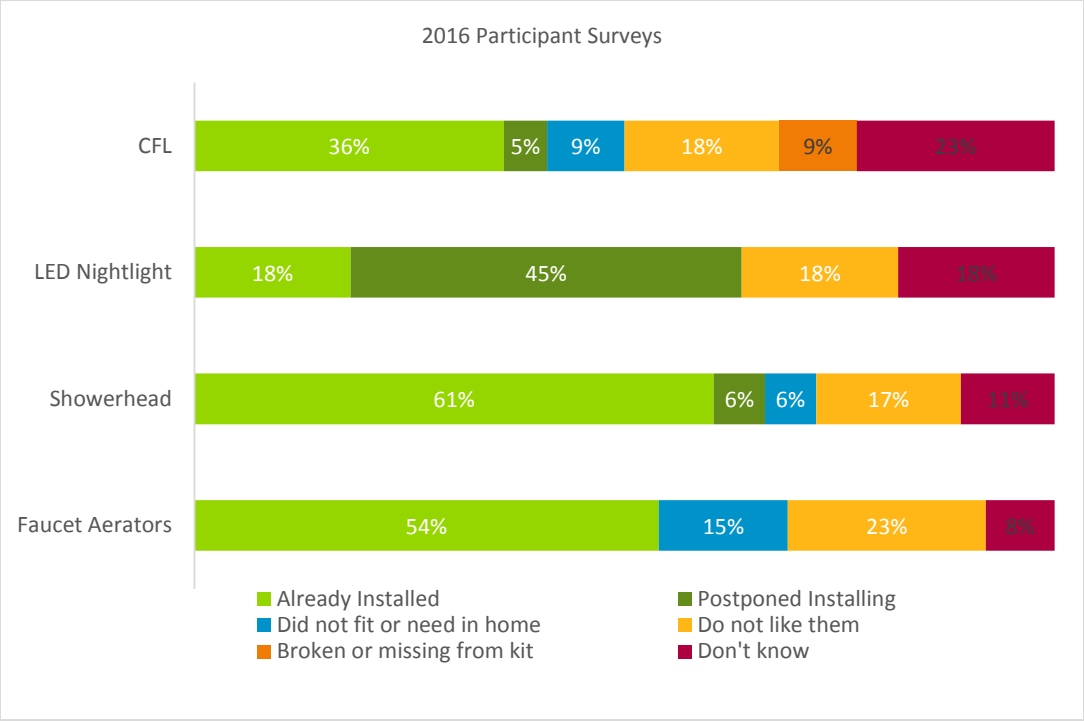


Table 3-8 shows installation rates for retrofit measures from telephone survey. All retrofit measures were found to have an installation rate of 100 percent.

Table 3-8. In-home Energy Program Retrofit Measure In-Service Rates

Retrofit Measures	Telephone Survey	
	2016 Percent Installed	2016 Number of Respondents
Air Conditioner	100%	23
Air Sealing	100%	3
Air Source Heat Pump	100%	5
Insulation	100%	3
Ground Source / Ductless Mini Split Heat Pump	100%	6
Thermostat	100%	19

3.1.3 Tracking System Review

Navigant reviewed program data in the AEP Ohio In-home Energy Program tracking system to verity its accuracy and effectiveness for use in recording, tracking, and reporting the processes and impacts of the program. This review included an assessment of the rebate processing timeframes and a review of the project data for outliers and missing information. However, the evaluator did not address whether the tracking system is adequate for regulatory prudency reviews or corporate requirements.

A final program tracking database was provided in support of this evaluation by AEP Ohio on February, 2017. A final summary database prepared by AEP Ohio compiled data extracts provided by the implementation contractor. The tracking data extract contained separate databases for single-family and multi-family measures. The single-family dataset contained 142 data fields and more than 25,000 records. The multi-family dataset contained 131 data fields and more than 33,640 records. The tracking data had significant improvements over 2015. Navigant accessed all the data associated with the audit type as well as the measure type from the database. There were some minor issues identified with the database which were corrected by AEP Ohio once the final database was received.

3.1.4 Ex Ante and Ex Post Savings Evaluation

Navigant reviewed the measure savings recorded in the tracking system to verify the energy savings algorithms matched those in the Draft Ohio 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. Navigant's algorithm review determined the energy and demand savings algorithms were properly constructed and applied.

Codes and Standards: Heat Pump Measure

Navigant reviewed the in-situ baselines of the measures in consideration of applicable federal standards. Per the Federal Regional Standards for cooling equipment[7] that went it to effect on Jan 1, 2015, the baseline efficiencies for heat pumps were increased. According to this standard, the allowable baseline values for a heat pump measure were a SEER value of 14 and HSPF value of 8.2. AEP Ohio gave contractors a grace period of 12 months to exhaust their existing inventory and implemented the new baselines in 2016. Navigant determined AEP Ohio had updated the savings algorithm for this measure to be compliant with the standard.

Interactive Effects: LED Measure

While calculating the *ex pos*t savings, Navigant updated the interactive effects for LED bulbs. The Ohio TRM currently has a waste heat factor for energy of 1.07, and a waste heat factor for demand of 1.21. These values were replaced with interactive factors (IF) for LEDs of 0.93 for energy and 1.34 for demand, based on the AEP Ohio Residential Lighting Interactive Effects Modeling Results memo. The implementation of this change led to a slight decrease in the energy *ex post* savings and a slight increase in the demand *ex post* savings.

Table 3-9 presents *ex ante* program savings along with Navigant's *ex post* estimates, which include verified measure installation rates. Measure installation rates of less than 100 percent were primarily responsible for the differences between *ex ante* and *ex post* savings estimates. The realization rate of each stratum (in this case, delivery channel) is calculated by aggregating the realization rates of each measure in the stratum and then weighted by their contribution to total savings in the stratum. The energy savings realization rate is therefore weighted by kWh savings, while the kW realization rate is weighted by kW contributions of the measure in a stratum.

Table 3-9. Tracking System (*Ex Ante*) and Verified (*Ex Post*) Savings Estimates

Stratum (Delivery channel)	*Ex Ante* Savings (MWh) (a)	*Ex Ante* Savings (MW) (b)	*Ex Post* Savings (MWh) (c)	*Ex Post* Savings (MW) (d)	Energy Savings Realization Rate RR = (c) / (a)	Demand Savings Realization Rate RR = (d) / (b)
SF Direct Install	1,062	0.06	933	0.05	0.88	0.89
MF Direct Install	2,967	0.35	2,298	0.29	0.77	0.82
Retrofit Measures	1,901	0.12	1,901	0.12	1.00	1.00
Online Energy Kit	865	0.05	576	0.03	0.67	0.68
Program	6,796	0.58	5,708	0.50	0.85	0.86

Note: Totals may not sum due to rounding. The overall realization rate is weighted by the ex post savings contributions.

[7] http://www.sgtorrice.com/files/Pages/News/2015-Regional-Standards-Cooling-Heating%20Products-rev1.pdf

Table 3-10 lists the *ex ante* and *ex post* savings for all the measures in the program.

Table 3-10. In-home Energy Program Retrofit Measure Ex Ante and Ex Post Verified Savings

Measure Description	*Ex Ante*			*Ex Post* Verified	
	Quantity	Energy Savings (MWh)	Demand Savings (MW)	Verified Energy Savings (MWh)	Verified Energy Savings (MWh)
MF CFL	58,655	1,427	0.17	1,241	0.15
MF LED night light	6,905	145	0.02	41	0.00
MF Showerhead	2,460	582	0.07	582	0.07
MF Faucet Aerator	3,093	95	0.01	87	0.01
MF LED bulb	8,450	309	0.04	269	0.04
MF Power Strip	4,014	408	0.04	78	0.01
Air Conditioner	2,095	988	0.06	988	0.06
Air Sealing	102	56	0.003	56	0.003
Air source Heat Pumps	371	474	0.03	474	0.03
Insulation	130	68	0.00	68	0.00
Ground Source/ Ductless Mini Split Heat Pumps	96	190	0.03	190	0.03
Thermostat	1,173	125	0.01	125	0.01
SF DI CFL	16,636	504	0.03	454	0.03
SF DI LED	4,449	158	0.01	138	0.01
SF DI LED nightlight	2,253	46	0.003	39	0.002
SF DI Low Flow Fixtures	1,133	161	0.01	142	0.01
SF DI Smart Strip	1,904	192	0.01	160	0.01
Energy Kit CFL	11,100	386	0.02	213	0.01
Energy Kit LED	4,024	146	0.01	146	0.01
Energy Kit LED nightlight	2,856	59	0.003	28	0.002
Energy Kit Low Flow Fixtures	3,771	273	0.02	189	0.01
Total	135,670	6,796	0.58	5,708	0.50

3.2 Process Evaluation Findings

The evaluation team deployed one telephone survey and one online survey to explore customer satisfaction with the In-Home Energy program, barriers to participation, effectiveness and customer impressions of program marketing materials, and trade ally participation and satisfaction. The following process evaluation findings are divided into three sections:

1. In-Home Energy Audit and Assessment customer survey findings

2. Online Energy Profile customer survey findings
3. Program Staff and Installation Contractor interview findings

3.2.1 In-Home Energy Audit and Assessment

The following section discusses the customer survey findings regarding energy audits and assessments. The survey was designed to examine the participant satisfaction with the In-Home Energy Audit and Assessment program, program effectiveness in behavior change, customer engagement with energy efficiency and usage, effectiveness of marketing and outreach, and barriers to participation.

3.2.1.1 Program Participant Satisfaction

The evaluation team asked all survey respondents a series of questions designed to assess customer satisfaction relating to several different aspects of the program. In 2016, satisfaction with various program elements was high including two categories which increased over the previous year, the overall satisfaction with 1) AEP Ohio and 2) the In-Home Energy Program. Respondents also ranked seven of the eight categories with satisfaction ratings of 7.4 or higher. Two categories that were lower compared to last year were satisfaction with electric savings and with the audit/assessment report.

Table 3-11 shows the mean satisfaction rating for the different metrics explored through the survey. Participants were asked to rate their satisfaction with each element on a scale from one (not at all satisfied) to ten (highly satisfied); for the purposes of this evaluation, the research team considers a rating of seven or above to be satisfied.

While participants gave satisfied ratings to every program element, the satisfaction for the electric savings was the lowest mean rating (6.9), a percentage point drop over last year. In addition, the auditor and the time needed to complete the audit both received high satisfaction rankings of 9.4. When comparing all metrics from 2016 to 2015, satisfaction increased for five of the program elements, one stayed neutral and two were lower.

Table 3-11. Program Satisfaction Ratings

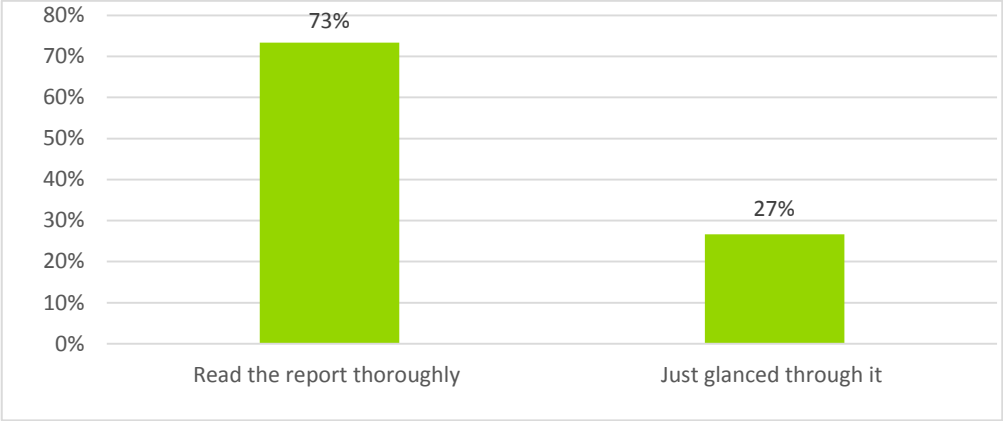
Program Element	2016 Mean Satisfaction	2015 Mean Satisfaction
Satisfaction with electric savings*	6.9	7.9
Energy audit/assessment report	7.4	7.7
Time taken to schedule the energy audit	9.1	8.6
Time taken to complete the audit/assessment in your home	9.4	8.7
Energy auditor that assessed your home's energy performance	9.4	8.9
Cost of the energy audit/assessment	8.3	8.3
In-home Energy program overall†	8.3	8.1
AEP Ohio overall	8.0	7.6

**Only asked of respondents who noticed savings on their electric bill; n=9.*
†In-home Energy and AEP overall satisfaction n=50.
n=19 for all program elements except for satisfaction.
Source: Navigant analysis of customer survey; P9, P10A-G, P11 and P11B.

3.2.1.2 Program Effectiveness and Report Engagement

The evaluation team asked customers a series of questions designed to determine their engagement with the audit report, as well as their motivations for making energy efficiency improvements to their homes. As mentioned earlier, the satisfaction for the energy audit/assessment report dropped for the second year. This finding is supported by 73 percent of respondents saying they read the report, but only 13 percent felt it was very useful (a ranking of nine or ten). Navigant believes this lower ranking is isolated to the report only, as 79 percent of the respondents also said they received enough information to make energy efficiency improvements to their home, while satisfaction with the energy auditor received the highest satisfaction ranking of 9.4. Figure 3-2 shows the amount of time participants spent reading the audit report.

Figure 3-2. Audit Report Engagement

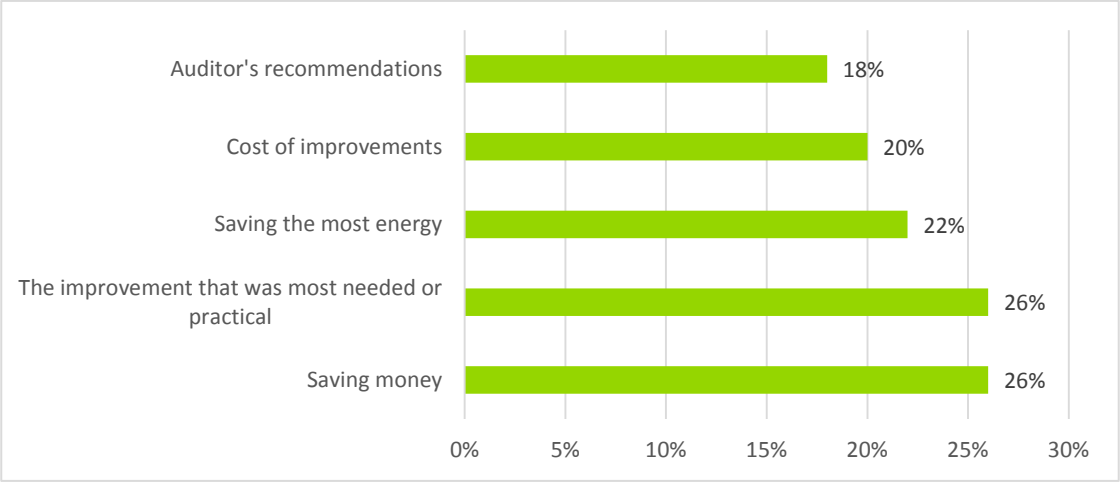


Participants=15 Source: Navigant analysis of customer survey; AR1a.

When respondents who provided, lower ratings were asked what could have been done to make the report more useful, responses focused on AEP Ohio being more knowledgeable about customers. Because the auditor could not identify additional ways for one customer to save energy, they suggested a questionnaire be given to the customer prior to the audit to determine if an audit could provide recommendations that were not already installed in the home. Another customer was frustrated due to letters they had received saying their consumption was 200 percent higher than their neighbors (presumably through a report provided through AEP Ohio's Home Energy Report Program), yet the auditor could not identify ways to save more energy.

The main drivers to the participant's decision to implement energy improvements were to save money and make improvements that were most needed; both elements received a ranking of 26 percent. In 2016, the importance of the auditor's recommendations in the report in regards to the participant's decision making when compared to 2015 dropped to 18 percent. Figure 3-3 provides the most important factors in decision making for the participant (multiple responses allowed).

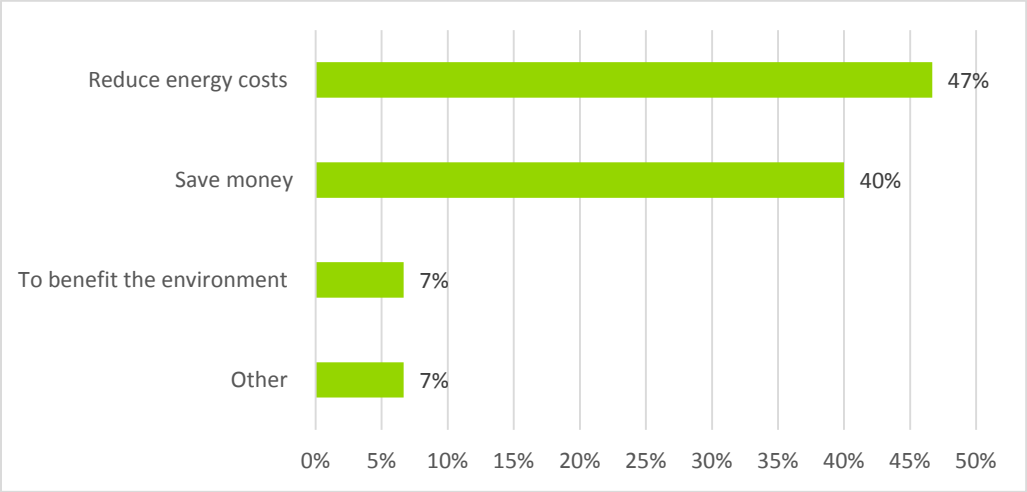
Figure 3-3. Most Important Factor in Decision to Make Improvements



Multiple responses accepted; Participants n=50, Source: Navigant analysis of customer survey; AR8A-E.

Survey respondents' attitude toward the recommendations in the report is further illustrated in Figure 3-4, where the evaluation team asked respondents to rank the following factors in their decision to make improvements in terms of importance: reducing energy costs, saving money, making their home more comfortable, improving the market value of their home, making general improvements to their home, and benefitting the environment. Eight-seven percent ranked reducing energy costs and saving money as their primary goal.

Figure 3-4. Primary Goal for Improvements*



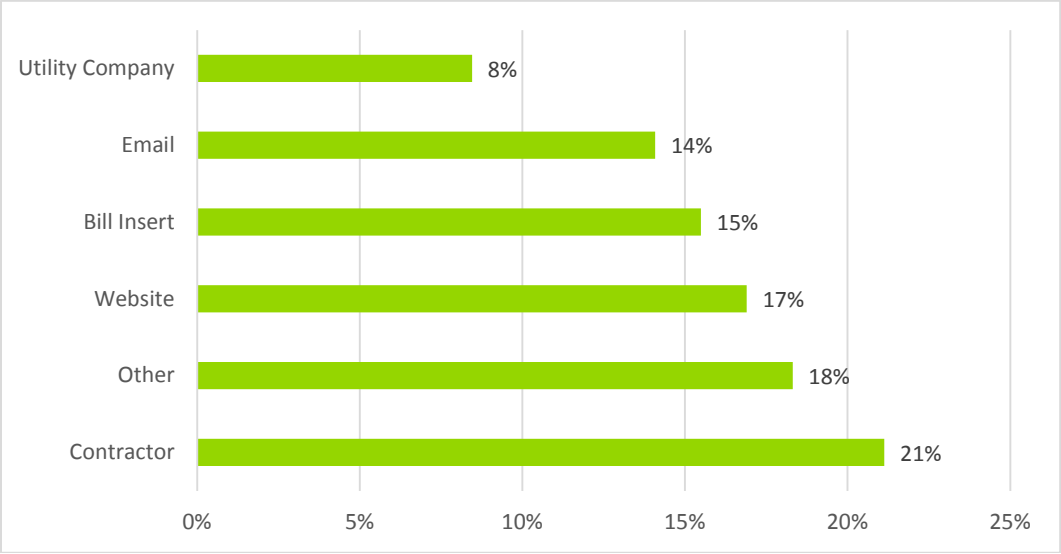
Participants n=15; Source: Navigant analysis of customer survey; AR7.
**Totals may not sum due to rounding.*

3.2.1.3 Marketing and Communications

Navigant asked In-Home Energy survey respondents about program marketing channels and their experience with communications regarding the program. These findings will help the evaluation team explore potential opportunities for improved program outreach and communications.

Program participants most frequently heard of the program through a contractor, often the person or company hired to install new equipment in their home, approximately 20 percent of respondents found out about the program through this channel. Figure 3-5 shows which sources of information were most successful at reaching customers. Direct outreach from AEP Ohio was the next most common source of information, with 15 percent of respondents hearing about the program through a bill insert and 14 percent from email. Indirect outreach from AEP Ohio also played a significant role with 17 percent of respondents finding information on AEP Ohio's website. The Other category grew significantly this year with respondents learning about the program through newspapers and Facebook.

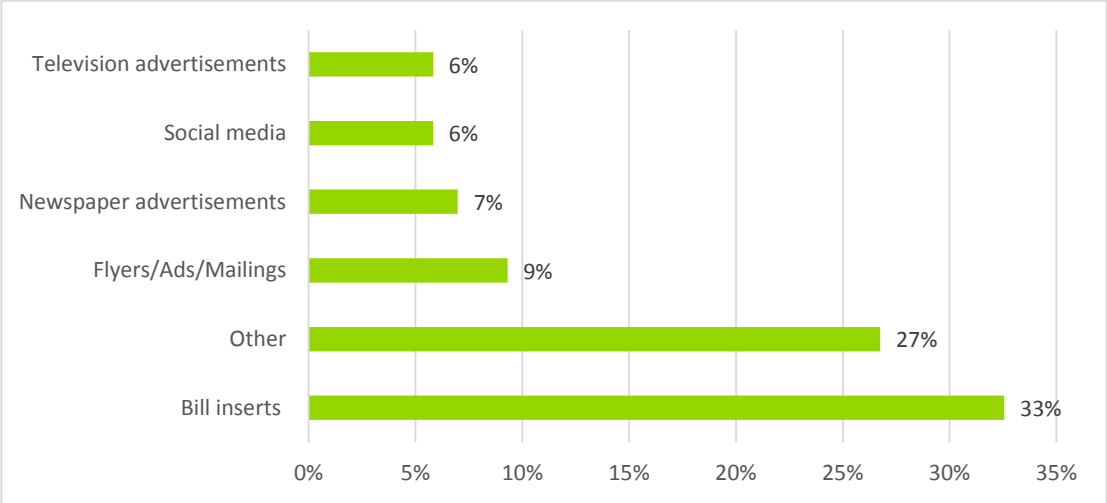
Figure 3-5. Source of Program Information



Multiple responses accepted; figure includes responses mentioned by at least 5% of respondents n=71, Source: Navigant analysis of customer survey; P1.

When asked to offer open-ended suggestions for additional outreach to get customers to participate in the program, 33 percent of all respondents mentioned bill inserts. Twenty-seven percent participants responded with "Other" suggestion with 68 percent of those suggesting email as the channel to use. Figure 3-6 lists participants' top suggestions for future marketing.

Figure 3-6. Suggestions for Future Outreach

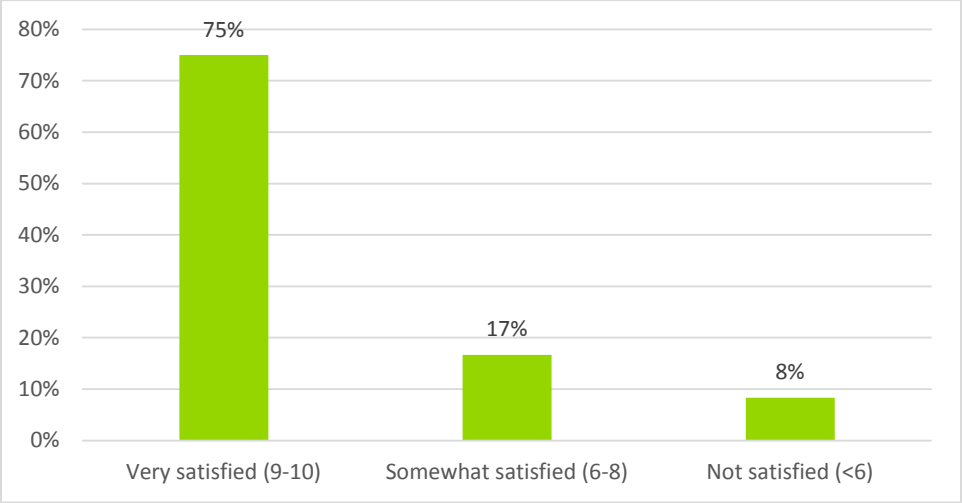


Multiple responses accepted; figure includes responses mentioned by at least 5% of respondents n=86, Source: Navigant analysis of customer survey; P3.

Most In-Home Energy Program customers have never contacted AEP Ohio staff with questions about the program. Of the customers who did reach out to AEP Ohio, a significant majority (81%) said they contacted AEP Ohio by telephone, with the remaining 15 percent contacting AEP Ohio via email or fax.

Of the 50 percent of customers who contacted AEP Ohio with questions, the majority (92%) were satisfied with their communications, with 75 percent falling into the highest (9-10) satisfaction range, with a mean of 9.0. The question associated with Figure 3-7 asked participants to rate their satisfaction on a scale from zero to ten; the evaluation team considers a response of seven or above to be satisfied.

Figure 3-7. Satisfaction with Communication with AEP Staff



n=24, Source: Navigant analysis of customer survey; P6.

3.2.1.4 Other AEP Ohio Programs

Participants were further asked about their involvement in other AEP Ohio programs. About 88 percent of the participants (n=44) have not participated in any other AEP Ohio program; six people, or 12 percent of respondents, mentioned that they had participated in any other offerings from AEP Ohio. Of the six participants, Appliance Rebates was the most popular, with three people. Table 3-12 shows additional programs that In-Home Energy Program customers have participated in.

Table 3-12. Participation in Other AEP Ohio Programs

AEP Ohio Program	Number of Participants
Efficient Lighting Discounts	1
Appliance Rebates	3
Appliance Recycling	1
Other	1

n=6, Source: Navigant analysis of customer survey; P14.

3.2.2 Online Energy Profile

The following section explores customer survey findings regarding the Online Energy Profile, also known as Online Energy Checkup or Online Energy Assessment. The evaluation team deployed an online survey instrument designed to explore participant satisfaction with the Online Energy Profile, program

effectiveness in behavior change, customer engagement with energy efficiency and usage, effectiveness of marketing and outreach, and barriers to participation.

3.2.2.1 Program Participant Satisfaction

Across all program elements, satisfaction ratings for the Online Energy Profile are high (ranging between 7.8 and 8.9), and except for satisfaction with energy savings, did not change significantly from 2015 to 2016. Table 3-13 lists the mean satisfaction ratings for several program elements, on a scale from one ("not at all satisfied") to ten ("very satisfied"). Most program element ratings decreased slightly by up to 0.3 points from 2015 to 2016, except for learning about other sources of energy efficiency information, and learned something new from the Online Profile. These two program elements increased by 0.3 and 0.02 points, respectively. There were very few respondents who installed retrofits through the Online Energy Profile channel and noticed savings of their energy bill. The sample size is small for this aspect of the survey, therefore, the 2016 results for this aspect are not statistically significant.

Table 3-13. Program Satisfaction Ratings

Program Element	2016 Mean Rating	n	2015 Mean Rating	n
Information was easy to understand	8.8	52	9.0	107
Learned about other sources of energy efficiency information and AEP Ohio programs	8.0	52	7.7	107
Learned something new from the Online Energy Profile	7.8	52	7.6	107
Online Energy Profile provided information needed to take energy and money-saving action	7.8	51	7.9	107
Online Energy Profile gave better understanding of where to save energy and money	7.8	50	8.0	107
Time needed to complete the Online Energy Profile	8.6	51	8.9	107
Ease of completing Online Energy Profile	8.9	50	9.2	107
Online Energy Profile overall	8.3	65	8.6	145
Savings on electric bill*	6.0	4	8.5	60

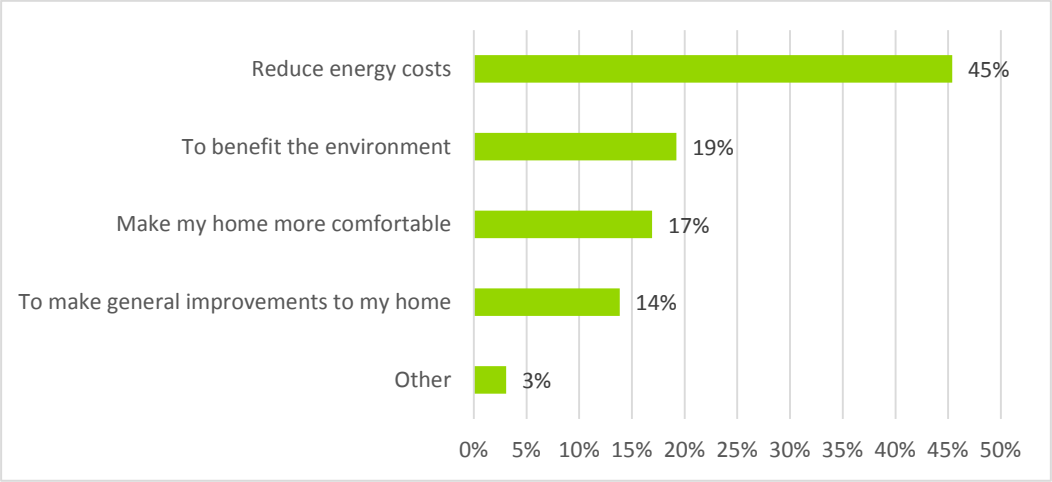
Source: Navigant, Online Energy Profile survey questions OS4, OS7A-G, P12.
**Only asked of respondents who installed retrofits (n=6) and noticed savings on their electric bill (n=4).*

Program Effectiveness and Customer Engagement

The research team asked a series of questions designed to assess the program's effectiveness. The following section explores the program's effectiveness in engaging customers in thinking about their energy usage, increasing awareness of energy-efficient options, and the influence of the program in compelling participants to take energy-saving actions.

When asked whether they recalled completing the Online Energy Profile interactive tool on the AEP Ohio website, three-quarters of respondents (n=54) stated they remembered using the tool. As shown in Figure 3-8, most customers signed up for the program primarily to reduce their energy costs, along with improving the comfort of their home. As with other AEP programs, the importance of protecting the environment is increasing as a motivator for customers. The program should consider promoting these three features in its marketing materials.

Figure 3-8. Primary Goal for Improvements



n=130 multiple, Source: Navigant analysis of customer survey; P15.

Customers who signed up for the Online Energy Profile ranked themselves somewhat knowledgeable (66%) to very knowledgeable (9%) regarding energy efficiency before participating in the program. Despite this high (75%) knowledge of energy efficiency, these customers were still willing to participate in the Online Energy Profile. Given this self-reported ranking, it appears the Online Energy Profile program appeals to people who are interested in staying current about energy efficiency and its implementation. These participants should be considered the customer base for any AEP Ohio residential pilot programs as their interest is high.

The Online Energy Profile succeeded at teaching customers about energy efficiency; every customer who recalled receiving the report said they learned about energy efficiency from the Online Energy Profile. Eight percent of respondents (n=53) answered they learned nothing, while a large majority (92%) said they learned some or a lot about energy efficiency. These findings, along with the previous figure, indicate the Online Energy Profile program provides additional information to a large group of customers.

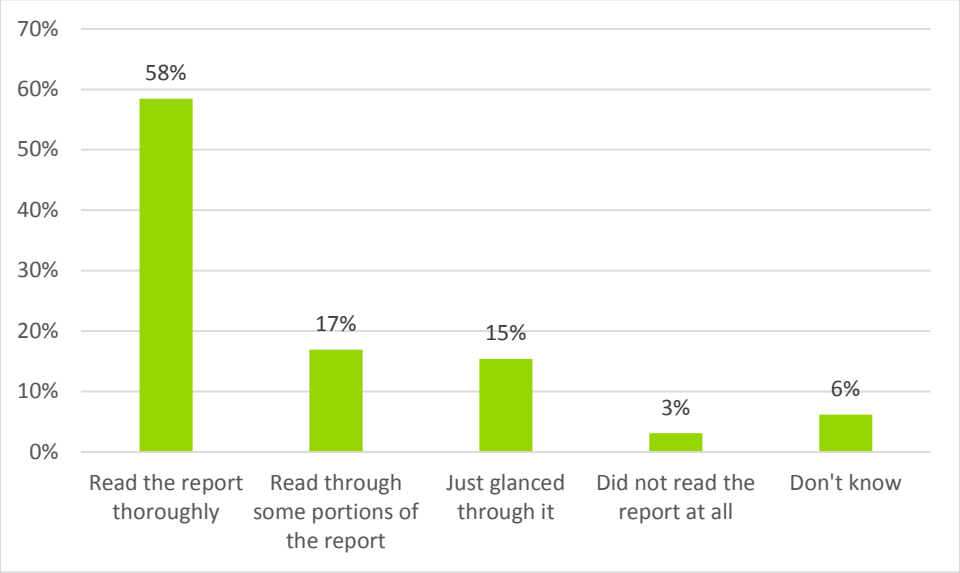
While the Online Energy Profile succeeded in teaching participants about energy efficiency, it was less effective in motivating participants to act by purchasing new products for their home. Of the 53 respondents, 45 percent purchased additional products for their home, an increase over 2015. It is unclear why the other 47 percent of respondents chose not to purchase additional products. Given their knowledge base and interest, it is a possibility their homes may be limited as to the additional improvements that could be made.

Survey respondents had extremely high satisfaction with the new energy efficiency upgrades they received in the energy savings kit. Almost all (85%) rated their satisfaction at a seven or higher on scale from one to ten, which the evaluation team considers to be a satisfied response, and 77 percent rated their satisfaction with the upgrades as a nine or ten (a 14 percent increase over 2016). The mean customer rating was 8.8. Customers who rated their satisfaction as a ten were the largest group, with 60 percent of respondents giving this response (a 17 percent increase over 2015).

The following findings relate to a set of questions designed to assess the effectiveness of the post-audit report, as well as the extent to which customers engaged with its recommendations. Overall, customers find the audit report useful and are willing to read it for recommendations. Figure 3-9 classifies participants' engagement with the report. The overall level of engagement is high: when asked how much time they spent reading the report, 90 percent of customers had at least glanced through the report,

indicating Online Energy Profile participants are interested in learning more about their own energy efficiency performance.

Figure 3-9. Engagement with Report



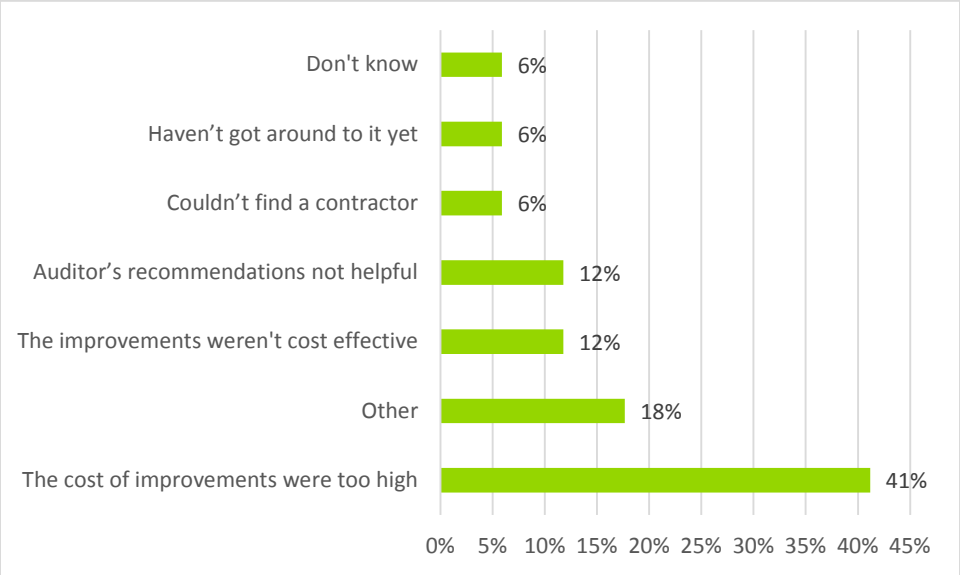
n=65, multiple. Source: Navigant analysis of customer survey; P16.

Customers who read the report found the recommendations valuable overall; 38 percent of respondents (n=65) rated the usefulness of the report's recommendations in the satisfied range, and another 43 percent rated it in the very satisfied range (an increase of 6% over 2016). The question associated with this figure asked participants to rate their satisfaction on a scale from one to ten; the evaluation team considers a response of seven or above to be satisfied.

The evaluation team asked respondents who completed the Online Energy Profile but did not apply for any AEP Ohio rebates a series of questions designed to identify barriers to full program participation, as shown in Figure 3-10. This report refers to these customers as "Profile-only" or "partial" participants. The majority (54 percent of Profile-only participants (n=50) claimed to have received enough information through the Online Energy Profile interactive tool to make energy efficiency upgrades on their own.

When the 17 partial participants were asked to elaborate on their reasons for not installing the report's recommendations, the overwhelming response was the cost of improvements were too high, or the cost of the improvements exceed the energy savings.

Figure 3-10. Reasons for Not Installing Recommendations*



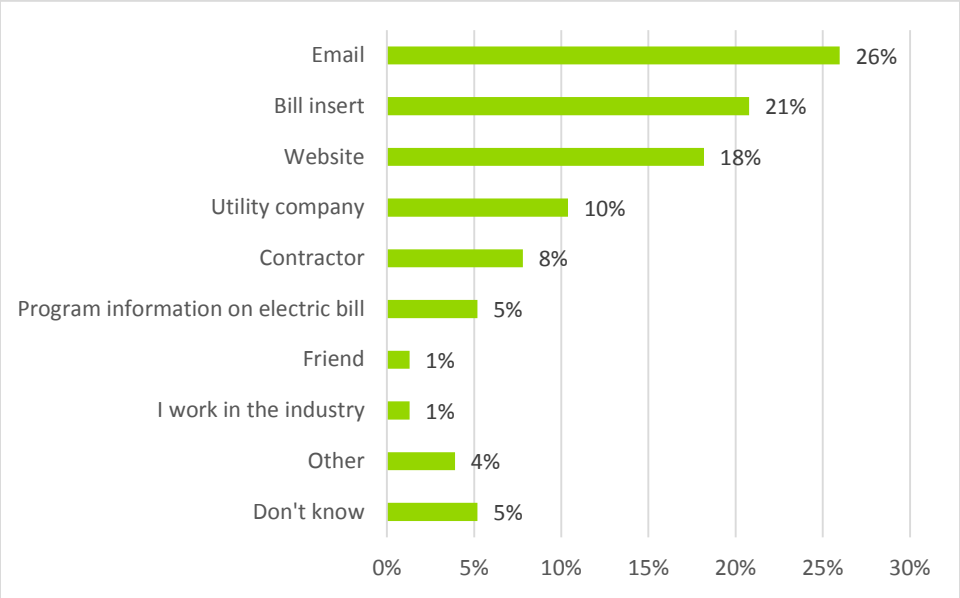
n=17, Source: Navigant analysis of customer survey; PP5.
Totals may not sum due to rounding.

3.2.2.2 Marketing and Communications

Navigant asked Online Energy Profile customers about program marketing channels and their experience with communications regarding the program. These findings will help the evaluation team explore potential opportunities for improved program outreach and communications.

Program participants most frequently heard of the program through AEP Ohio's website or a contractor; approximately one-quarter of respondents found out about the program through these channels. Bill inserts and email outreach from AEP Ohio were the next most common sources of information, with 14 percent of respondents hearing about the program these channels. Figure 3-11 shows which sources of information were most successful at reaching customers.

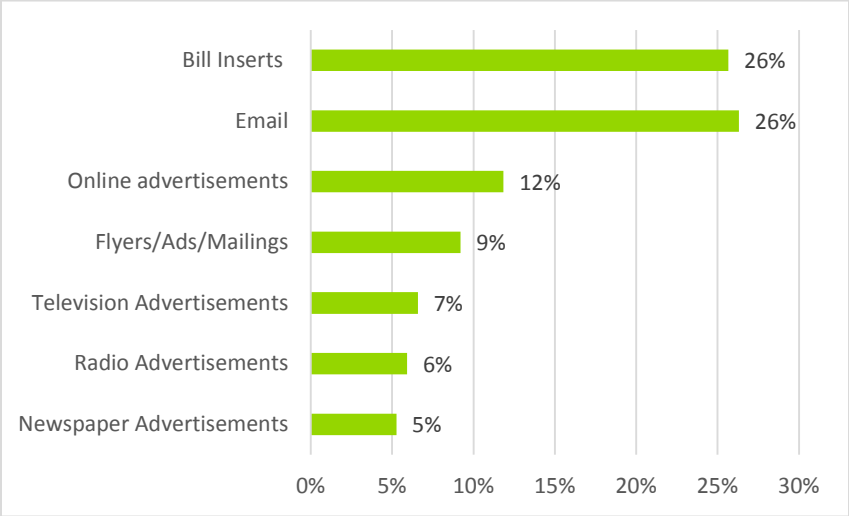
Figure 3-11. Source of Program Information*



n=77, Source: Navigant analysis of customer survey; P1.
**Totals may not sum due to rounding.*

When asked to offer open-ended suggestions for additional outreach to get customers to participate in the program, 39 percent of respondents mentioned bill inserts, and one-quarter mentioned using email or direct mailings. Figure 3-12 lists suggestions for future marketing mentioned by at least five percent of respondents. Other suggestions not included in the figure below include text messages, outreach through contractors, and events at retail stores.

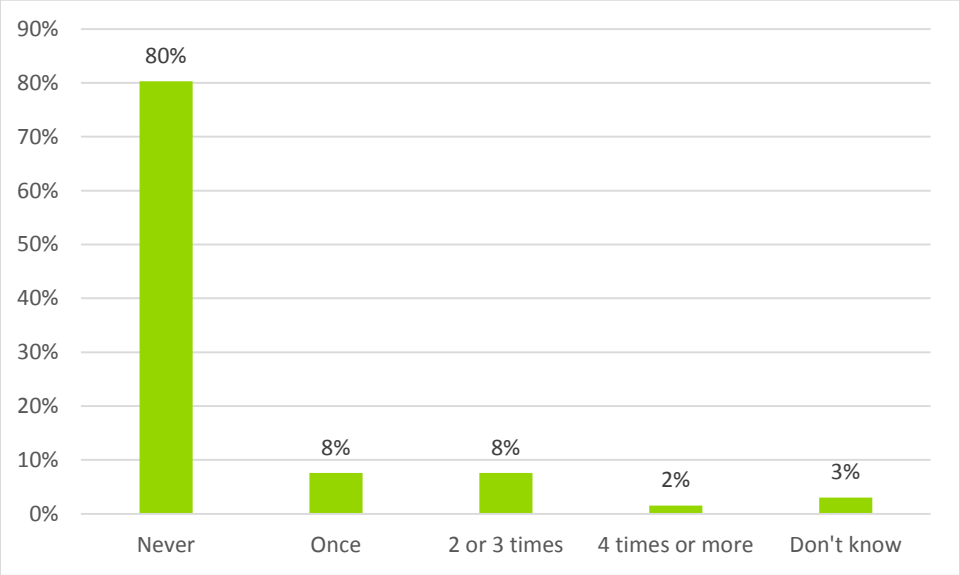
Figure 3-12. Suggestions for Future Outreach



Multiple responses accepted; figure includes responses mentioned by at least 5% of respondents.
n=152, Source: Navigant analysis of customer survey; P3.

Most Online Energy Profile customers have never contacted AEP Ohio staff with questions about the program. Of the customers who did reach out to AEP Ohio, a large majority (76%) said they contacted AEP Ohio by telephone, with an additional 17 percent contacting AEP Ohio via email or fax. Figure 3-13 shows the frequency with which participants contacted program staff with questions.

Figure 3-13. Frequency of Contact with AEP Ohio Staff



n=66, Source: Navigant analysis of customer survey; P4.

Of the 23 percent of customers (n=42) who contacted AEP Ohio with questions, the majority (81%) were satisfied with their communications, with 57 percent falling into the highest (9-10) satisfaction range. The question associated with this figure asked participants to rate their satisfaction on a scale from zero to ten; the evaluation team considers a response of seven above to be satisfied.

3.2.2.3 Other AEP Ohio Programs

Most (61%) of respondents (n=64) mentioned they had not participated in any other AEP Ohio energy efficiency programs in the past two years. When asked, which programs they had engaged with, nine customers indicated Appliance Rebates, four said Efficient Lighting Discounts, three said In-Home Energy Audit, and one Appliance Recycling. Customers varied in whether they participated in these other programs before or after Online Energy Profile; four had participated before, four had participated after, and the remaining three were unsure. This suggests the Online Energy Profile is moderately effective in channeling customers into other AEP Ohio programs, as one-third of customers participated in other programs afterward. Table 3-14 shows participation in other AEP Ohio programs.

Table 3-14. Participation in Other AEP Ohio Programs

AEP Ohio Program	Number of Participants
Appliance Rebates	9
Appliance Recycling	1
In-Home Energy Audit	3
In-Home Energy Assessment	1
Efficient Lighting Discount	4
Other: Incandescent exchange for high efficiency bulbs	1

n=19, Source: Navigant analysis of customer survey; OP2.

3.2.3 Staff and Contractor Interviews

This section presents findings resulting from in-depth interviews with program staff and installation 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.

3.2.3.1 Program Staff Interviews

AEP Ohio Program Coordinator Interview
The AEP Ohio Program Coordinator oversees the In-Home Energy Program and is responsible for maintaining effective communication between AEP Ohio and the implementation contractor. The AEP Ohio Program Coordinator also regularly reviews savings, tracks sales and marketing efforts from AEP Ohio, and ensures daily operations affecting the program run smoothly. The primary concern from AEP Ohio staff is attaining energy savings goals, and high customer engagement and satisfaction.

In 2017, the audits and assessments components were removed from the program as these were not considered to significantly contribute to meeting the program's savings targets.

The AEP Ohio Program Coordinator commented that marketing efforts and incentive levels for retrofit measures remained significant areas of improvement for AEP Ohio. On the contractor side, AEP Ohio would like to improve their affiliation with the program. On the customer side, the program is continuing tried-and-true methods of email blasts, bill inserts, and bill messaging. Outreach to the multi-family customer segment has been most successful—at the time of this interview, appointments for multi-family installations through the program were booked up several months in advance. Impressions of the program tracking, data management platform and QA/QC process were neutral.

Implementation Contractor Interview
Interviews were completed with program managers from the implementation contractor in November 2016. Implementer responsibilities include developing program implementation strategies, tracking program budget, maintaining operations, and managing implementation staff. The implementer's goals are high quality audits, installations through the program, and customer satisfaction.

The implementation contractor perceived positive highlights of the program year were a greater focus on targeting underserved areas in the program service territory and the implementation of an electronic funds transfer system to allocate payment to contractors. Marketing and branding efforts focused on the AEP Ohio name. The implementation contractor has multiple points of contact to ensure both customer and installation contractor access to the program and its association with AEP Ohio. The idea of branded materials come from experiences and best practices from working with similar programs at other utilities. Materials include branded clipboards, seals, and magnets.

Overall remarks made by both the program manager and the implementation staff in separate interviews reveal they have the same goals and vision towards the program—both see the program's potential to reach many participants and garner savings. This presents an opportunity for strengthening the program through collaboration.

3.2.3.2 Installation Contractor Interviews

Navigant interviewed ten of the trade allies who participated in the In-home Energy Program; participants included seven local contracting firms and three auditors and assessors.

Installation Contractor Participation

Navigant analyzed participation data for the program's contractors to identify trends and patterns in participation. A total of 110 contractors submitted projects to the program in 2016, compared to 123 in 2015 and 141 in 2014. The top 10 contractors in 2016 accounted for 61 percent of energy savings, very similar to 2015 (60%). Comparing the number of contractors since 2015, it appears the pool of contractors is decreasing. In 2014, 34 contractors submitted over 100 unique projects; in 2015, nine did; and in 2016 eight contractors submitted 105 projects. In addition, four of the contractors who had the highest number of projects were also in the top ten group of energy savings. Navigant interviewed two of the top energy contractors and found both have been participating in AEP's In-home Energy Program for five years. The average years of participation for all contractors interviewed (n=10) was 4.8 years. As other contractors gain more experience, it is anticipated the number of projects and the associated energy savings also will increase.

Installation Contractor Satisfaction

Interviews additionally explored contractors' satisfaction with various aspects of the program. To develop a more detailed understanding of satisfaction with key program processes, Navigant asked contractors to rate their satisfaction with various program components on a 1-10 scale, from "very dissatisfied" (1) to "extremely satisfied." (10). Contractors satisfaction with the program dropped compared to 2016; comments given suggest the elimination of the program contributed to the lower ranking of the In-home Energy Program in general (mean=7.8). Table 3-15 compares 2016 satisfaction scores with previous program years, although it should be noted that satisfaction ratings were asked for a different set of program elements previously.

Table 3-15. Mean Contractor Satisfaction Scores

Program Element	Satisfaction Rating (1-10)			
	2016	2015	2014	2013
The process for submitting a rebate application	6.8*	8.75*	6.9	4.3
The amount of time it takes to receive a rebate	6.8*	8.75*	5.0	4.2
Online implementation contractor data entry system	8.3†	7.2	N/A	N/A
The In-home Energy Program in general	7.8	9.0	7.9	7.3

N/A = contractors were not asked to rate the program element in this year
** = the same question was asked to rank these two program elements*
† = 7 of the ten trade allies interviewed used the system

Contractor satisfaction regarding the process for submitting a rebate along with the amount of time it takes to receive the rebate fell. Reasons for the dissatisfaction (ratings of five or below) were the length of time to receive a rebate was eight weeks, the process is becoming too cumbersome, and there is too much paperwork. The seven contractors who used the CAKE system gave it a higher rating (8.5) compared to 2015 (7.2).

Navigant asked contractors to identify all the benefits participating in the program provides their company. The top responses for benefits were the instant rebates, increased sales and marketing opportunities for the contractor while helping them to raise awareness for energy efficiency among customers.

Contractors were also asked to identify drawbacks to participation. The most common drawback was extra administrative burdens. As previously stated, complexities with the paperwork and submittal process presented difficulties for contractors and their staff. As expected, the auditors interviewed were also disappointed in the elimination of the audit portion of the program, and indicated their customers loved learning about energy efficiency and saving money.

Contractors identified barriers for customer's not participating in the rebate portion of the program. Some of the comments include:

- **Awareness** – The customer's lack of knowledge about the program, which equipment qualifies, the availability of a rebate and how to apply for it.

- **Affordability** – Some customers cannot cost justify the cost of new equipment versus the energy savings.
- **Time Commitment** – The paperwork is cumbersome and the customer does not want to take the time to complete it.

Contractors felt AEP's In-home Energy program supported them through its training and offering of rebates. The rebate helps the trade allies to promote energy efficiency, with four of the contractors interviewed stating 50 to 70 percent of their business was related to the In-home Energy rebate program. The program training for contractors appears to be effective as none of the contractors who were inspected after an installation needed to change their practices. Finally, contractor satisfaction with the implementation contractor was 8.6 on a scale of one to ten, with one being not at all satisfied and ten being very satisfied.

When asked about current marketing approaches and recommendations for improvements, three main themes were discussed that also address the barriers they mentioned earlier.

- **Education** – Many customers do not understand the significant savings they can realize by installing energy efficient equipment. The efficiency levels of many appliances have improved over the last 15 years. A comparison chart of the energy savings a new appliance could have over an older one, plus the associated rebate amount for the new appliance will help the customer better understand the importance of energy efficiency.
- **Advertising** – Contractors thought many customers were not aware rebates were available for the appliances they were purchasing, and that more advertising of the program is needed. Contractor's suggested joint advertising, along with brochures or flyers that could be given to the customer.
- **Rebate Offerings** – The contractors interviewed would like to see the rebate offerings expanded to reflect the products the customers are pursuing. Some suggested products included insulation, light bulbs, thermostats and air conditioners (when the furnace is not replaced). Although these rebates are already being offered as a part of the program, it seems like not all contractors are not aware of them.

3.3 Cost-Effectiveness Review

This section addresses the cost effectiveness of the In-home Energy Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-16 summarizes the unique inputs used in the TRC test.

Table 3-16. Inputs to Cost-Effectiveness Model for In-home Energy Program

Item	Input
Average Measure Life	12
Residences	14,454
Ex Post Annual Energy Savings (kWh)	5,708,235
Ex Post Coincident Peak Savings (kW)	503
Third Party Implementation Costs	$1,480,306
Utility Administration Costs	$434,500
Utility Incentive Costs	$2,105,677
Participant Contribution to Incremental Measure Costs	$11,743,064

Based on these inputs, the TRC ratio is 0.2. Therefore, the program does not pass the TRC test. Table 3-17 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 3-17. Cost Effectiveness Results for the In-home Energy Program

Test Results	B/C Ratio
Total Resource Cost	0.2
Participant Cost Test	0.5
Ratepayer Impact Measure	0.3
Utility Cost Test	0.8

Now, 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

Navigant used engineering algorithms to verify energy and demand savings for the 2016 In-home Energy Program. The In-home Energy Program reported 6,796 MWh of energy savings and 0.58 MW of demand savings in 2016. The verified (*ex post*) energy and demand savings for 2016 were 5,708 MWh and 0.50 MW. The realization rates were 85 percent for MWh and 86 percent for peak kW. *Ex post* savings fell short of the program energy savings goal of 13,700 MWh and demand savings goal of 0.9 MW, as shown in Table 4-1.

Table 4-1. 2016 Overall Evaluation Results

	2016 Program Goals[1] (a)	*Ex Ante* Savings (b)	*Ex Post* Savings (c)	Realization Rate[2] RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	13,720	6,796	5,708	0.85	42%
Demand Savings (MW)	0.90	0.58	0.50	0.86	56%

Source:[1] AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.
[2] Note: The overall realization rate is weighted by the ex post savings contributions.

Program Activity. There were more than 100,000 direct install measures and 3,900 retrofits in 2016. Single-family and multi-family direct install measures accounted for 59 percent of the total *ex ante* program energy saving in 2016, energy kit measures accounted for 13 percent, and retrofit measures accounted for 28 percent of the program's total *ex ante* MWh savings.

Measure Installation Rate. The in-service rate for each measure installed through the program was determined through both on-site audits as well as participant online and telephone surveys. Installation rates for direct install measures ranged from 18 percent (multi-family smart strips) to 100 percent (multi-family showerheads). All retrofit measures were found to have a realization rate of 100 percent. Energy kit measure installation rates ranged from 48 percent for nigh lights and aerators to 69 percent for showerheads and aerators[8].

3. **Impact Finding 1: Overall Realization Rate**. Although, the realization rates of the individual delivery channels were higher as compared to 2015 but the overall realization rate remained like its 2015 value. This is primarily because of the shift in the contribution of savings from the delivery channels. Retrofit measures had a realization rate of 100 percent both in 2015 and 2016 but they contributed to only 28 percent of the total savings in 2016 as compared to the 44 percent in 2015. So, they influenced the overall realization rate more in 2015. Multi-family Direct Installs had the highest contribution to savings and hence influenced the realization rate most in 2016.

[8] There is no installation rate for kit LED bulbs due to limited sample size and their late introduction into the kit in November 2016.

Table 4-2. Energy Savings Contribution by Delivery Channel

Stratum (Delivery channel)	Percent Savings (2016)	Percent Savings (2015)
SF Direct Install	16%	17%
MF Direct Install	44%	29%
Retrofit Measures	28%	44%
Online Energy Kit	13%	9%
Total	100%	100%
Overall Realization Rate	85%	83%

Note: totals may not sum due to rounding.

Impact Recommendation 1: The percentage of savings contributed by an individual delivery channel, along with the installation rates of the measures delivered through the channel, are key to realizing a high realization rate. Retrofit measures historically have a 100 percent installation rate. Increasing the contribution of savings from these measures is key to a high program realization rate. Rebate measures have a much higher per unit savings as compared to the direct install and kit measures, and a 100 percent realization rate. Navigant recommends allocating more funds to implementation of rebate measures as that will directly translate to a higher program realization rate.

Impact Recommendation 2: Navigant recommends separating the on-line delivery channel into a standalone program (as the online energy audit program), as it has historically had a lower realization rate. Without the on-line kits portion, the realization rate of the program would be 88 percent for energy and 87 percent for demand respectively. This number would be even higher if there were greater contributions from the rebate measures, which typically have a realization rate of 100 percent. The on-line energy audit can still serve as a participation channel for this program. There are utilities in nearby states that have separated out the online aspect of their in-home programs, which has improved the program realization rate.

4. **Impact Finding 2: *Ex Post* Savings Evaluation.** Navigant conducted a review of measure savings recorded in the tracking system to verify that the energy savings algorithms matched those in the Draft 2010 Ohio Technical Reference Manual (Draft 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 Draft TRM. Navigant's algorithm review found that the energy and demand savings algorithms have been constructed and applied properly per Draft TRM specification. Following are two additional findings based on the review of updated Federal standards and LED interactive effects.

Codes and Standards: Heat Pump measure

Navigant reviewed these in-situ baselines of the measures in consideration of applicable federal codes and standards. Per the Federal Regional Standards for cooling equipment[9] that went it to effect on Jan 1, 2015, the baseline efficiencies for Heat pumps were increased. According to this standard,

[9] http://www.sgtorrice.com/files/Pages/News/2015-Regional-Standards-Cooling-Heating%20Products-rev1.pdf

the allowable baseline values for a heat pump measure were SEER value of 14 and HSPF value of 8.2. AEP Ohio gave contractors a grace period of 12 months to exhaust their existing inventory and implemented the new baselines in 2016.Navigant found that AEP Ohio had updated the savings algorithm for this measure to be compliant with the standard.

Interactive Effects: LED measure

While calculating the ex-post savings, Navigant updated the interactive effects for LED bulbs. The Ohio TRM currently has Waste heat factor for energy value of 1.07 and the Waste heat factor for demand value of 1.21. These were replaced with the Interactive factor for Energy of 0.93 and interactive factor for demand of 1.34 for LEDs from the AEP Ohio Residential Lighting Interactive Effects Modeling Results memo. The implementation of this change led to a slight decrease in the energy ex post savings and a slight increase in the demand ex post savings,

4.2 Key Process Evaluation Findings and Recommendations

The process evaluation component of the In-home Energy Program assessed the effectiveness of the program operations, delivery for the energy audits/assessments, and rebates for retrofit measures. Navigant's process evaluation methods included in-depth interviews with program staff, participating customers and installation contractors, and a review of program tracking systems, reports and marketing materials. Findings follow along with recommendations.

1. **Process Finding 1:** Many participants are using technology such as emails, websites and social media to learn about AEP Ohio's programs.
    - **Process Recommendation 1:** As customers are becoming more technologically savvy, AEP Ohio should use technology more its program promotion, channels to increase the use of email, website, online advertising via social media.
2. **Process Finding 2:** Seventy-five percent of the Online Energy Profile customers ranked themselves as knowledgeable or very knowledgeable regarding energy efficiency; yet they still chose to participate in the Online survey to ensure their knowledge was current.
    - **Process Recommendation 2:** Given the Online Energy Profile program appeals to people who are interested in staying current about energy efficiency and its implementation, these participants should be considered the customer base for any AEP Ohio residential pilot programs as their interest is high.
3. **Process Finding 3:** Participants from the Online Energy Profile did not install the recommendations primarily because they felt that the costs of implementing these recommendations were too high. Many customers do not understand the significant savings they can realize by installing energy efficient equipment.
    - **Process Recommendation 3:** Include the rebate amounts of the equipment recommended to be installed so customers have a full understanding of the net costs. Additional information about the benefits, including non-energy benefits, federal/state tax credits, etc. of the new equipment can add more value to the customer's understanding of this measure.
    - **Process Recommendation 3:** A comparison of the approximate energy savings a new appliance could have over an older one will help the customer better understand the importance of energy efficiency.

4. **Process Finding 4:** Overall, the trade allies are satisfied with the program. However, 30 percent of trade allies found the rebate process complicated and cumbersome. Compared to other utilities, trade allies indicated the paper work involved with AEP Ohio was more work for them.
    - **Process Recommendation 4:** Work with the implementation contractor to develop a more streamlined rebate fulfillment process by benchmarking paperwork requirement of other neighboring utilities.

5. **Process Finding 5:** Some trade allies want to understand how to engage customers who are not aware of the opportunity to install energy efficiency equipment through the program. Many customers were not aware rebates were available for the equipment they were purchasing. Trade allies also believe this can be established by more targeted advertising of the program.
    - **Process Recommendation 5:** Develop a joint advertising effort with trade allies, including brochures or flyers that could be given to the customer.

7. **Process Finding 6:** Some customers received high energy use reports from AEP Ohio through the Home Energy Report Program. These customers participated in the program through audits and assessments to determine the cause of their high-energy use. The audits and assessments did not help these customers in identifying actionable items for reducing their energy use, as their homes were already energy-efficient. There is no recommendation based on this finding as the audits and assessments have been discontinued as a part of the IHE Program.

APPENDIX A. DATA COLLECTION INSTRUMENTS

A.1 In-Home Energy Program Participant Telephone Survey

Statement of purpose: The evaluation team will use these surveys to determine measure realization rates and to identify key program strengths and weaknesses.

Sample size: 50 energy retrofit/audit/assessment participants to achieve 90/10 confidence/precision

Survey timeline: February 2017

Key Evaluation Questions	Survey Questions
What were the realization rates for each measure?	CFL1 – R10
How do customers become aware of the program? What marketing strategies could AEP Ohio use to boost program awareness?	P1 – P14
Is the energy audit/assessment providing sufficient information to overcome barriers to implementing energy efficiency improvements (specifically the lack of customer information about EE)?	AR1 – AR8
How do participating customers perceive the incentives and costs related to this program?	AR5, AR7, AR8, P10
Are customers satisfied with the program?	P6, P9-P11

Introduction

Hello, my name is _____ with The Blackstone Group calling on behalf of AEP Ohio, your electric utility. I'm calling recent participants in AEP Ohio's In-Home Energy Program to learn about their experience and satisfaction with the program, all responses will be kept anonymous. This is not a sales call.

May I please speak with [CONTACT NAME]?

[IF NOT AVAILABLE] May I please speak with someone in your household who was involved with your recent energy audit or assessment; or the decision to purchase energy efficiency equipment for your home (IF NEEDED: such as high-efficiency furnace, air sealing, insulation, etc.)? [IF THE DECISION-MAKER IS NO LONGER THERE, THANK AND TERMINATE]

[IF NEEDED] Depending on your responses, this survey will take approximately 10 minutes to complete.

Screeners

S1. Our records indicate you participated in AEP Ohio's In-home Energy program, either through a rebate; or, an Energy Assessment or Audit which provided information on ways to save energy in your home. Is that correct?

1. YES [SKIP TO AR1]
2. NO [CONTINUE TO S1A]
98. DON'T KNOW [CONTINUE TO S1A]
99. REFUSED [TERMINATE]

[ASK IF S1=2, 98]
S1A. The energy rebate provided an incentive for you to purchase energy efficient equipment, or conduct an energy audit or assessment, involved a visit to your home by an energy expert who inspected your home to determine energy savings opportunities. Do you remember either of these?

1. YES [CONTINUE TO S2]
2. NO [TERMINATE]
98. DON'T KNOW [TERMINATE]
99. REFUSED [TERMINATE]

[ASK IF S1A=1]
S2. Were you the one who participated in the energy audit or assessment process or received a rebate?

1. YES [SKIP TO AR1]
2. NO [CONTINUE TO S2A]
98. DON'T KNOW [CONTINUE TO S2A]
99. REFUSED [THANK AND TERMINATE]

[ASKIF S2= 2, 98]
S2A. May I speak with someone who received the rebate or was present during the energy audit or assessment process?

1. YES [SKIP AR1, REINTRODUCE YOURSELF IF NECESARY]
2. NO [THANK AND TERMINATE]
98. DON'T KNOW [THANK AND TERMINATE]
99. REFUSED [THANK AND TERMINATE]

[IF Audit >0, or, Assess>0, ask questions in this section, OTHERWISE SKIP TO R1]

Audit Report

I would like you to focus on the Report you received after the audit or assessment that contained recommendations for ways to reduce your energy consumption and your utility bill.

AR1. Do you remember receiving the report?

1. YES [CONTINUE TO AR1A]
2. NO [SKIP TO CFLL1]
98. DON'T KNOW [SKIP TO CFL1]
99. REFUSED [SKIP TO CFL1]

[ASK IF AR1=1]
AR1A. Would you say you… [RANDOMIZE ORDER, SINGLE RESPONSE]

1. Read the report thoroughly
2. Read some portions of the report
3. Just glanced through it
4. Did not read the report at all
98. DON'T KNOW [SKIP TO CFL1]
99. REFUSED [SKIP TO CFL1]

[ASK IF AR1A<4]
AR2. On a scale of 1 to 10 where 1 is "not useful at all" and 10 is "extremely useful", please rate the usefulness of the recommendations contained in the report.

[RECORD, 1-10]

98. DON'T KNOW

99. REFUSED

AR3. Did you receive enough information during the audit to be able to make energy efficiency improvements to your home?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF AR2<6 or, AR3=2 or 98]
AR4. What do you think AEP Ohio could do to make the report more useful?

[RECORD OPEN END RESPONSE]

98. DON'T KNOW

99. REFUSED

[ASK IF RETROFIT=0]
AR5. Which of the following describes the main reason you decided not to install any of the auditor's recommendations? [RANDOMIZE ORDER, SELECT MULTIPLE; READ LIST]

1. Haven't got around to it yet
2. Auditor's recommendations were not helpful
3. The cost of improvements was too high
4. The improvements would not have saved enough energy
5. Needed other equipment or improvements
6. Couldn't find a contractor to do the job
97. OTHER [SPECIFY]
98. DON'T KNOW
99. REFUSED

AR6. On a scale of 1 to 10 where 1 is "not important" and 10 is "extremely important," how important were the auditor's recommendations to your decision for which improvements to make?

[RECORD RESPONSE 1-10]

98. DON'T KNOW
99. REFUSED

AR7. What was your primary goal in trying to improve the energy efficiency of your home? [RECORD ONE ANSWER; READ LIST]

1. Reduce energy costs
2. Save money

3. Make my home more comfortable
4. To improve the market value of my home
5. To make general improvements to my home
6. To benefit the environment
97. Other [SPECIFY]
98. DON'T KNOW
99. REFUSED

AR8. Please rank the following in order of importance in your decision of which improvements to make? [RANKING, RANDOMIZE ORDER; READ FULL LIST BEFORE ENTERING RESPONSE, REPEAT IF NECESSARY]

1. Auditor's recommendations
2. Cost of improvements
3. Saving the most energy
4. Saving money
5. The improvement that was most needed or practical
98. DON'T KNOW
99. REFUSED

Ask this block of questions [IF DIM >0]

Direct Install Measure Verification [Measure verification battery is the same for each measure]

CFLs [ASK CFL1 IF QTYCFL>0, IF QTYCFL=0 SKIP TO LED1]

CFL1. Our records indicate the auditor gave you [QTYCFL] CFL bulbs, is this correct?

1. YES [SKIP TO CFL2]
2. NO [CONTINUE TO CFL1A]
98. DON'T KNOW [SKIP TO LED1]
99. REFUSED [SKIP TO LED1]

[ASK IF CFL1=2]
CFL1A. How many CFL bulbs did the auditor give you?

[NUMERIC, 0-50] [IF > 0, SKIP TO CFL2] [IF = 0, SKIP TO LED1]
98. DON'T KNOW [CONTINUE TO CFL2]
99. REFUSED [SKIP TO LED1]

CFL2. How many CFL bulbs were actually installed, as opposed to being left for you to install later?

[NUMERIC, 0-50] [IF < QTYCFL, CONTINUE TO CFL2A], [IF = QTYCFL, CONTINUE TO CFL3],
98. DON'T KNOW [CONTINUE TO CFL3]
99. REFUSED [CONTINUE TO LED1]

CFL2A. How many of the remaining [INSERT DIFFERENCE BETWEEN QTYCFL AND RESPONSE TO CFL2] CFL bulbs did you install yourself?

[NUMERIC, 0-50]
98. DON'T KNOW [CONTINUE TO CFL3]
99. REFUSED [CONTINUE TO CFL3]

[ASK IF CFL2>0]
CFL3. [IF CFL2=1] Is the CFL bulb installed still in place?
[IF CFL2>1 or CFL2=98 or 99] Are all of the CFL bulbs installed still in place?

1. YES [SKIP TO LED1]
2. NO [CONTINUE TO CFL4]
98. DON'T KNOW [SKIP TO LED1]
99. REFUSED [SKIP TO LED1]

[ASK IF CFL3=2]
CFL4. How many of the CFL light bulbs are still installed?

[NUMERIC, 0-50] [CONTINUE TO LED1]
98. DON'T KNOW [CONTINUE TO LED1]
99. REFUSED [SKIP TO LED1]

LEDs [ASK LED1 IF QTYLED>0, IF QTYLED=0 SKIP TO SHOW1]

LED1. Our records indicate the auditor gave you [QTYLED] LED light bulbs, is this correct?

1. YES [SKIP TO LED2]
2. NO [CONTINUE TO LED1A]
98. DON'T KNOW [SKIP TO SHOW1]
99. REFUSED [SKIP TO SHOW1]

[ASK IF LED1=2]
LED1A. How many LED light bulbs did the auditor give you?

[NUMERIC, 0-50] [IF > 0, CONTINUE TO LED2] [IF = 0, SKIP TO LED2]
98. DON'T KNOW [CONTINUE TO LED2]
99. REFUSED [SKIP TO SHOW1]

LED2. How many LED light bulbs were actually installed, as opposed to being left for you to install later?

[NUMERIC, 0-50] [IF < QTYLED, CONTINUE TO LED2A], [IF = QTYLED, CONTINUE TO LED3],
98. DON'T KNOW [CONTINUE TO LED3]
99. REFUSED [CONTINUE TO SHOW1]

LED2A. How many of those remaining [INSERT DIFFERENCE BETWEEN QTYLED AND RESPONSE TO LED2] LED light bulbs that were left behind did you install yourself?

[NUMERIC, 0-50]
98. DON'T KNOW [CONTINUE TO LED3]
99. REFUSED [CONTINUE TO SHOW1]

[ASK IF LED2>0]
LED3. [IF LED2=1] Is the LED light bulb that was installed still in place?
[IF LED2>1 or LED2=98 or 99] Are all the LED light bulbs that were installed still in place?

1. YES [SKIP TO SHOW1]
2. NO [CONTINUE TO LED4]
98. DON'T KNOW [SKIP TO SHOW1]
99. REFUSED [SKIP TO SHOW1]

[ASK IF LED3=2]
LED4. How many of the LED light bulbs that were installed are still installed?
[NUMERIC, 0-50] [CONTINUE TO SHOW1]
98. DON'T KNOW [CONTINUE TO SHOW1]
99. REFUSED [SKIP TO SHOW1]

Showerheads [ASK SHOW1 IF QTYSHOW>0, IF QTYSHOW=0 SKIP TO AER1]
SHOW1. Our records indicate the auditor gave you [QTYSHOW] showerhead(s), is this correct?
1. YES [SKIP TO SHOW2]
2. NO [CONTINUE TO SHOW1A]
98. DON'T KNOW [SKIP TO AER1]
99. REFUSED [SKIP TO AER1]

[ASK IF SHOW1A=2]
SHOW1A. How many showerheads did the auditor give you?
[NUMERIC, 0-50] [CONTINUE TO SHOW2]
98. DON'T KNOW [CONTINUE TO SHOW2]
99. REFUSED [SKIP TO AER1]

SHOW2. Was/were the showerhead(s) actually *installed* or just left behind?
1. All were installed [CONTINUE TO SHOW3]
2. Some were installed [CONTINUE TO SHOW2A]
3. All were left behind [SKIP TO SHOW2A]
98. DON'T KNOW [CONTINUE TO SHOW3]
99. REFUSED [SKIP TO AER1]

SHOW2A. Did you install the showerheads the auditor left behind?
1. YES [CONTINUE TO SHOW3]
2. NO [CONTINUE TO SHOW3]
98. DON'T KNOW [CONTINUE TO SHOW3]
99. REFUSED [CONTINUE TO AER1]

SHOW3. How many of the showerheads are still installed?
[NUMERIC, 0-50] [CONTINUE TO AER1]
98. DON'T KNOW [CONTINUE TO AER1]
99. REFUSED [CONTUNE TO AER1]

AERATORS [SHOW AER1 IF QTYAER>0, IF QTYAER=0 SKIP TO STRIP1]

AER1. Our records indicate the auditor gave you [QTYAER] faucet aerators(s), is this correct?
1. YES [SKIP TO AER2]
2. NO [CONTINUE TO AER1A]
98. DON'T KNOW [SKIP TO STRIP1]
99. REFUSED [SKIP TO STRIP1]

[ASK IF AER1=2]
AER1A. How many faucet aerators did the auditor give you?
[NUMERIC, 0-50] [CONTINUE TO AER2]

98. DON'T KNOW [CONTINUE TO AER2]
99. REFUSED [SKIP TP STRIP1]

AER2. How many of those faucet aerators were actually *installed*, as opposed to being left behind?
[NUMERIC, 0-50][IF = 0, CONTINUE TO AER2A], [IF < QTYAER, CONTINUE TO AER2A] [IF = QTYAER, CONTINUE TO AER3]
98. DON'T KNOW [CONTINUE TO AER3]
99. REFUSED [CONTINUE TO STRIP1]

AER2A. Did you install the faucet aerators the auditor left at your home?
1. YES [CONTINUE TO AER3]
2. NO [CONTINUE TO AER3]
98. DON'T KNOW [CONTINUE TO AER3]
99. REFUSED [CONTINUE TO STRIP1]

AER3. How many of the faucet aerators are still installed?
[NUMERIC, 0-50] [CONTINUE TO STRIP1]
98. DON'T KNOW [CONTINUE TO STRIP1]
99. REFUSED [CONTINUE TO STRIP1]

Smart Strip [SHOW STRIP1 IF QTY_STRIPS>0, IF QTY_STRIP=0 SKIP TO NIGHT1]

STRIP1. Our records indicate the auditor gave you a 7-plug Smart Strip, is this correct?
1. YES [SKIP TO STRIP2]
2. NO [SKIP TO NIGHT1]
98. DON'T KNOW [SKIP TO NIGHT1]
99. REFUSED [SKIP TO NIGHT1]

STRIP2. Did the auditor install a 7-plug Smart Strip, as opposed to leaving it at your home?
1. YES [CONTINUE TO STRIP3]
2. NO [SKIP TO STRIP2A]
98. DON'T KNOW [SKIP TO STRIP2A]
99. REFUSED [SKIP TO NIGHT1]

STRIP2A. Did you install the 7-plug Smart Strip the auditor left at your home?
1. YES [CONTINUE TO STRIP3]
2. NO [CONTINUE TO NIGHT1]
98. DON'T KNOW [CONTINUE TO NIGHT1]
99. REFUSED [CONTINUE TO NIGHT1]

STRIP3. Is the 7-plug Smart Strip that was installed still in place?
1. YES [SKIP TO NIGHT1]
2. NO [SKIP TO NIGHT1]
98. DON'T KNOW [SKIP TO NIGHT1]
99. REFUSED {SKIP TO NIGHT1]

LED Nightlight [ASK IF QTY_NIGHT>0, IF QTY_NIGHT=0 SKIP TO R1]

NIGHT1. Our records indicate the auditor gave you an LED nightlight, is this correct?
1. YES [SKIP TO NIGHT2]

2. NO [SKIP TO R1]
98. DON'T KNOW [SKIP TO R1]
99. REFUSED [SKIP TO R1]

NIGHT2. Did the auditor install the nightlight, as opposed to leaving it at your home?
1. YES [CONTINUE TO NIGHT3]
2. NO [CONTINUE TO NIGHT2A]
98. DON'T KNOW [CONTINUE TO NIGHT3]
99. REFUSED [SKIP TO R1]

NIGHT2A. Did you install the nightlight the auditor left at your home?
1. YES [CONTINUE TO NIGHT3]
2. NO [CONTINUE TO R1]
98. DON'T KNOW [CONTINUE TO R1]
99. REFUSED [CONTINUE TO R1]

NIGHT3. Is the LED Nightlight that was installed still installed?
1. YES [SKIP TO R1]
2. NO [CONTINUE TO R!]
98. DON'T KNOW [SKIP TO R1]
99. REFUSED [SKIP TO R1]

[Ask this block of questions if Retrofit >0]

Retrofit Measure Verification

Ask Questions below for each retrofit measure installed.

[ASK IF Central Air Conditioner > 0, ELSE SKIP TO R2]
R1. Our records indicate you installed a new central air conditioner, is this correct?
1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF Air Sealing > 0, ELSE SKIP TO R3]
R2. Our records indicate you received air sealing, is this correct?
1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF ASHeat Pump > 0, ELSE SKIP TO R4]
R3. Our records indicate you installed a new air source heat pump, is this correct?
1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF Attic Insulation > 0, ELSE SKIP TO R5]
R4. Our records indicate you installed attic insulation, is this correct?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF Duct Insulation > 0, ELSE SKIP TO R6]
R5. Our records indicate you installed duct insulation, is this correct?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF DMSHeatPump> 0, ELSE SKIP TO R7]
R6. Our records indicate you installed a ductless mini split heat pump, is this correct?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF GSHeatPump> 0, ELSE SKIP TO R8]
R7. Our records indicate you installed a ground source heat pump, is this correct?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF PThermostat > 0, ELSE SKIP TO R9]
R8. Our records indicate you installed a new programmable thermostat, is this correct?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF SThermostat > 0, ELSE SKIP TO R10]
R9. Our records indicate you installed a new smart thermostat, is this correct?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK IF Wall Insulation > 0, ELSE SKIP TO P1]
R10. Our records indicate you installed wall insulation, is this correct?

1. YES

2. NO
98. DON'T KNOW
99. REFUSED

Process Questions

P1. How did you find out about the In-Home Energy Program? [DO NOT READ LIST] [SELECT MULTIPLE]

1. BILL INSERT
2. COMMUNITY EVENT/COUNTY/STATE FAIR
3. CONTRACTOR (SUCH AS A PLUMBER, ELECTRICIAN, OR GENERAL CONTRACTOR)
4. EMAIL
5. FAMILY
6. FRIEND
7. RESPONDENT WORKS IN THE INDUSTRY
8. UTILITY COMPANY (GENERAL)
9. WEBSITE
10. YARD SIGNS
97. OTHER [SPECIFY]
98. DON'T KNOW
99. REFUSED

[IF P1 HAS MORE THAN ONE ANSWER, ASK P2, OTHERWISE RECORD P2=P1]
P2. Which of these sources of information was most influential in your decision to participate in the program? [SELECT ONE]

[DISPLAY ANSWERS GIVEN IN P1]

P3. How would you suggest AEP Ohio try to reach out to its customers in the future to get them to participate in this program? [DO NOT READ] [ALLOW MULTIPLE RESPONSES]

1. BILL INSERTS
2. FLYERS/ADS/MAILINGS
3. HOMEOWNERS ASSOCIATION
4. NEWSPAPER ADVERTISEMENTS
5. RADIO ADVERTISEMENTS
6. TELEVISION ADVERTISEMENTS
7. PHONE CALLS
8. AEP OHIO WEBSITE
9. INTERNET ADVERTISING – SEARCH ENGINES
10. FACEBOOK, TWITTER, or other social media
97. OTHER [SPECIFY]
98. DON'T KNOW
99. REFUSED

P4. In the course of participating in the In-home Energy program, how often did you contact AEP Ohio or program staff with questions?

1. Never
2. Once
3. 2 or 3 times
4. 4 times or more
98. Don't know

99. Refused

[IF P4=2-4, ASK P5; OTHERWISE GO TO P8]

P5. How did you contact them? [CHECK ALL THAT APPLY]

1. Phone
2. Email or fax
3. Mailed a letter
4. In person
98. Don't know
99. Refused

P6. On a scale of 1 to 10, where 1 is extremely dissatisfied and 10 is extremely satisfied, how would you rate your communications with AEP Ohio and program staff?

[RECORD 1-10]

98. Don't know
99. Refused

[IF P6<6, ASK P7; OTHERWISE GO TO P8]

P7. Why did you give that answer?

[OPEN END]

98. DON'T KNOW
99. REFUSED

[IF Audit>0 or Assess>0, ask P8, OTHERWISE GO TO P11]

P8. Have you noticed any savings on your electric bill since the energy audit?

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

[IF P8=1, ASK P9; OTHERWISE GO TO P10]

P9. On a scale of 1 to 10, where 1 is extremely dissatisfied and 10 is extremely satisfied, how satisfied are you with the savings on your electric bill?

[RECORD 1-10]

98. Don't know
99. Refused

[IF Audit>0 or Assess>0, ask P10, OTHERWISE GO TO P11]

P10. Next, I'd like to ask you to rate your satisfaction on different elements of the program. On a scale of 1 to 10, where 1 is extremely dissatisfied and 10 is extremely satisfied, how would you rate your satisfaction with… [SCALE 1-10; 96=not applicable, 98=Don't know,] [SHOW GRID]

P10A. The energy audit report you received that showed your home's energy usage and recommended ways to save energy
P10B. The time it took to schedule the energy audit
P10C. The length of time it took to complete the audit in your home
P10D. The energy auditor that assessed your home's energy performance
P10E. The cost of the energy audit

P11. Next, I'd like to ask you to rate your satisfaction on different elements of the program. On a scale of 1 to 10, where 1 is extremely dissatisfied and 10 is extremely satisfied, how would you rate your satisfaction with… [SCALE 1-10; 96=not applicable, 98=Don't know,] [SHOW GRID]

P11A. The In-Home Energy program overall
P11B. AEP Ohio overall
P11C. The rebate you received
P11D. The contractor that installed your equipment

[ASK FOR EACH P10A-E<7 or P11A-D<7]
P12A-G. You mentioned you were not satisfied with <P10A-G, P11A-D>. Why did you give this rating?
[RECORD OPEN END RESPONSE]
98. DON'T KNOW
99. REFUSED

P13. Have you participated in any other AEP Ohio energy efficiency programs in the past two years?
1. YES [CONTINUE TO P14]
2. NO [SKIP TO D1]
98. DON'T KNOW [SKIP TO D1]

P14. Which other programs have you participated in? [OPEN END]
1. EFFICIENT LIGHTING DISCOUNTS
2. APPLIANCE REBATES
3. APPLIANCE RECYCLING
4. COMMUNITY ENERGY SAVERS
5. MULTIFAMIILY DIRECT INSTALL PROGRAM
6. COMMUNITY ASSISTANCE PROGRAM
7. EFFICIENCYCRAFTED NEW HOMES
8. EDUCATION PROGRAMS FOR KIDS
9. COMMERCIAL OR BUSINESS PROGRAM [SPECIFY]
97. OTHER [SPECIFY]
98. DON'T KNOW

[IF Audit>0 or Assess>0, ask P15, OTHERWISE GO TO P11]

P15. Did you participate in this/these other programs before or after the energy audit?
1. BEFORE THIS ONE
2. AFTER THIS ONE
3. BOTH BEFORE AND AFTER (NOTE TO INTERVIEWER: CUSTOMER COULD PARTICIPATE IN MULTIPLE PROGRAMS OR PARTICIPATION COULD HAVE TAKEN A LONGER TIME)
98. DON'T KNOW
99. REFUSED

We're almost done. I want to ask you a few more questions about your household. Please note, this information is confidential and individual answers are not shared with AEP Ohio or anyone else.

Demographics

D1. Do you own or rent your home? [DO NOT READ LIST] [ENTER ONE RESPONSE]
1. Own

2. Rent
98. DON'T KNOW
99. REFUSED

D2. Which of the following best describes your home/residence? READ LIST
1. Single-family home, detached construction [NOT A DUPLEX, TOWNHOME, OR APARTMENT; ATTACHED GARAGE IS OK]
2. Single family home, factory manufactured/modular
3. Single family, mobile home
4. Row House
5. Two or Three family attached residence—traditional structure
6. Apartment (4 + families)---traditional structure
7. Condominium---traditional structure
97. Other [SPECIFY]
98. Don't know
99. Refused

D6. How many square feet is the above-ground living space (IF NECESSARY, THIS EXCLUDES WALK-OUT BASEMENTS)?
NUMERICAL OPEN END [RANGE 0-99,999]
98. DON'T KNOW
99. REFUSED

D7. [ASK IF D6=98,99] Would you estimate the above-ground living space is about:
1. Less than 1,000 sqft
2. 1,001-2,000 sqft
3. 2,001-3,000 sqft
4. 3,001-4,000 sqft
5. 4,001-5,000 sqft
6. Greater than 5,000 sqft
98. Don't know
99. Refused

D10. Is there anything you like to mention about the program that was not captured during the interview here? [RECORD OPEN END RESPONSE]
96. Nothing
98. Don't Know
99. Refused

Closing

Those are all the questions we have. On behalf of AEP Ohio, I'd like to thank you again for taking the time to participate in this study.

A.2 2016 Online Energy Assessment Participant Survey

Statement of purpose: These surveys will be used by the evaluation team to determine measure realization rates and to identify key program strengths and weaknesses.

Sample size: 50 Online Energy Profile participants to achieve 90/10 confidence/precision.

Survey timeline: February 2017

Key Evaluation Questions	Survey Questions
What were the realization rates for each measure?	CFL1 – R8
How do customers become aware of the program? What marketing strategies could be used to boost program awareness?	P1 - P3
Is the energy audit/assessment providing sufficient information to overcome barriers to implementing energy efficiency improvements (specifically the lack of customer information about EE)?	OS1-OS8 P4-P6 PP1-PP5
Are customers satisfied with the program?	OS6-OS8

Screeners

S1. Our records indicate you completed an Online Energy Profile on AEP Ohio's website at some point in 2016 and, as part of your participation, AEP Ohio mailed your household an Energy Savings Kit including products like a low-flow showerhead and LED nightlight. Is that correct?
1. YES [CONTINUE TO OS1]
2. NO [TERMINATE]
98. DON'T KNOW [TERMINATE]
99. [TERMINATE]

S2. To start are a few questions about your experience with the online energy checkup. Do you recall completing the Online Energy Profile interactive tool that helps you evaluate how you use energy in your home and where you can save money?

1. YES [CONTINUE TO OS1]
2. NO [SKIP TO CFL1]
98. DON'T KNOW [SKIP TO CFL1]
[SKIP TO CFL1]

Online Energy Profile Information Retention and Satisfaction

OS1. On a scale from 1 to 10, where 1 is "not at all knowledgeable" and 10 is "extremely knowledgeable" how would you rate your knowledge of energy efficiency **before** you participated in the Online Energy Profile?

OS2. [Add scale where 1 is Not at all knowledgeable and 10 is Extremely knowledgeable]

98. DON'T KNOW

OS3. How much did you learn about energy efficiency from the Online Energy Profile? Would you say you learned…? Please select one:

1. Nothing (SKIP TO OS3)
2. Very Little (SKIP TO OS3)
3. Some
4. A lot
98. DON'T KNOW (SKIP TO OS3)
(SKIP TO OS3)

OS2a. Do you remember anything specific that you found helpful?
[OPEN ENDED]
98. DON'T KNOW

OS3. Did the Online Energy Profile cause you to purchase any additional measures?

1. YES
2. NO
98. DON'T KNOW

[ASK IF OS3=1]
OS3A. What measures did you purchase?
[RECORD OPEN END RESPONSE]
98. DON'T KNOW

OS4. On a scale of 1to 10, where 1 means "extremely dissatisfied" and 10 means "extremely satisfied", how satisfied were you with the Online Energy Profile overall?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]

98. DON'T KNOW

[ASK IF OS4 < 6. ELSE SKIP TO OS6.]
OS5. Why did you rate it that way? [OPEN END]
98. DON'T KNOW

OS6. On a scale of 1-10 with 1 being "strongly disagree" and 10 being "strongly agree," please indicate how much you agree or disagree with the following statements.

[Add scale where 1 is Strongly disagree and 10 is Strongly Agree, SHOW GRID]

A. The information provided was easy to understand
B. The Online Energy Profile helped me learn about other sources of energy efficiency information and AEP Ohio energy efficiency programs
C. I learned something new from the Online Energy Profile
D. The Online Energy Profile provided information that I needed in order to take action to save energy and money in my home
E. The Online Energy Profile gave me a better understanding of where I can save energy and money in my home
F. The time needed to complete the Online Energy Profile was reasonable
G. The Online Energy Profile was easy to complete

OS7. On a scale of 1 to 10, where 1 means "extremely dissatisfied" and 10 means "extremely satisfied", how satisfied were you with the Energy Savings Kit?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]

98. DON'T KNOW

[ASK OS8 IF OS7 <= 5. ELSE SKIP TO CFL1.]

OS8. Why did you rate it that way?
[RECORD OPEN END RESPONSE]

98. DON'T KNOW

Measure Verification

[ASK IF CFL=5]
CFL BATTERY

CFL1) The Energy Savings Kit included five energy efficient compact fluorescent light bulbs. How many of those five light bulbs did you install in your home?

1. ONE
2. TWO
3. THREE
4. FOUR
5. FIVE

97. NONE [ASK CFL2 THEN GO TO SKIP BEFORE LED1]
98. DON'T KNOW [SKIP TO LED1]
[SKIP TO LED1]

[ASK CFL2 IF CFL1<5. ELSE SKIP TO CFL4]

CFL2) Why didn't you **install all** of the energy efficient light bulbs? (PLEASE SELECT ALL THAT APPLY.)

1. ALREADY HAVE EFFICIENT LIGHT BULBS INSTALLED
2. DO NOT LIKE THE LIGHT THAT THE BULBS GIVE OFF
3. THE LIGHT BULB WAS BROKEN
4. THE LIGHT BULB(S) DID NOT WORK
5. HAVEN'T GOTTEN AROUND TO IT YET

97. OTHER (RECORD REASON) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]
99. [EXCLUSIVE]

CFL3) How many of the light bulbs that you originally installed are still installed?

[NUMERIC, 0-5]

98. DON'T KNOW

[ASK IF CFL4 < CFL1. ELSE GO TO CFL6]

CFL4) On a scale of 1 to 10, where 1 means "extremely dissatisfied" and 10 means "extremely satisfied", how satisfied were you with the energy efficient light bulbs?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]
98. DON'T KNOW

[ASK IF LED NIGHTLIGHT=1]
LED NIGHTLIGHT BATTERY
LED1. Did you install the LED nightlight you received in the Energy Savings Kit?
1. YES [CONTINUE TO LED2]
2. NO [SKIP TO LED3]
98. DON'T KNOW [SKIP TO SH1]
[SKIP TO SH1]

[ASK IF LED1=2, ELSE SKIP TO LED4]
LED2. Why didn't you install the LED nightlight? (PLEASE SELECT ALL THAT APPLY.)
1. WAITING FOR EXISTING NIGHTLIGHT TO BURN OUT
2. HAVEN'T GOTTEN AROUND TO IT YET
3. DO NOT LIKE THE TYPE OF LIGHT IT PROVIDES
4. DO NOT HAVE THE NEED FOR ANOTHER NIGHTLIGHT
97. OTHER (RECORD RESPONSE**)** [OPEN END]
98. DON'T KNOW [EXCLUSIVE]
[EXCLUSIVE]

[ASK IF LED2=1, ELSE SKIP TO SH1]
LED3. Is the LED nightlight still plugged-in?
1. YES [SKIP TO LED6]
2. NO [CONTINUE TO LED5]
98. DON'T KNOW [SKIP TO SH1]
[SKIP TO SH1]

ASK IF LED1=1
LED4. On a scale of 1 to 10, where 1 means "extremely dissatisfied" and 10 means "extremely satisfied", how satisfied were you with the LED nightlight?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]

98. DON'T KNOW

[ASK IF SHOWERHEAD=1]
SHOWERHEAD BATTERY

SH1. Did you install the showerhead you received in the Energy Savings Kit?
1. YES [SKIP TO SH4]
2. NO [CONTINUE TO SH3]
98. DON'T KNOW [SKIP TO FA1]
[SKIP TO FA1]

SH2. Why didn't you install the showerhead? (PLEASE SELECT ALL THAT APPLY.)

1. ALREADY HAVE AN EFFICIENT SHOWERHEAD INSTALLED
2. I LIKE MY CURRENT SHOWERHEAD THAT IS NOT ENERGY EFFICIENT
3. TOO DIFFICULT TO INSTALL
4. WORRIED ABOUT THE POSSIBLE REDUCED PRESSURE OF THE SHOWERHEAD
5. HAVEN'T GOTTEN AROUND TO IT YET
6. DIDN'T LIKE THE APPEARANCE

97. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]

[ASK IF SH2=1, ELSE SKIP TO SH6]
SH3. Is the showerhead still installed?
1. YES [SKIP TO SH6]
2. NO [CONTINUE TO SH5]
98. DON'T KNOW [SKIP TO SH6]
99 [SKIP TO SH6]

ASK IF SH2=1
SH4. On a scale of 1 to 10, where 1 means "extremely dissatisfied" and 10 means "extremely satisfied," how satisfied were you with the showerhead?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]
98. DON'T KNOW

[ASK IF FAUCET AERATORS=2]
FAUCET AERATORS BATTERY

FA1. Did you install both kitchen and bathroom faucet aerators you received in the Energy Savings Kit? (PLEASE SELECT ONE.)
1. YES, I INSTALLED BOTH [SKIP TO FA4]
2. NO, I JUST INSTALLED THE KITCHEN AERATOR [CONTINUE TO FA3]
3. NO, I JUST INSTALLED THE BATHROOM AERATOR [CONTINUE TO FA2]
4. NO, I DID NOT INSTALL EITHER [CONTINUE TO FA2 AND THEN FA3]
98. DON'T KNOW [SKIP TO PI1]
99. [SKIP TO PI1]

FA2. Why didn't you install the kitchen faucet aerator(s)? (SELECT ALL THAT APPLY.)
1. ALREADY HAVE (AN) EFFICIENT FAUCET AERATOR(S) INSTALLED
2. DO NOT LIKE THE PRESSURE OF THE FAUCET AERATOR
3. TOO DIFFICULT TO INSTALL
4. HAVEN'T GOTTEN AROUND TO IT YET
5. DIDN'T LIKE THE APPEARANCE
97. OTHER (RECORD REASON) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]

[ASK IF FA1=2-4)
FA3. Why didn't you install the BATHROOM faucet aerator(s)? (SELECT ALL THAT APPLY.)
1. ALREADY HAVE (AN) EFFICIENT FAUCET AERATOR(S) INSTALLED
2. DO NOT LIKE THE PRESSURE OF THE FAUCET AERATOR
3. TOO DIFFICULT TO INSTALL

4. HAVEN'T GOTTEN AROUND TO IT YET
5. DIDN'T LIKE THE APPEARANCE
97. OTHER (RECORD REASON) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]

[ASK IF FA1=1or 2]
FA4. Is the kitchen faucet aerator still installed?

1. YES
2. NO [SKIP TO FA6]
98. DON'T KNOW [CONTINUE TO FA5]

[ASK IF FA1=1 or 3]
FA5. Is the bathroom faucet aerator still installed?
1. YES
2. NO [SKIP TO FA8]
98. DON'T KNOW [SKIP TO FA9]

98.]

[ASK IF FA1<4]
FA7. On a scale of 1 to 10, where 1 means "extremely dissatisfied" and 10 means "extremely satisfied", please tell me how satisfied were you with the faucet aerators?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]

98. DON'T KNOW

Retrofit Measure Verification

Ask Questions below for each retrofit measure installed.

[ASK IF Central Air Conditioner = 1, ELSE SKIP TO R2]
R1. Our records indicate that you installed a new efficient central air conditioner, is this correct?
1. YES
2. NO
98. DON'T KNOW

[ASK IF R1 =1, ELSE R2]
R1a. Did you install the central air conditioning before or after you participated in the Online Energy Profile"
5. Before
6. After
98. Don't know

[ASK IF Air Sealing = 1, ELSE SKIP TO R3]
R2. Our records indicate that you received air sealing, is this correct?

1. YES
2. NO
98. DON'T KNOW

[ASK IF R2 =1, ELSE R3]
R2a. Did you install the air sealing before or after you participated in the Online Energy Profile"
1. Before
2. After
98. Don't know

[ASK IF Air Source Heat Pump = 1, ELSE SKIP TO R4]
R3. Our records indicate that you installed a new efficient air source heat pump, is this correct?
1. YES
2. NO
98. DON'T KNOW
[ASK IF R3 =1, ELSE R4]
R3a. Did you install the air source heat pump before or after you participated in the Online Energy Profile"
1. Before
2. After
98. Don't know

[ASK IF Attic Insulation = 1, ELSE SKIP TO R5]
R4. Our records indicate that you installed attic insulation, is this correct?
1. YES
2. NO
98. DON'T KNOW

[ASK IF R4 =1, ELSE R5]
R4a. Did you install the attic insulation before or after you participated in the Online Energy Profile"
1. Before
2. After
98. Don't know

[ASK IF Ductless Mini-Split = 1, ELSE SKIP TO R6]
R5. Our records indicate that you installed insulation ductless mini-split heat pump, is this correct?
1. YES
2. NO
98. DON'T KNOW

[ASK IF R5 =1, ELSE R6]
R5a. Did you install the ductless mini-split heat pump before or after you participated in the Online Energy Profile"
1. Before
2. After
98. Don't know

[ASK IF Ground Source Heat Pump= 1, ELSE SKIP TO R7]
R6. Our records indicate that you installed a new ground source heat pump, is this correct?

1. YES
2. NO
98. DON'T KNOW

[ASK IF R6 =1, ELSE R7]
R6a. Did you install the ground source heat pump before or after you participated in the Online Energy Profile"

3. Before
4. After
98. Don't know

[ASK IF Programmable Thermostat = 1, ELSE SKIP TO R8]
R7. Our records indicate that you installed a new programmable thermostat, is this correct?

1. YES
2. NO
98. DON'T KNOW

[ASK IF R7 =1, ELSE R8]
R7a. Did you install the programmable thermostat before or after you participated in the Online Energy Profile"

1. Before
2. After
98. Don't know

[ASK IF Smart Thermostat = 1, ELSE SKIP TO P1]
R8. Our records indicate that you installed a smart thermostat, is this correct?

1. YES
2. NO
98. DON'T KNOW

[ASK IF R8 =1, ELSE P1]
R8a. Did you install the smart thermostat before or after you participated in the Online Energy Profile"

1. Before
2. After
98. Don't know

Process Questions

P1. How did you find out about the Online Energy Profile? (PLEASE SELECT ALL THAT APPLY.)

1. BILL INSERT
2. COMMUNITY EVENT/COUNTY/STATE FAIR
3. CONTRACTOR (SUCH AS A PLUMBER, ELECTRICIAN, OR GENERAL CONTRACTOR)
4. EMAIL

5. FAMILY
6. FRIEND
7. RESPONDENT WORKS IN THE INDUSTRY
8. UTILITY COMPANY (GENERAL)
9. WEBSITE
10. YARD SIGNS
11. PROPERTY MANAGEMENT COMPANY OR BUILDING OWNER
12. PROGRAM INFORMATION ON ELECTRIC BILL
97. OTHER (RECORD RESPONSE.) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]
99.

[IF P1 HAS MORE THAN ONE ANSWER, ASK P2, OTHERWISE AUTO-FILL.]

P2. Which one of these sources of information was **the most influential** in your decision to participate in the program? (CARRYFORWARD ALL ANSWERS GIVEN IN P1..]

P3. How would you recommend AEP Ohio reach out to customers in the future to get them to participate in this program? (PLEASE SELECT ALL THAT APPLY.)

1. BILL INSERTS
2. FLYERS/ADS/MAILINGS
3. HOMEOWNERS ASSOCIATION
4. NEWSPAPER ADVERTISEMENTS
5. RADIO ADVERTISEMENTS
6. TELEVISION ADVERTISEMENTS
7. WITH PHONE CALLS
97. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW

P4. In the course of participating in the AEP Ohio program, how often did you contact AEP Ohio or program staff with questions?

1. Never [Skip to P7]
2. Once
3. 2 or 3 times
4. 4 times or more
99. Don't know [Skip to P7]

P5. How did you contact them? [CHECK ALL THAT APPLY]

5. Phone
6. Email or fax
7. Mailed a letter
8. In person
99. Don't know

P6. On a scale of 1 to 10, where 1 is extremely dissatisfied and 10 is extremely satisfied, how would you rate your communications with AEP Ohio and program staff?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]

99. Don't know

[ASK IF ANY RETROFIT MEASURE > 0]
P7. Have you noticed any savings on your electric bill since installing your new energy efficient equipment?

4. Yes
5. No
6. Not sure
99. Don't know

[IF P7=1, ASK P8; OTHERWISE GO TO P9]

P8. On a scale of 1 to 10, where 1 is extremely dissatisfied and 10 is extremely satisfied, how satisfied are you with the savings on your electric bill?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]

99. Don't know
100.

[IF P8<6, ASK P9; OTHERWISE GO TO P10]

P9. Why did you give this rating?
[OPEN END]
97. DON'T KNOW

P10. On a scale of 1 to 10, where 1 is extremely dissatisfied and 10 is extremely satisfied, how satisfied are you with your new energy efficiency upgrades?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]

98. Don't know

[IF P10<6, ASK P11; OTHERWISE GO TO P12]

P11. Why did you give this rating?
[OPEN END]
98. DON'T KNOW

P12. Finally, on a scale of 1 to 10, where 1 is extremely dissatisfied and 10 is extremely satisfied, how would you rate your overall satisfaction with the AEP Ohio Online Energy Profile Program?
[Add scale where 1 is Extremely dissatisfied and 10 is Extremely satisfied]
98. Don't know

P13. Why do you give your overall satisfaction with AEP's Online Energy Profile this rating?

[OPEN END]
98. DON'T KNOW

P14. What was your primary goal in trying to improve the efficiency of your home? (Please SELECT all that apply.)
1. TO REDUCE ENERGY COSTS

2. TO MAKE MY HOME MORE COMFORTABLE
3. TO MAKE GENERAL IMPROVEMENTS TO MY HOME
4. TO BENEFIT THE ENVIRONMENT
97. OTHER (RECORD RESPONSE) [OPEN END] _____
98. DON'T KNOW [EXCLUSIVE]

P15. Focusing on the Report you received after the Online Energy Profile. After receiving the report that contained recommendations for ways to reduce your energy consumption and your utility bill, would you say that you…?

1. Read the report thoroughly
2. Read some portions of the report
3. Just glanced through it, or
4. Did not read the report at all [Skip to PP1]
98. DON'T KNOW [Skip to PP1]

[ASK IF P15<5. ELSE SKIP TO PP1]
P16. On a scale of 1 to 10 where 1 is "not useful at all" and 10 is "extremely useful", please rate the usefulness of the recommendations contained in the report.

[Add scale where 1 is Not at all useful and 10 is Extremely useful]

98. DON'T KNOW

PARTIAL PARTICIPANT BATTERY [ASK IF "PARTICIPANT TYPE"=Partial, ELSE SKIP TO OP1]
PP1. Did you receive enough information during the Online Energy Profile to be able to make energy efficiency improvements to your home?

1. YES [SKIP TO PP3]
2. NO [CONTINUE TO PP2]
98. DON'T KNOW [SKIP TO PP3]

PP2. Did you install any of the Online Energy Profile's recommendations?

1. YES [CONTINUE TO PP4]
2. NO [SKIP TO PP5]
98. DON'T KNOW [SKIP TO OP1]

[ASK IF PP2=2]
PP3. Which of the following describes the main reason you decided not to install any of the Online Energy Profiles's recommendations? [SELECT MULTIPLE]

1. Haven't got around to it yet
2. The recommendations were not helpful
3. The cost of improvements was too high
4. The improvements wouldn't have saved enough energy
5. Needed other equipment or improvements more
6. Couldn't find a contractor to do the job
97. OTHER [SPECIFY]
98. DON'T KNOW

OTHER PROGRAMS

OP1. Have you participated in any <u>other</u> AEP Ohio energy efficiency programs in past two years?

3. YES [CONTINUE TO OP2]
4. NO [SKIP TO D1]
98. DON'T KNOW [SKIP TO D1]

OP2. Which other programs have you participated in? PLEASE SELECT ALL THAT APPLY:]

10. IN-HOME ENERGY AUDIT
11. IN-HOME ENERGY ASSESSMENT
12. EFFICIENT LIGHTING DISCOUNTS
13. APPLIANCE REBATES
14. APPLIANCE RECYCLING
15. COMMUNITY ENERGY SAVERS
16. MULTIFAMIILY DIRECT INSTALL PROGRAM
17. COMMUNITY ASSISTANCE PROGRAM
18. EFFICIENCYCRAFTED NEW HOMES
19. EDUCATION PROGRAMS FOR KIDS
20. COMMERCIAL OR BUSINESS PROGRAM [SPECIFY]
97. OTHER [SPECIFY]
98. DON'T KNOW

OP3. Did you participate in this/these programs before or after you completed the Online Energy Profile?

4. BEFORE THIS ONE
5. AFTER THIS ONE
6. BOTH BEFORE AND AFTER (NOTE TO INTERVIEWER: COULD BE PARTICIPATION IN MULTIPLE PROGRAMS OR PARTICIPATION COULD HAVE TAKEN A LONGER TIME)

98. DON'T KNOW

We're just about done. We have a couple more questions about your household. Please be assured we will not reveal your individual answers to AEP Ohio or anyone else.

Demographics

D1. Which of the following best describes your home/residence? PLEASE SELECT ONE RESPONSE.

8. Single-family home, detached construction [NOT A DUPLEX, TOWNHOME, OR APARTMENT; ATTACHED GARAGE IS OK]
9. Single family home, factory manufactured/modular
10. Single family, mobile home
11. Row House
12. Two or Three family attached residence
13. Apartment (4 + families)---
14. Condominium

97. Other (specify)
98 DON'T KNOW

D1A. Do you own or rent this residence?

1. Own
2. Rent
98. DON'T KNOW

D2. How many square feet of conditioned living space is below- ground (IF NECESSARY, THIS INCLUDES WALK-OUT BASEMENTS)

NUMERICAL OPEN END [RANGE 0-99,999]
98. DON'T KNOW

D3. Finally, is there anything you would like us to know about the program?
[RECORD OPEN END RESPONSE]
96. Nothing
99. Don't Know

END. Those are all the questions we have. On behalf of AEP Ohio, like to thank you very much for taking the time to participate in this study.

A.3 Program Staff Interview Guide

Statement of Purpose: This interview guide will be used by the evaluation team to identify key program issues

Sample size: 2

Survey timeline: October – November 2016

Topic Area	Topic Objective
Roles and Responsibilities	Understand internal staff structure and identify key staff
Program Implementation and Delivery	Understand the program goals, activities, and detailed objectives; identify any changes the program has implemented; identify any upcoming changes to program delivery.
Marketing and Outreach	Understand ongoing marketing strategies.
Program Tracking	Understand program data tracking and QA/QC procedures.
Other	Miscellaneous and wrap-up questions.

Introduction

Thank you for talking with me today about the In-Home Energy Program. The goal of this discussion is to understand the roles and responsibilities of staff involved in the program, and to talk more fully about the way this program was designed and implemented. All comments will remain confidential.

Roles and Responsibilities

1. Please briefly summarize your role in the In-Home Audit program. *[Probe for main responsibilities, length of time with program, and percent of time dedicated to the program]*
2. Who are the key staff involved in the program's implementation? *[Probe for an understanding of each person's role]*
3. Have your roles and responsibilities for the program changed over the past year?
4. What activities does each individual complete on a day-to-day basis? *[Probe for an understanding of each person's role]*
5. Who is your main contact at [AEP Ohio / the implementation contractor firm]? *[Probe for details on this person's role, how often they communicate, and any issues with relationship.]*
6. Besides funding and staff resources, are there other resources invested in the program?

Program Implementation and Delivery

1. Please describe the main components of the program. *[Confirm current understanding of the program components. Probe for as many details as possible regarding the following components as necessary.]*

2. 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.]*
3. How successful is the program so far in achieving these goals? *[Ask about each individual goal.]*
4. We know that you switched implementation contractors this year. Can you talk about that process and the reasons behind the change?
5. Did you make any other changes to the program in 2016? *[If not mentioned, ask about changes to customer/contractor participation process, trade ally participation process, and updates to program documents.]*
6. What were the reasons for those changes?
7. What effects have you seen from those changes so far? *[Probe about effects on participation rates and contractor/customer satisfaction]*
8. Have those changes affected participation rates or customer/contractor satisfaction? Is AEP Ohio doing anything to measure satisfaction changes?
9. Are you satisfied with program participation and enthusiasm in terms of numbers?
10. [AEP Ohio staff only] What are future plans for the program? *[Probe for details about specific components of the program, changes to implementation, or goals.]*
11. Where do you see room for improvements in the program? *[Probe for specific areas of improvement for customer/contractor participation process.]*

Marketing and Outreach

1. What marketing strategies does the program currently use? *[Confirm current understanding of marketing strategies. Probe for details on any additional strategies not listed below.]*
2. Has the program marketing strategy changed since the program started? *[Probe about marketing strategy changes that occurred in 2016 and the reasoning behind these changes.]*
3. What outreach mechanisms were most effective at increasing awareness of the program in 2016?

Program Tracking

1. What data does the implementation contractor provide? *[Probe about frequency and specific metrics tracked by CLEAResult.]*
2. What sort of performance metrics do you track for each component of the program? *[Probe for details about specific components of the program.]*
3. How often do you receive this performance data from CLEAResult? / How often do you provide this performance to AEP Ohio? *[Probe for whether the format is actionable, effective, or needs improvement.]*
4. What data quality assurance and control procedures do you implement to ensure the data is accurate? *[Probe for whether these are consistently implemented]*
5. What changes have you made to the data collection and tracking process in 2016?

6. What challenges have there been with the CAKE rebate processing system? What feedback have you received from contractors?
7. Do you track customer rebate application flaws? If so, can you please send us a report? What are the most common application flaws? What actions are you taking (or have taken) for minimize them?

Other

Miscellaneous and wrap-up questions.

1. From your standpoint, what questions are most important for us to answer through our evaluation?
2. Is there anything I didn't ask about that you would like to add?
3. Are there any additional people we should speak with who may have pertinent information about the program?

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?

A.4 Installation Contractor Interview Guide

Statement of purpose: These in-depth interviews will be used by the evaluation team to determine satisfaction and program perceptions among participating contractors.

Sample size: 10

Survey timeline: March 2017

Topic Area	Topic Objective
Introduction	Introduce evaluation and reasons for calling.
Program Characteristics and Barriers	Understand contractor satisfaction of program components, overall satisfaction and program feedback, customer barriers to participation, and areas for improvement.
Program Administration and Delivery	Understand audit-to-rebate conversion rates, understand QA/QC process, and explore IC switch.
Marketing and Participation	Understand effectiveness of program marketing efforts.
Conclusion	Wrap-up.

Introduction

Hello, my name is _____ with Navigant Consulting calling on behalf of AEP Ohio, regarding your participation in the In-Home Energy Program. I am interviewing trade allies to learn about their experiences and satisfaction with the program. May I please speak with [TITLE/NAME]? This interview should take about 15 – 20 minutes of your time.

[IF NOT AVAILABLE, SCHEDULE TIME TO CALL BACK]

Introduction

1. How long have you been involved with the In-Home Energy Program?
2. How did you first learn about the In-Home Energy Program?

Program Characteristics and Barriers

3. Overall, how satisfied are you with the In-Home Energy Program? (On a scale of 1 to 10, where 1 is not satisfied at all and 10 being extremely satisfied)
4. How satisfied are you with the submittal and payment process [probe about rebate application forms, audit/assessment verification forms, electronic funds transfer vs. check]? (On a scale of 1 to 10, where 1 is not satisfied at all and 10 being extremely satisfied)
5. How satisfied are you with the CAKE system? (On a scale of 1 to 10, where 1 is not satisfied at all and 10 being extremely satisfied)
6. What do you see as the main benefits of the In-Home Energy Program for companies like yours? What are the drawbacks?

7. What types of feedback about the program do you receive from customers?
8. What do you think are the main barriers for customers to participate in the program? Why is that?
9. What improvements could the program make that would make it easier for you to participate?
10. Have you participated in other AEP Ohio energy efficiency programs? Name the programs if any.
11. Have you participated in other utility programs? Which utilities?

Program Administration and Delivery

12. How much of your current work is through the In-Home Energy Program [prompt for a percentage]?
13. After an Audit/Assessment was performed, what percentage do you end up returning to install energy efficient measures? [Probe for specific types of measures with high or low conversion rates]
14. Which type of measures? (Refer Question 2)
15. Have any of your projects received a quality assurance field inspection from the In-Home Energy Staff?
    a. If yes, did you receive any feedback from program staff after the inspection? Did that feedback lead you to make any changes in your installation of energy efficiency measures?
16. How satisfied are you with CLEAResult as an implementation contractor? (On a scale of 1 to 10, where 1 is not satisfied at all and 10 being extremely satisfied)

Marketing and Participation

17. Do you think the program's marketing efforts have been successful at reaching the right audience? How so?
18. How could the program help you sell your services to customers?

Conclusion

19. In closing, do you have any last thoughts on any aspects of the program, insights or lessons learned that would help improve it, or that would make participation in the program more compelling for you and other contractors?

APPENDIX F

Community Assistance Program

2016 Evaluation Report

Prepared for:

AEP Ohio

A unit of American Electric Power

May 1, 2017

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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, 2016 through December 31, 2016. 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 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 use for residential low-income customers by installing a range of cost-effective weatherization upgrades and energy efficiency measures in eligible dwellings. In 2016, the program was administered by AEP Ohio through 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 Impact Evaluation Findings and Recommendations

The program reported *ex ante* 10,120 MWh of energy savings and 0.98 MW of demand savings in 2016. The verified (*ex post*) energy and demand savings for 2016 were 9,085 MWh and 1.23 MW. *Ex post* energy savings did not meet the program goal of 10,847 MWh, while the *ex post* demand savings goal of 1.07 MW was exceeded, as shown in Table ES-1. The realization rates were 90 percent for energy and 125 percent for peak demand savings. The lower energy savings realization rate is largely due to Navigant implementing an in-service rate (ISR) (calculated from data collected during on-site visits) for the following measures: refrigerators, freezers, CFLs, showerheads, attic insulation, pipe insulation, smart strips, and faucet aerators. The discrepancy between *ex ante* and *ex post* peak demand is largely due to AEP Ohio claiming fewer savings than allowed in the Draft 2010 Ohio Technical Reference Manual (TRM) for refrigerators.

Table ES-1. Savings Estimates for 2016 Community Assistance Program

	2016 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)	10,847	10,120	9,085	90%	84%
Demand Savings (MW)	1.07	0.98	1.23	125%	115%

Note: [1] AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.

1. **Finding 1:** AEP Ohio claims slightly lower demand savings than what is specified in the Ohio TRM for refrigerators and freezers.

- **Impact Recommendation 1:** Update unit demand savings for refrigerators and freezers to align with the Ohio TRM.

2. **Finding 2:** AEP Ohio calculates low-flow showerhead savings using an equation provided by Navigant in 2009.

    - **Impact Recommendation 2:** Follow the Draft 2010 Ohio TRM equations to calculate both energy and demand savings for low-flow showerheads.

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.

    - **Impact Recommendation 3:** To calculates 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.

ES.3 Key Process Evaluation Findings and Recommendations

The process evaluation objectives included documenting program processes and tracking efforts, as well as identifying and recommending potential program improvements. The data collection approach for the process evaluation included in-depth interviews with AEP Ohio program staff, the program administrator, and community-based agencies. The EM&V team gathered information on the community-based agencies' performance during onsite visits.

4. **Finding 1:** Detailed measure information, such as post system efficiency, SEER, EER, blower door readings, and R-values, are not consistently entered into the tracking system.

    - **Process Recommendation 1:** Provide additional agency training on how to identify detailed measure information. Training should focus on recording R-values prior to installation and details information about efficiency measures.

5. **Finding 2:** The evaluation team found the in-service rates (ISRs) for Compact Fluorescent Lamps (CFLs) decreased by 10 percent from 2015, to 76 percent.

    - **Process Recommendation 2:** Monitor the ISR for LED light bulbs compared to the 2016 ISR for CFLs.[1] If the ISR for LED light bulbs does not increase, identify if and whether there are any aspects of program delivery that could be improved.

6. **Finding 3:** Agencies reported some refrigerators were poor quality and the one-year warranty was insufficient. AEP Ohio is exploring purchasing refrigerators in bulk to obtain higher quality refrigerators at a price point that is reasonable for cost-effectiveness.

[1] AEP Ohio switched to LED light bulbs in 2017 and is no longer offering CFLs.

- **Process Recommendation 3:** Pursue the bulk purchasing option to obtain higher quality refrigerators at a cost-effective price. Monitor the quality of refrigerators bought through the bulk purchasing process.

7. **Finding 4:** Some agencies are currently having success installing weatherization measures cost effectively. However, several agencies indicated they need more training on how to incorporate weatherization measures into their offerings and how to promote the installation of more weatherization measures in a cost-effective manner.

    - **Process Recommendation 4:** Provide additional training on weatherization measures based on what successful agencies do as an example. Agencies should explore using multiple funding sources for their weatherization projects.

    Finding 5: The evaluation team identified agencies do not have a uniform way to record CAP participants' questions and program input.

    - **Process Recommendation 5:** AEP Ohio is going to utilize an online option to gather customer feedback. AEP Ohio can then use the online option to gather participant feedback on ways to improve the program.

8. **Finding 6:** Agencies reported many homes need health and safety upgrades before energy efficiency services can be performed. Agencies stated current CAP funds are not able to be used to address health and safety upgrades. As a result, some homes are not serviced by CAP due to the need to first address health and safety upgrades.

    - **Process Recommendation 6:** Agencies should explore all sources of funding for health and safety upgrades. The Home Weatherization Assistance Program (HWAP) and Low Income Home Energy Assistance Program (LIHEAP) are two programs that provide funding for health and safety upgrades.

9. **Finding 7:** 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.

    - **Process Recommendation 7:** 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.

1. INTRODUCTION

1.1 Program Overview

In 2016, the CAP was administered by AEP Ohio through a network of local community-based agencies (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.

1.1.1 Implementation Strategy

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.

1.1.2 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 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.

1.1.3 Roles of the Agencies

In 2016, AEP Ohio contracted with numerous local community-based agencies to conduct weatherization services and energy-efficient measure installations. The agencies receive their training from the OWTC. The agencies are contracted to be in compliance with insurance liability and federal law.

1.1.4 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 community-based agencies may, however, 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 identify ways in which the program can be improved, and (3) determine program cost-effectiveness. 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 for a sample of 71 participants.

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? Are these consistently maintained? Do these 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 2016 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 2016 evaluation plan and a review of the key outcomes of the 2015 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 2017
In-Depth Telephone Interview	AEP Ohio Program Coordinator	Contact from AEP Ohio	Census	2	March 2017
Onsite Field Surveys	Program Participants	Tracking Database	Random Sample	85	November to December 2016
Community-Based Agencies Telephone Surveys	Program Participants	Tracking Database	Random Sample	5	February 2017

2.2 Onsite Verifications

Navigant conducted onsite field verification visits to a sample of 85 projects during the months of November and December 2016. Navigant used a stratified random sample from the population of program participants in the 2016 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, Navigant 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 installation rate. Where discrepancies were identified in the type or quantity of measures, the field engineer attempted to gather information from the participant regarding the reason(s) for such discrepancies.

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 evaluator 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

Table 2-1 lists the data collection activities conducted for the evaluation. An in-depth interview with program staff members was conducted by telephone in March 2017. 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 objectives of the interviews were to explore the measure installation procedures and the quality control actions conducted

by agencies. Questions about program communications, the tracking system, and program delivery were also asked. 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

Navigant reviewed all program materials provided by AEP Ohio for 2016 and conducted a review of best practices for implementing residential low-income programs. A summary list of program materials reviewed for this report includes:

- Tracking data
- Impact algorithms and assumptions
- Implementation plans
- Operation manuals

3. PROGRAM LEVEL RESULTS

3.1 Impact Evaluation

This section provides a detailed description of impact findings for the 2016 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 2016 realization rates. Using the engineering algorithms, Navigant confirmed the CAP reported *ex ante* 10,120 MWh of energy savings and 0.98 MW of demand savings in 2016. The verified (*ex post*) energy and demand savings for 2016 were 9,085 MWh and 1.23 MW. *Ex post* energy savings did not meet the program goal of 10,874 MWh, while the *ex post* demand savings goal of 1.07 MW was exceeded. The realization rates were 90 percent for energy and 125 percent for demand. AEP Ohio assumes an ISR of 1.0 for all measures aside from CFLs, largely driving the discrepancy in energy savings. The discrepancy in demand savings appears to be due largely to the savings claimed for the refrigerator and freezer measures. AEP Ohio is claiming fewer savings than what is outlined in the Draft 2010 Ohio TRM.

Table 3-1. Savings Estimates for 2016 Community Assistance Program

	2016 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)	10,847	10,120	9,085	90%	84%
Demand Savings (MW)	1.07	0.98	1.23	125%	115%

Note: [1] Program goals from AEP Ohio Volume 1: 2012 to 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.

3.1.2 Ex Post Savings Evaluation

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 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.

Navigant's algorithm review found the energy and demand savings algorithms were constructed properly, although AEP Ohio could not provide inputs for some of the parameters outlined in the Draft 2010 Ohio TRM. 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 erroneous data.

3.1.3 Tracking Systems

The tracking system accurately gathers data on installed measures reported by the agencies. Navigant's review of the tracking system revealed more detailed measure information (SEER, EER, pre and post R values, blower door results) often is missing. Reporting of this detailed measure information will improve the accuracy of the reported savings. A survey of agencies indicated they could use more training to understand how to enter such detailed measure information. The evaluator 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 85 onsite visits to 2016 participant's homes to verify if the 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 for 2015 and 2016. The evaluation team applied the 2016 ISRs to the verified energy and demand savings. The ISRs for CFLs, faucet aerators, and low-flow showerheads decreased from 2015 to 2016. The 10 percent decrease in CFL ISR is a significant driver of program realization rate differences between the 2015 and 2016 studies.

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

Measure	Number of Claimed Units (a)	Number of Verified Installed Units (b)	In-Service Rate 2016 ISR = (b) / (a)	In-Service Rate 2015
CFLs	821	620	76%	86%
Low-Flow Showerhead	17	14	82%	100%
Faucet Aerator	14	9	64%	88%
Refrigerators	55	55	100%	100%
Freezer	23	23	100%	100%
Attic Insulation per Foot Installed	22,248	22,248	100%	N/A
Pipe Insulation per Foot Installed	8	7	88%	N/A
Smart Strips	18	14	78%	N/A

3.1.5 Per Measure Savings

The evaluation team adjusted AEP Ohio's *ex ante* savings based on the ISRs per measure determined from the onsite verification visits. Table 3-3 presents the energy savings for each measure. Table 3-4 presents the demand savings for each measure. The vast majority of energy and demand savings (between 75% to 80%) come from CFLs and refrigerator replacement.

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	4,621	4,621	4,510.1	4,510.1	1.00	49.6%
CFL	89,181	67,778	2,838.9	2,274.7	0.80	25.0%
Freezer Replacement	1,321	1,321	1,380.4	1,165.4	0.84	12.8%
Attic-Roof-Ceiling Insulation (per home retrofitted)	408	408	560.2	360.9	0.64	4.0%
Smart Strip	3,213	2,506	263.5	199.6	0.76	2.2%
Air Sealing (per home retrofitted)	92	92	172.2	103.6	0.60	1.1%
Showerhead	1,850	1,517	94.8	97.0	1.02	1.1%
Water Pipe Insulation	3,286	2,892	53.7	96.6	1.80	1.1%
Wall Insulation (per home retrofitted)	81	81	64.0	64.2	1.00	0.7%
Air Source Heat Pump	38	38	8.2	54.3	6.63	0.6%
Water Heat Replacement	126	126	44.0	44.0	1.00	0.5%
Duct Sealing (per home retrofitted)	26	26	41.8	41.8	1.00	0.5%
Faucet Aerator	1,791	1,146	43.8	28.0	0.64	0.3%
Hot Water Wrap	218	218	17.0	17.0	1.00	0.2%
Other	N/A	N/A	11.8	11.8	1.00	0.1%
Refrigerator Retirement	7	7	9.6	9.6	1.00	0.1%
Freezer Retirement	3	3	3.7	3.7	1.00	0.0%
Air Conditioner Replacement	10	10	2.0	2.0	1.00	0.0%
Tank Temperature Setback	2	2	0.3	0.3	1.00	0.0%
Total			10,120	9,085	0.90	-

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	0.3004	0.7209	2.40	59%
CFL	0.4108	0.2453	0.60	20%
Freezer Replacement	0.1822	0.1782	0.98	15%
Smart Strip	0.0000	0.0229	N/A	2%
Water Pipe Insulation	0.0061	0.0110	1.80	1%
Showerhead	0.0439	0.0109	0.25	1%
Air Source Heat Pump	0.0043	0.0100	2.32	1%
Attic-Roof-Ceiling Insulation	0.0120	0.0069	0.57	1%
Duct Sealing	0.0056	0.0056	1.00	0%
Faucet Aerator	0.0055	0.0035	0.64	0%
Wall Insulation	0.0024	0.0020	0.83	0%
Hot Water Wrap	0.0019	0.0019	1.00	0%
Water Heater Replacement	0.0017	0.0017	1.00	0%
Refrigerator Retirement	0.0014	0.0015	1.08	0%
Air Sealing	0.0015	0.0014	0.95	0%
Other	0.0011	0.0011	1.00	0%
Freezer Retirement	0.0004	0.0006	1.48	0%
Air Conditioner Replacement	0.0002	0.0002	1.00	0%
Total	0.9815	1.2257	1.25	100%

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

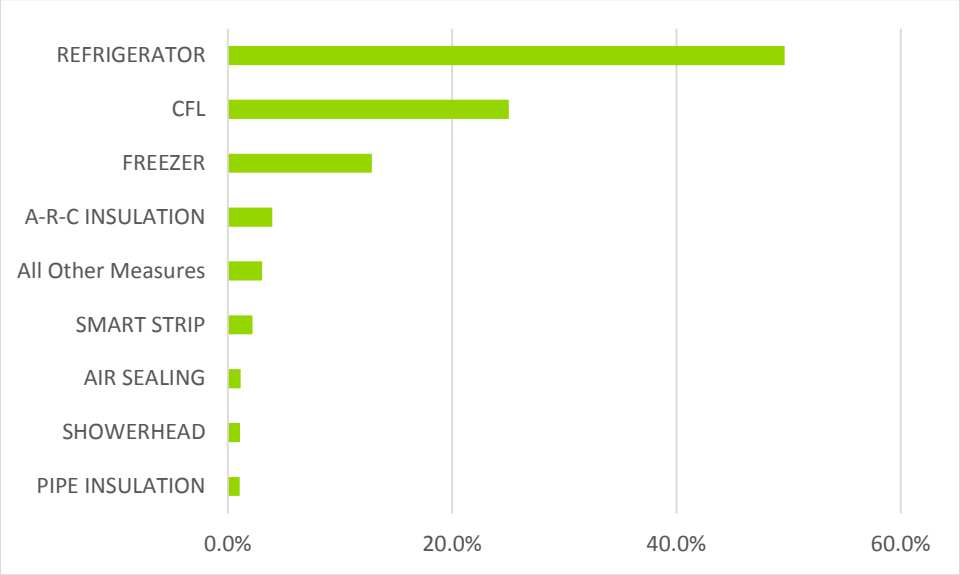
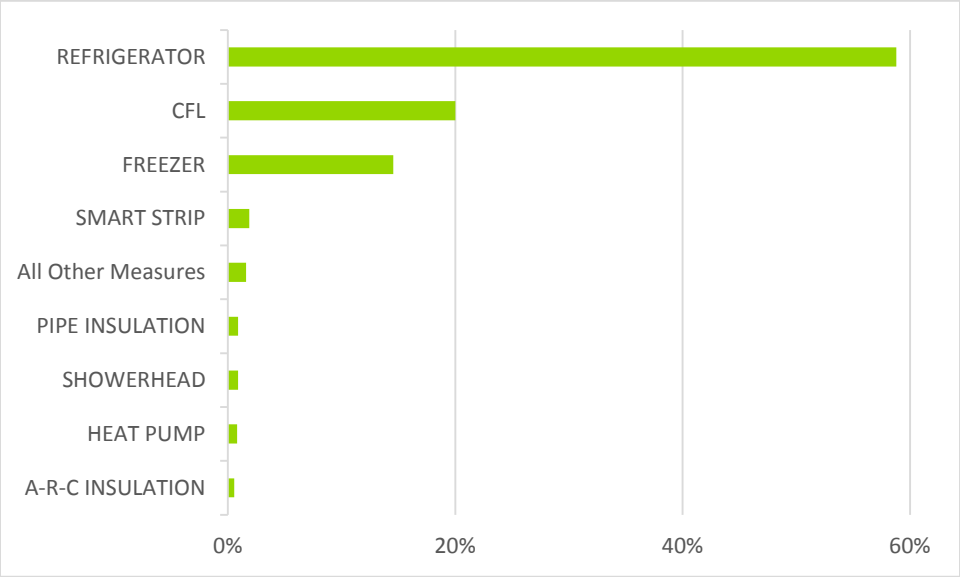


Figure 3-2. Percentage of Demand Savings by Measure



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 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. Efficiency of installed rebated equipment has increased over time, while the 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 CFLs

The Navigant team used a combination of equations from the Draft 2010 Ohio TRM, the installation rate collected from onsite visits, and CFL wattages in order to calculate savings for CFLs. The Draft 2010 Ohio TRM equations are shown in Equation 3 and Equation 4. The delta watts multiplier is specified in Table 3-6; Table 3-7 shows the values of the key parameters.

Equation 3. Draft 2010 Ohio TRM-Specified Energy Savings for CFLs

*ΔkWh = ((ΔWatts) /1000) * ISR * HOURS * WHFe*
Where: *ΔWatts = Compact Fluorescent Watts * Delta Watts Multiplier*

Equation 4. Draft 2010 Ohio TRM-Specified Demand Savings for CFLs

*ΔkW = ((ΔWatts) /1000) * ISR * WHFd * CF*
Where: *ΔWatts = Compact Fluorescent Watts * Delta Watts Multiplier*

Table 3-6. Delta Watts Multiplier

CFL Wattage	2009–2011	2012	2013	2014 and Beyond
15 or less	3.25	3.25	3.25	2.05
16–20	3.25	3.25	2.00	2.00
21 or greater	3.25	2.06	2.06	2.06

Source: State of Ohio Draft Technical Reference Manual (2010)

Table 3-7. Key Parameters for CFLs

Parameter Description	Parameter	Value	Source
Average Hours of Use per Year	HOURs	1,040	Draft 2010 Ohio TRM
Waste Heat Factor for Energy	WHFe	1.07	Draft 2010 Ohio TRM
Waste Heat Factor for Demand	WHFd	1.21	Draft 2010 Ohio TRM
Summer Peak Coincidence Factor	CF	0.11	Draft 2010 Ohio TRM
Change in CFL Watts	Delta Watts	Varies by size	Draft 2010 Ohio TRM
In-Service Rate	ISR	76%	Onsite Visits

The Navigant team used the 2014 delta watts multiplier with a baseline delay of one year, which is supported by AEP Ohio's shelf surveys and is the same value recommended in the Energy Independence and Security Act of 2007 (EISA). The EISA delta watts multiplier now applies to all standard CFL wattages.

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 database in order to calculate savings for this measure. The attic-roof-ceiling 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, but has rolled up savings to present category level summary realization rates.

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

*Air Conditioning Savings: ΔkWh = ((1/Rexist – 1/Rnew) * CDH * DUA * Area) / 1000 / ηCool*
*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

*ΔkW = ΔkWh / FLHcool *CF*

Table 3-8. 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 was 64 percent for energy savings and 57 percent for demand savings. The savings discrepancy is partially caused by Navigant using Rexist and Rnew values from the tracking data for all applicable measures. In some cases, AEP Ohio used proper Rexist and Rnew values but did not include the discretionary use adjustment factor of 0.75 in the calculation, leading to a 75% realization rate for the cooling savings on these 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 3-9. 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

The energy savings realization rate is 1.00 for both refrigerators and freezers. The demand realization rate is 1.08 for refrigerators and 1.48 for freezers. This is because AEP Ohio claims slightly lower demand savings than what is specified in the Draft 2010 Ohio TRM, 0.199 for freezers and 0.203 for refrigerators.

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 3-10) 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 2.40 for demand. It is unclear to Navigant why AEP Ohio is using a much lower kW unit savings than what is specified in the Draft 2010 Ohio TRM.

Table 3-10. 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*
LSAFexist = Load Shape Adjustment Factor for existing unit = 1.074
LSAFnew = 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 0.98. 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[2]

kWh for remaining life of existing unit (1st 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) * 173*
Where: *GPMlow = 2.5*

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

*ΔkW = ΔkWh/Hours * CF*

AEP Ohio calculates savings using an equation provided by Navigant in 2009, which resulted in an energy realization rate of 1.25 for homes with electric water heating before applying the ISR. The demand realization rate was 0.30 for homes with electric water heating before applying the ISR. AEP Ohio calculates demand savings using an equation provided by Navigant in 2009. Using the 51.3 kWh unit savings and the kW calculation from the Draft 2010 Ohio TRM should result in demand savings of 0.006 kW. AEP Ohio is claiming demand savings of 0.0238 kW.

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 0.64 for energy, and 0.64 for demand. AEP Ohio and Navigant calculated savings using the following equations from the 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*

The lower realization rates for energy and demand are caused entirely by Navigant applying an ISR of 0.64 based on the findings of the onsite visits.

[2] 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

3.1.13 Energy and Demand Savings Calculations for Air Sealing

Air sealing savings realization rates are 0.60 for energy, and 0.95 for demand. AEP Ohio and 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

$$\text{Annual Cooling kWh Savings} = (((CFM50Exist - CFM50New) / N\text{-}Factor) * 60 * CDH * 0.0135) / 1000 / \eta Cool$$

$$\text{kWh Savings (electric heating)} = ((((CFM50Exist - CFM50New) / N\text{-}factor) * 60 * 24 * HDD * 0.018) / 1{,}000{,}000 / COP) * 293.1$$

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

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

Table 3-11. 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).

Navigant and AEP Ohio both assumed CFM50exist-CFM50new was equal to the invoice quantity in the database. CFM50exist and CFL50new are fields in the tracking database, though most often the entries for these fields were missing or unreasonable. Navigant did not find evidence that the invoice quantity corresponds to readings taken from an accurate blower door test. AEP Ohio assumed an N-factor of 17.8 for the electric heating portion of savings, while Navigant used 29.4. The Ohio TRM supports the 29.4 value based on a Lawerence 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 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 Wall Insulation

The energy savings realization rate for this measure was 1.00 and the demand savings realization rate was 0.83. Navigant utilized the Draft 2010 Ohio TRM to calculate savings for wall insulation. Much like with attic-roof-ceiling insulation, Navigant attributes the realization rate discrepancy to the use of Rnew and Rexist values from the tracking database and the discretionary use adjustment factor.

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

*Air conditioning Savings Annual kWh Savings = ((1/Rexist – 1/Rnew) * CDH * DUA * Area) / 1000 / ηCool*

*Annual kWh Savings (electric heating) = (((1/Rexist – 1/Rnew) * HDD * 24 * Area) / 1,000,000 / COP) * 293.1*

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

*Summer Coincident Peak kW Savings = ΔkWh / FLHcool * 0.5*

Table 3-12. Key Parameters for Wall Insulation

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
Square footage of insulated area	Area	Varies	Measure Quantity (Actual)
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

3.1.16 Energy and Demand Savings Calculations for Pipe Insulation

The energy and demand savings realization rates for this measure both were 180 percent. Navigant used equations from the Ohio 2010 Draft 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 20. Draft 2010 Ohio TRM-Specified Energy Savings for Pipe Insulation

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

Equation 21. Draft 2010 Ohio TRM-Specified Demand Savings for Pipe Insulation

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

Table 3-13. Key Parameters for Pipe Insulation

Parameter Description	Parameter	Value	Source
Pipe Heat Loss Coefficient of Uninsulated Pipe	Rexist	1	Ohio 2010 Draft 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	Ohio 2010 Draft TRM
Recovery Efficiency of Electric Hot Water Heater	ηDHW	0.98	Ohio 2010 Draft TRM

3.1.17 Energy and Demand Savings Calculations for Smart Strips

The energy savings realization rate for this measure was 97 percent before applying the ISR. AEP Ohio claims no demand savings for this measure, thus a demand savings realization rate is not applicable. Navigant 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 being distributed.

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 3-14. 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

3.1.18 CAP installed measure for non-AEP Ohio customers

For 176 different homes, and over 600 measures were installed by CAP for non-AEP Ohio customers, for which the program claims no savings. The primary reason for measures being installed in non-AEP Ohio customer's homes is that the data entry system does not check if the customer is an AEP Ohio customer. Once the measures are installed and the payment to the implementer is made, it is difficult to correct the payment transaction.

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, and the agencies.

3.2.1 Installation Verification and Quality Control

The agencies stated an audit is conducted of the participant's home to identify the measures needed, and then the agency schedules a time to install measures that need to be ordered. Once the installations are complete, the agencies then report the audit results. Some of these 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. During the audit, the agencies ask the customer which light bulbs are most used in their home to correctly identify bulbs that should be replaced.

All agencies reported their staff train at the OWTC. Agencies reported that there are not enough opportunities to train their staff at the OWTC. With the increased amount of certification requirements for agency workers, it is difficult to maintain a certified crew.

When surveyed, one agency said more guidance about weatherization methods could help the agencies make weatherization cost-effective. Several CAP agencies are installing weatherization measures cost effectively while other agencies are unsure how to install weatherization measures cost-effectively. The

agencies that are able to install weatherization methods cost effectively use the Ohio Development Services Agency's Excel spreadsheet which indicates how to split the costs of weatherization measures and labor between multiple funding sources.

The Ohio Development Services Agency has encouraged the use of multiple weatherization programs to complete weatherization upgrades for homes. The use of multiple weatherization programs can make the weatherization measures and their installation more cost-effective for agencies.

3.2.1.1 CFL In-Service Rate

The evaluation team determined that the ISR for CFLs decreased by 10 percent from last year's (2015) result of 86 percent to 76 percent. The 76 percent ISR for CFLs is similar to prior years, except for last year's 86 percent.

The evaluation team continues to find uninstalled CFLs in boxes left at participants' homes. This issue could be due to a disconnect in messaging from the higher management at the agency and the person installing the equipment. Starting in 2017, the program only will offer LED light bulbs.

3.2.2 Customer and Agency Satisfaction

The agencies reported high program satisfaction from customers and for their organization. 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. Agencies reported what customers like most about CAP is the amount of improvements they receive through the program.

3.2.3 Communication

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-realted 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 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 2017 through 2020 agency contract for CAP requires 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 Enrollment Process

Of the five agency interviews, there was a split in how agencies enroll participants in the program. Three of the agencies reported using the information of those who have enrolled in the Percentage of Income Payment Plan (PIPP) and Home Energy Assistance Programs (HEAP) as a guide for potential eligible customers. The other two agencies said their customers hear about the program by word of mouth and come to them seeking to enroll.

The agencies reported many of the homes need health and safety upgrades before energy efficiency upgrades can be performed. Agencies stated current CAP funds usually are not able to address the needed health and safety upgrades. As a result, some homes are not serviced by CAP due to the need to first address health and safety upgrades.

3.2.5 Agency Perception of the CC Tracking System

The agencies stated the tracking system captures the needed program information. Several agencies mentioned more training is needed to understand what information should be collected for tracking purposes. Agencies said they need training on how to record pre and post system efficiency, SEER, EER, and R-values. The training should be focused on recording the R-values prior to installation and the replaced equipment information.

Agencies also stated it was frustrating not being able to remove incorrect customer information and that once a customer was entered into the system, it could not be removed.

3.3 Cost Effectiveness Review

This section addresses program cost-effectiveness. The cost effectiveness of CAP is assessed through the use of the Total Resource Cost (TRC) test. Table 3-15 summarizes the unique inputs used in the TRC test.

Table 3-15. Inputs to Cost-Effectiveness Model for CAP Program

Item	Value
Average Measure Life	15
Residences	6,936
Annual Energy Savings (kWh)	9,084,558
Coincident Peak Savings (kW)	1,225.662
Third Party Implementation Costs	$1,248,604
Utility Administration Costs	$958,016
Utility Incentive Costs	$7,006,671
Participant Contribution to Incremental Measure Costs	$0

Based on these inputs, the TRC ratio is 0.7. 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 3-16. Cost Effectiveness Results for CAP Program

Test Results	B/enefit-Cost Ratio
Total Resource Cost	0.7
Participant Cost Test	N/A
Ratepayer Impact Measure	0.3
Utility Cost Test	0.7

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* 10,120 MWh of energy savings and 0.98 MW of demand savings in 2016. The verified (*ex post*) energy and demand savings for 2016 were 9,085 MWh and 1.23 MW. *Ex post* energy savings did not meet the program goal of 10,847 MWh, while the *ex post* demand savings goal of 1.07 MW was exceeded, as shown in Table 4-1. The realization rates were 90 percent for energy and 125 percent for peak demand savings. The lower energy savings realization rate is largely due to Navigant implementing an in-service rate (ISR) (calculated from data collected during on-site visits) for the following measures: refrigerators, freezers, CFLs, showerheads, attic insulation, pipe insulation, smart strips, and faucet aerators. The discrepancy between *ex ante* and *ex post* peak demand is largely due to AEP Ohio claiming fewer savings than allowed in the Draft 2010 Ohio Technical Reference Manual (TRM) for refrigerators.

Table 4-1. Savings Estimates for 2016 Community Assistance Program

	2016 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)	10,847	10,120	9,085	90%	84%
Demand Savings (MW)	1.07	0.98	1.23	125%	115%

Note: [1] AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.

1. **Finding 1:** AEP Ohio claims slightly lower demand savings than what is specified in the Ohio TRM for refrigerators and freezers.

    - **Impact Recommendation #1:** Update unit demand savings for refrigerators and freezers to align with the Ohio TRM.

2. **Finding 2:** AEP Ohio calculates low-flow showerhead savings using an equation provided by Navigant in 2009.

    - **Impact Recommendation #2:** Follow the Draft 2010 Ohio TRM equations to calculate both energy and demand savings for low-flow showerheads.

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.

    - **Impact Recommendation #3:** To calculates 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.

4.2 Key Process Evaluation Findings and Recommendations

The process evaluation objectives included documenting program processes and tracking efforts, as well as identifying and recommending potential program improvements. The data collection approach for the process evaluation included in-depth interviews with AEP Ohio program staff, the program administrator, and community-based agencies. The EM&V team gathered information on the community-based agencies' performance during onsite visits.

4. **Finding 1:** Detailed measure information, such as post system efficiency, SEER, EER, blower door readings, and R-values, are not consistently entered into the tracking system.

    - **Process Recommendation #1:** Provide additional agency training on how to identify detailed measure information. Training should focus on recording R-values prior to installation and details information about efficiency measures.

5. **Finding 2:** The evaluation team found the in-service rates (ISRs) for Compact Fluorescent Lamps (CFLs) decreased by 10 percent from 2015, to 76 percent.

    - **Process Recommendation #2:** Monitor the ISR for LED light bulbs compared to the 2016 ISR for CFLs.[3] If the ISR for LED light bulbs does not increase, identify if and whether there are any aspects of program delivery that could be improved.

6. **Finding 3:** Agencies reported some refrigerators were poor quality and the one-year warranty was insufficient. AEP Ohio is exploring purchasing refrigerators in bulk to obtain higher quality refrigerators at a price point that is reasonable for cost-effectiveness.

    - **Process Recommendation #3:** Pursue the bulk purchasing option to obtain higher quality refrigerators at a cost-effective price. Monitor the quality of refrigerators bought through the bulk purchasing process.

7. **Finding 4:** Some agencies are currently having success installing weatherization measures cost effectively. However, several agencies indicated they need more training on how to incorporate weatherization measures into their offerings and how to promote the installation of more weatherization measures in a cost-effective manner.

    - **Process Recommendation #4:** Provide additional training on weatherization measures based on what successful agencies do as an example. Agencies should explore using multiple sources for their weatherization projects.

8. **Finding 5:** The evaluation team identified agencies do not have a uniform way to record CAP participants' questions and program input. AEP Ohio will soon have an online option to gather customer feedback.

[3] AEP Ohio is switching to LED light bulbs in 2017 and is no longer offering CFLs.

- **Process Recommendation #5:** Use the online option to gather participant feedback on ways to improve the program.

9. **Finding 6:** Agencies reported many homes need health and safety upgrades before energy efficiency services can be performed. Agencies stated current CAP funds are not able to be used to address health and safety upgrades. As a result, some homes are not serviced by CAP due to the need to first address health and safety upgrades.

    - **Process Recommendation #6:** Agencies should explore all sources of funding for health and safety upgrades. The Home Weatherization Assistance Program (HWAP) and Low Income Home Energy Assistance Program (LIHEAP) are two programs that provide funding for health and safety upgrades.

10. **Finding 7:** 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.

    - **Process Recommendation #7:** 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.

Appendix A. 2016 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 2017

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 CFLs?
13. Have these procedures changed in the last year?
14. How do you feel about CFLs 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 2016?
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 conduct the in-depth surveys.

AEP Ohio In-Home Energy Program Participant Survey (Audit/Assessment Recipients)

In-Home Energy 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: CFLs

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)		Quantity	Wattage	Base Type (Pin Based / Screw Based)
1) Kitchen	6) Closet			
2) Living	7) Basement			
3) Bedroom	8) Garage			
4) Bathroom	9) Outdoor			
5) Hall	10) Other			

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 G

EFFICIENCYCRAFTED℠ HOMES PROGRAM

2016 Evaluation Report

Prepared for:

AEP Ohio

A unit of American Electric Power

April 10, 2017

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EXECUTIVE SUMMARY

This report describes the results of an evaluation of the 2016 AEP Ohio EfficiencyCrafted[SM] 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[SM] 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. AEP Ohio collaborates with Columbia Gas to offer a consistent program offering across both territories, though incentive amounts vary based on service territory.

ES.2 Key Impact Findings

Navigant used REM/Rate™ building simulation modeling to verify energy and peak demand savings for the EfficiencyCrafted[SM] 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 15 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* 4,144 MWh of energy savings and 2.5 MW of demand savings for the EfficiencyCrafted[SM] New Homes Program in 2016. The *ex post* energy and demand savings for 2016 were 4,144 MWh and 2.5 MW. These savings exceeded the program goals, as shown in Table ES-1. The realization rates were 100 percent for energy savings and 100 percent for peak demand savings.

Table ES-1. Overall Evaluation Results

	2016 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)	1,540	4,144	4,144	100%	269%
Demand Savings (MW)	0.38	2.5	2.5	100%	651%

Note: AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.

[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[SM] New Homes Program assessed the effectiveness of the program operations and delivery. Navigant's process evaluation was limited to in-depth interviews with program staff and a review of program tracking systems, reports, and marketing materials.

Finding 1: Program Activity. Program participation and energy savings remained consistent with previous years. However, program volume was lower than expected in 2016 due to slow growth in the single-family production home market. To recruit new builders for additional participation, a $100 bonus incentive was offered on the first 20 homes completed through the program in 2016. This promotion was successful in recruiting three new builders to the program in late 2016.

Finding 2: Participation Forecasting. Many program operational decisions are based on forecasts of builder participation. However, these forecasts - based on builder estimates - are inconsistently reliable, and participation has fallen short of outsized expectations over the past few years as a result. While forecasting is inherently difficult, any improvements in the quality of these forecasts will assist in program planning, budgeting and operations.

a. **Recommendation #1:** Participation forecasts could be improved with a data-driven approach, using historical program data and secondary market data to develop a participation forecasting model. A basic method might involve simply discounting builder forecasts using historical data to compare forecasts to actual completions. A more sophisticated regression model could be developed with publicly available, leading indicators of construction activity. Numerous third-party vendors also supply custom market forecasts.

b. **Recommendation #2:** Consider additional tactics for encouraging builders to improve forecasts. Possible solutions might include:
    - Sharing statistics with each builder on their estimated versus actual completions the previous year, compared to the program-average. This could be included with an annual and/or quarterly request for updated forecasts, conducted through web or email survey.
    - Use these statistics in combination with educational information on best-practice tips and/or tools for forecasting participation. For instance, the construction activity forecasting model results in Recommendation #1 could be shared with participants as an additional program benefit.

c. **Recommendation #3:** As discussed in the 2015 Evaluation Report, some builders neglect to submit the site enrollment form that helps the program track and forecast participation. While strict enforcement of this policy may be difficult and/or unfavorable for builders, an online reservation system (instead of email) may improve compliance.

d. **Recommendation #4:** Consider tactics for incentivizing the use of the site enrollment process. For instance, provide a small portion of the incentive (e.g. $25) up front to acknowledge the administrative burden of the site submittal process. Once the home is completed, the remainder of the incentive would be disbursed per usual. However, if the incentive application is submitted without pre-enrollment, the builder would forego the up-front portion of the expected incentive.

Finding 2: Marketing and Promotion. The program's marketing strategy and tactics remained largely unchanged in 2016. The program was promoted to homebuilders and homebuyers in 2016 through in-person meetings, outreach at industry meetings, and through TV, print and digital advertisements. The

program employed an innovative method of geo-fencing (location based digital marketing) to send targeted ads to potential homebuyers, in real-time, during events.

Finding 3: Data Tracking and Reporting. Data tracking and reporting systems remained unchanged in 2016. Navigant reviewed REM/Rate™ files for a sample of 15 projects for missing information, outliers and compliance with program requirements. The tracking system was well organized and complete and all data needed for evaluation is tracked.

Finding 4: Application and Payment Processing. Incentive application processes remained unchanged in 2016. Navigant completed a review of the incentive processing times entered into the incentive tracking dataset. There was a 35-day decrease in the average incentive processing time in 2016. This apparent decrease in average processing time actually reflects a spike in processing times in 2015 due to difficulties arranging the incentive pre-funding pool early in 2015. These difficulties delayed the average time between application approval and incentive payment in 2015, and skewed the year-end results.

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 "EfficiencyCrafted℠ 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 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 cooperative advertising efforts 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 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)

[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

- Registration and tracking of committed homes, including all pertinent site data and contact information
- 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 2016 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 2016. Table 1-2 shows the incentive levels offered for each performance level, based on the home's HERS score. Each program level is based on specific technical requirements targeted to advance specific construction practices in the AEP Ohio service territory. Incentive amounts are determined by the home's performance as measured by the HERS rating process, which is carried out by HERS raters who inspect homes throughout the building process and upon completion. To recruit new builders, a $100 bonus incentive was offered to new participants for the first 20 homes completed through the program in 2016. This promotion was successful in recruiting four new builders to the program in late 2016.

Table 1-1. Technical Requirement for Program Homes

Technical Requirement	EfficiencyCrafted	EfficiencyCrafted[SM] 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)	95%	95%
All ENERGY STAR® appliances if supplied by builder	√	√

The program collaborated with Columbia Gas of Ohio to offer a consistent program offering across both territories, though incentive amounts vary based on service territory. Table 1-2 presents incentive amounts based on HERS score and home type.

Table 1-2. AEP Ohio Efficiency Crafted Homes Participation Levels and Incentives

	HERS Score Incentive	HERS Score 70-61	HERS Score 60-51	HERS Score 50-0
Columbia Gas/AEP Ohio	EfficiencyCrafted℠ (Single-Family)	$300	$1,225	$1,975
	EfficiencyCrafted℠ Plus (Single-Family)	$375	$1,450	$2,225
AEP Ohio (Non-Electric Heat)	EfficiencyCrafted℠ (Single-Family)	$150	$525	$800
	EfficiencyCrafted℠ Plus (Single-Family)	$175	$650	$950
AEP Ohio (All-Electric Heat)	EfficiencyCrafted℠ (Single-Family)	$200	$850	$1,175
	EfficiencyCrafted℠ Plus (Single-Family)	$300	$950	$1,275
Multi-Single Family Homes	75% per unit of single-family incentives (above)			
Multifamily Homes	Custom incentive per project			

1.4 Evaluation Objectives

The three major objectives of this evaluation are to: 1) quantify energy and summer peak demand savings impacts from the program during 2016; 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. 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. Has the program as implemented changed from 2015? If so, how, why, and was this an advantageous change?
2. 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 2016 evaluation of the EfficiencyCrafted[SM] 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 2016 evaluation plan with AEP Ohio staff and a review of the key outcomes of the 2015 program evaluation.
2. **Tracking Data Review**. The program tracking data collected by the implementation contractor were reviewed.
3. **Review of New Program Documentation**. Reviewed any program documentation that differed from 2015 (e.g., new marketing materials).
4. **Primary Data Collection**. Primary data collection was performed through interviews with program staff and implementers.
5. **Methods Used to Analyze Impact Data**. Key impact parameters for program homes were extracted from REM/Rate[TM] 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

Primary data collection activities were limited in 2016 to in-depth interviews with program staff and implementation contractors. Program staff members were interviewed by telephone in January 2017. 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.

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 2017
	Staff of Program Implementer	Contacts from the Program Implementation Contractor	Program Manager, VP Program Development	2	January 2017

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 claimed savings calculated for a sample of projects using the REM/Rate™ building simulation model. Navigant audited savings through the following steps:

1. Reviewed baseline model characteristics against TRM[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 TRM, 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 2015 impact evaluation sample. Realization rates for this low-rigor 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 a sample size of four file reviews. However, Navigant applied a slightly more conservative CV of 0.20 to ensure sufficient sample for verification and due diligence purposes, resulting in a target sample of 13 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 2016, the number of file reviews completed, and the resulting sampling error. Overall sampling efforts resulted in +/- 9.0 percent precision at a 90 percent level of confidence.

Table 2-2. 2016 File Review Completes and Population-Level Sampling Error

Strata	2016 Strata Population Size (N)	Coefficient of Variation*	Target Completes	Actual Completes (n)	Sampling Error (90% CI)
EfficiencyCrafted[SM] New Homes	1,792	0.2	13	15	9.0%

*Estimated from the results of the 2015 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[SM] New Homes Program.

3.1 Impact Evaluation Findings

3.1.1 Summary of Program Activity

Participation in the EfficiencyCrafted[SM] New Homes Program in 2016 was above Plan forecasts. The program reported 1,792 building projects in 2016, submitted by more than 40 building companies and eight rating companies. The top ten builders accounted for 83 percent of total program savings, while three rating companies accounted for 86 percent of total project volume in 2016. Table 3-1 shows a summary of key impact evaluation metrics over the past four program years.

Table 3-1. Summary of Key Program Activity Metrics

Program Activity Metric	2016	2015	2014	2013
Participation				
Number of Units	1,792	1,842	1,723	2,186
Number of Active Builders	41	35	32	35
Program Market Penetration*	33%	24%	24%	24%
ENERGY STAR Level Penetration**	7%	6%	7%	7%
Energy Savings				
Total *Ex Ante* Savings (MWh)	4,144	4,196	3,815	5,835
Average Savings / Unit (kWh)	2,313	2,278	2,214	2,669
Average Savings / SF (kWh/SF)	0.65	0.66	0.59	0.75
Average HERS Score	57	55	55	59
Incentive Spending				
Average Incentive / Home ($)***	$442	$333	$296	$999
Average Incentive / kWh ($)***	$0.19	$0.15	$0.13	$0.37
Participant Satisfaction (0-10)	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
*** Represents the AEP Ohio portion of the combined incentive.

3.1.2 Summary of Impact Findings

The *ex ante* energy and demand savings for 2016 were 4,144 MWh and 2.5 MW. These savings exceeded the program goals of reducing energy usage by 1,540 MWh and peak demand by 0.38 MW.

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)	2,318	2,291	2,313
Number of Units	1,418	374	1,792
Ex Ante Energy Savings (MWh)	3,287	857	4,144

3.1.4 Audited 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 audited energy savings.

Table 3-3. Ex Post Energy Savings

	EfficiencyCrafted	EfficiencyCrafted℠ Plus	Total or Overall Average
Average Savings/Unit (kWh)	2,318	2,291	2,313
Number of Units	1,418	374	1,792
Ex Ante Energy Savings (MWh)	3,287	857	4,144

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)	1.4	1.3	1.4
Number of Units	1,418	374	1,792
Ex Ante Demand Savings (MW)	2.0	0.5	2.5

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 audited demand savings.

Table 3-5. Ex Post Coincident Demand Savings

s	EfficiencyCrafted℠	EfficiencyCrafted℠ Plus	Total or Overall Average
Average Savings / Unit (kW)	1.4	1.3	1.4
Number of Units	1,418	374	1,792
Ex Post Demand Savings (MW)	2.0	0.5	2.5

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 2016. The realization rates were 100 percent for energy and peak demand savings.

Table 3-6. 2016 Realization Rates

2016 *Ex Ante* Claimed Savings		2016 *Ex Post* Audited Savings		Realization Rates	
MWh	MW	MWh	MW	MWh	MW
4,144	2.5	4,144	2.5	100%	100%

3.2 Process Evaluation Findings

This section presents detailed findings of the process evaluation of the EfficiencyCrafted^{SM} New Homes Program. Navigant's process evaluation for 2016 was limited to in-depth interviews with program staff and review of program materials and tracking data.

3.2.1 Marketing and Promotion

The EfficiencyCrafted^{SM} New Homes Program was promoted to homebuilders in 2016 through in-person meetings with builders, outreach at industry meetings, and through TV, 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^{SM} 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. The program employed an innovative method of geo-fencing (location based digital marketing) to send targeted ads to potential homebuyers, in real-time, during events.

3.2.2 Market Progress

The program implementation contractor tracked market penetration in 2016 by comparing data provided by AEP Ohio on new meters installed in single-family new construction with the number of incentive payments issued. Table 3-7 presents a comparison of program market penetration from 2013 to 2016. While program volume decreased slightly in 2016, so did the number of new meters installed, resulting in an apparent increase in market penetration (33%). However, the decrease in new meters was largely due to the removal of mobile homes and other non-program housing types from the new-meter count.

Table 3-7. Market Penetration Based on Projects Completed in 2016

Description	2016	2015	2014	2013
Number of new projects completed	1,792	1,842	1,723	1,664
Number of new meters installed in new single family homes	5,365	7,533	7,130	6,865
Market penetration of the EfficiencyCrafted^{SM} New Homes Program	33%	24%	24%	24%

3.2.3 Participation Forecasting

Program participation and energy savings have remained largely consistent since 2013, despite significant changes in the market for new homes. This consistency is due to a stable network of contractors who remain committed to the program.

Many program operational decisions are based on forecasts of builder participation. These forecasts - based on builder estimates - are inconsistently reliable, and participation has fallen short of expectations over the past few years as a result. Improving the quality of these forecasts may improve quarterly program planning, budgeting and operations.

3.2.4 Application and Payment Processing

The application and incentive payment processes remained consistent in 2016. Builders submit a PDF Site Submittal Form for each project, which is entered upon receipt by the implementation contractor into its VISION tracking system. Once the HERS rater completes the final inspection of the home, the application form is completed and sent to the implementation contractor, along with the final REM/Rate[TM] file. Once the forms have been reviewed and approved by program staff and AEP Ohio representatives, the incentive is processed and sent to the builder within four to six weeks. Key data needed for evaluation and monitoring program performance are being tracked and reported. The site submittal forms are clear and concise, and data submitted is reviewed at several different levels.

Incentive Processing Time
Navigant completed a review of the incentive processing times entered into the incentive tracking dataset. Table 3-8 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 59 days. Once incentive forms were approved, the average duration for incentive payment was 7 days. Therefore, the total duration between project completion and incentive payment was 65 days on average. This apparent decrease in 2016 processing time largely reflects a spike in processing times in 2015 due to difficulties arranging the incentive pre-funding pool early in 2015. These difficulties delayed the average time between application approval and incentive payment in 2015 and skewed the year-end results.

Table 3-8. Incentive Processing Time (Average Days)

Process	2016	2015	2014	2013
Project Completion to Application Approval	59	78	69	80
Application Approval to Incentive Payment	7	12	4	42
Total Rebate Processing Time	65	90	73	122

3.2.5 Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) processes are well established and remain unchanged from 2015. 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 that the tracking system and REM/Rate[TM] files were in good order.

3.2.6 Tracking and Reporting

There were no major changes to the data tracking processes for the EfficiencyCrafted[SM] New Homes Program in 2016. 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.

A final end-of-year data extract was provided in support of this evaluation by AEP Ohio in February of 20167. The data contained roughly 120 fields and 1,792 unique project entries. REM/Rate[TM] files for a sample of 15 projects were reviewed for missing information, outliers and compliance with program requirements. The tracking system was found to be well organized and complete and all data needed for evaluation is being tracked; however, 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[SM] New Homes Program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. Table 3-9 summarizes the unique inputs used in the TRC test.

Table 3-9. Inputs to Cost-Effectiveness Model for EfficiencyCrafted[SM] New Homes Program

Item	Value
Average Measure Life	25
Units	1,792
Annual Energy Savings (kWh)	4,144,102
Coincident Peak Savings (kW)	2,468
Third Party Implementation Costs	$942,226
Utility Administration Costs	$222,704
Utility Incentive Costs	$697,025
Participant Contribution to Incremental Measure Costs	$3,244,864

Based on these inputs, the TRC ratio is 1.5. Table 3-10 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 3-10. Cost Effectiveness Results for the EfficiencyCrafted[SM] New Homes Program

Test Results	Ratio
Total Resource Cost	1.5
Participant Cost Test	1.4
Ratepayer Impact Measure	0.9
Utility Cost Test	3.6

4. CONCLUSIONS

This section highlights the findings from the impact and process evaluation of the EfficiencyCrafted℠ New Homes Program.

4.1 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 Ohio TRM. 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 15 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.

The EfficiencyCrafted℠ New Homes Program reported *ex ante* 4,144 MWh of energy savings and 2.5 MW of demand savings in 2016. The *ex post* energy and demand savings for 2016 were 4,144 MWh and 2.5 MW. These savings exceeded the program goals as shown in Table 4-1. The realization rates were 100 percent for energy savings and 100 percent for peak demand savings.

Table 4-1. Overall Evaluation Results

	2016 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)	1,540	4,144	4,144	100%	269%
Demand Savings (MW)	0.4	2.5	2.5	100%	651%

Note: AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.

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 was limited to in-depth interviews with program staff and a review of program tracking systems, reports, and marketing materials.

Finding 1: Program Activity. Program participation and energy savings remained consistent with previous years. However, program volume was lower than expected in 2016 due to slow growth in the single-family production home market. To recruit new builders for additional participation, a $100 bonus incentive was offered on the first 20 homes completed through the program in 2016. This promotion was successful in recruiting three new builders to the program in late 2016.

Finding 2: Participation Forecasting. Many program operational decisions are based on forecasts of builder participation. However, these forecasts - based on builder estimates - are inconsistently reliable, and participation has fallen short of outsized expectations over the past few years as a result. While

forecasting is inherently difficult, any improvements in the quality of these forecasts will assist in program planning, budgeting and operations.

e. **Recommendation #1:** Participation forecasts could be improved with a data-driven approach, using historical program data and secondary market data to develop a participation forecasting model. A basic method might involve simply discounting builder forecasts using historical data to compare forecasts to actual completions. A more sophisticated regression model could be developed with publicly available, leading indicators of construction activity. Numerous third-party vendors also supply custom market forecasts.

f. **Recommendation #2:** Consider additional tactics for encouraging builders to improve forecasts. Possible solutions might include:

   - Sharing statistics with each builder on their estimated versus actual completions the previous year, compared to the program-average. This could be included with an annual and/or quarterly request for updated forecasts, conducted through web or email survey.
   - Use these statistics in combination with educational information on best-practice tips and/or tools for forecasting participation. For instance, the construction activity forecasting model results in Recommendation #1 could be shared with participants as an additional program benefit.

g. **Recommendation #3:** As discussed in the 2015 Evaluation Report, some builders neglect to submit the site enrollment form that helps the program track and forecast participation. While strict enforcement of this policy may be difficult and/or unfavorable for builders, an online reservation system (instead of email) may improve compliance.

h. **Recommendation #4:** Consider tactics for incentivizing the use of the site enrollment process. For instance, provide a small portion of the incentive (e.g. $25) up front to acknowledge the administrative burden of the site submittal process. Once the home is completed, the remainder of the incentive would be disbursed per usual. However, if the incentive application is submitted without pre-enrollment, the builder would forego the up-front portion of the expected incentive.

Finding 2: Marketing and Promotion. The program's marketing strategy and tactics remained largely unchanged in 2016. The program was promoted to homebuilders and homebuyers in 2016 through in-person meetings, outreach at industry meetings, and through television, print and digital advertisements. The program employed an innovative method of geo-fencing (location based digital marketing) to send targeted ads to potential homebuyers, in real-time, during events.

Finding 3: Data Tracking and Reporting. Data tracking and reporting systems remained unchanged in 2016. Navigant reviewed REM/Rate files for a sample of 15 projects for missing information, outliers and compliance with program requirements. The tracking system was found to be well organized and complete and all data needed for evaluation is being tracked.

Finding 4: Application and Payment Processing. Incentive application processes remained unchanged in 2016. Navigant completed a review of the incentive processing times entered into the incentive tracking dataset. There was a 35-day decrease in the average incentive processing time in 2016. This apparent decrease in average processing time actually reflects a spike in processing times in 2015 due to difficulties arranging the incentive pre-funding pool early in 2015. These difficulties delayed the average time between application approval and incentive payment in 2015 and skewed the year-end results.

APPENDIX H

Home Energy Report Program

2016 Evaluation Report

Prepared for:

AEP Ohio

A unit of American Electric Power

April 27, 2017

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EXECUTIVE SUMMARY

This document summarizes the 2016 evaluation of AEP Ohio's Home Energy Report (HER) Program. The program has been operating since August 2010, making 2016 the sixth full year in which the program has been in operation. This sixth annual impact evaluation of the program includes estimates of electric energy and demand savings as well as recommendations based on the impact evaluation conducted.

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 2016, 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, and 2016.

- 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, and 2016.

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 2016, 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 (program) household or a control household. Navigant also utilized a Post Program Regression (PPR) model as a robustness check on the savings results.

ES.3.2 Process Evaluation

Due to the relative stability of the HER Program and the lack of significant program changes during the 2016 calendar year, no detailed process evaluation was performed for the HER Program as part of the 2016 evaluation.

Table ES-1 summarizes the data used during the 2016 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 2017 – Mar 2017
Billing Data	Participant and control customers	NA	Attempted program census	Feb 2017 – Mar 2017
In-depth Telephone Interviews	Program manager and implementer	NA	2	Feb 2017

ES.4 Key Evaluation Findings and Recommendations

ES.4.1 Evaluation Findings

The Home Energy Report Program reported *ex ante* 67,262 MWh of energy savings and 8,744 kW of demand savings in 2016. The verified *(ex post)* energy and demand savings for 2016 for all HU and PIPP customers combined were 68,807 MWh and 8,971 kW respectively, for a realization rate of 102 percent for energy savings and 103 percent for demand savings. A comparison of *ex ante* and *ex post* HER Program savings are shown in Table ES-2.

Table ES-2. 2016 Overall Evaluation Results

	2016 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)	46,338	67,262	68,807	102%	148%
Demand Savings (kW)	6,178	8,744	8,971	103%	145%

Source: Navigant analysis of customer billing data provided by AEP Ohio.
AEP Ohio EE/PDR 2016 Performance Report 12-31-2016 Final.

[1] *Volume 1: 2012 to 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.*

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 6,044 MWh of energy savings and 788 kW of peak demand savings. A summary of the savings from each customer group includes:

- All High-use customers accounted for a total of 66,075 MWh of energy savings, corresponding to 8,615 kW of peak demand savings. HU customers represent 88 percent of the total savings.
- Low-income customers accounted for 2,732 MWh of energy savings, corresponding to 356 kW of peak demand savings, and represent approximately 4 percent of total savings.
- AMI customers accounted for 6,044 MWh of energy savings, corresponding to 788 kW of peak demand savings, representing8 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	PIPP	TOTAL
Number of Participants (beginning of 2016)	91,147	15,611	85,634	63,577	34,159	62,338	10,322	362,788
2016 Move-outs	4,614	906	7,632	6,414	5,554	8,275	1,167	34,562
2016 Opt-outs±	29	1	32	15	15	15	0	107
Number of Participants (end of 2016)	86,533	14,705	78,002	57,163	28,605	54,063	9,155	328,226
Average Daily Household kWh Used	46.9	61.5	41.9	36.6	36.8	40.8	39.3	N/A
Estimated Daily kWh Savings per participant	0.93	1.06	0.74	0.14	0.38	-0.03	0.77	N/A
(standard error)	(0.08)	(0.24)	(0.08)	(0.09)	(0.15)	(0.10)	(0.21)	N/A
Estimated Annual kWh Savings per participant	*341*	*386*	*271*	*53*	*139*	*-10*	*280*	N/A
(standard error)	*(29)*	*(87)*	*(28)*	*(33)*	*(54)*	*(37)*	*(78)*	N/A
Estimated Percentage Savings	1.95%	1.69%	1.74%	0.39%	1.03%	0.00%	1.91%	N/A
Estimated Total MWh Savings* (a)	30,397	5,875	22,253	3,182	4,368	0	2,732	68,807
Savings Counted in Other Programs (b)	-52	-60	104	-87	16	-131	47	-163
Total Savings (MWh) ** = (a)	30,397	5,875	22,253	3,182	4,368	0	2,732	68,807
Total Savings (kW) †	3,963	766	2,901	415	570	0	356	8,971

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 double-counted savings resulted in a negative value (decreased participation in other programs). Since negative double-counted savings would increase the total savings, double-counted savings are assumed to be zero.*
† 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 active participant count.

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 2016.

Table ES-4. Estimated Program Savings by AMI Participant Group Using Equations 1 and 2

g	2010/11 AMI	2013 AMI‡	2014 AMI	2015 AMI	2016 AMI	TOTAL
Number of Participants (beginning of 2016)	33,340	4,398	8,142	11,214	9,317	66,411
2016 Move-outs	2,944	871	1,260	3,383	2,342	10,800
2016 Opt-outs±	10	0	2	3	2	17
Number of Participants (end of 2016)	30,396	3,527	6,882	7,831	6,975	55,611
Average Daily Household kWh Used	29.4	28.9	30.8	24.4	26.5	N/A
Estimated Daily kWh Savings per participant	0.38	-0.61	0.34	0.12	0.19	N/A
(standard error)	(0.16)	(0.21)	(0.14)	(0.09)	(0.18)	N/A
Estimated Annual kWh Savings per participant	*139*	*-223*	*123*	*42*	*68*	N/A
(standard error)	*(57)*	*(76)*	*(51)*	*(31)*	*(65)*	N/A
Estimated Percentage Savings	1.28%	0.00%s	1.08%	0.47%	0.70%	N/A
Estimated Total MWh Savings* (a)	4,454	0	925	397	268	6,044
Savings Counted in Other Programs** (b)	7	11	-3	31	2	47
Total Savings (MWh)** = (a)	4,454	0	925	397	268	6,044
Total Savings (kW)†	581	0	121	52	35	788

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 double-counted savings resulted in a negative value (decreased participation in other programs). Since negative double-counted savings would increase the total savings, double-counted savings are assumed to be zero.*
‡ The analysis of the 2013 AMI 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 active participant count.

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 compared to other participant cohorts. On a relative basis, the savings from the earlier cohorts enrolled in 2010 through 2013 all exceed one percent of daily energy usage (excluding the 2013 AMI cohort).

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 three cohorts enrolled during 2015 and 2016 are estimated to have generated under one percent savings. Prior experience has shown once customers begin receiving Home Energy Reports, 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 2016 HU and AMI cohorts, but the 2015 AMI cohort was enrolled in the program for over a year prior to the beginning of the 2016 program year. However, this cohort has the lowest average daily usage of any cohort, and low energy users tend to produce lower savings.

This year, overall program savings were not 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. Instead, Navigant found a decrease in participation in other programs. 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 program 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	Total
Average Post-Only-Difference (DID) Statistic	-0.04%	-0.01%	0.04%	0.04%	N/A
Change in Program Participation due to HER Program (# of Participants)	-130	-85	129	150	64
Average Savings per Program Participant (kWh)	1,376	1,385	202	450	N/A
Total Savings (MWh)	-179	-72	27	61	-163

Source: Navigant analysis

Due to decreased participation, the analysis determined an estimated -163 MWh of the evaluated savings from the HER Program was double counted in other AEP EE/PDR programs. Negative double counted savings suggest the HER program is depressing participation in other programs. It was determined these reductions were due to random chance, not a direct results of receiving HER reports. Since accounting for these reductions would increase the evaluated savings, Navigant assumed no (zero) double-counted savings for the 2016 program year

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. There may be a household characteristic or personality, either seen or unseen, which is more prevalent in this cohort that negatively impacts program savings. Depending on the outcome of these investigations, it may be possible it is not cost-effective to continue including this cohort in the HER Program.

3. The program evaluation in 2014 included a live audit performed via telephone survey with program participants. This audit asked participants to report on the current state of lighting and thermostats settings in their household. This approach provided quantifiable evidence of specific actions participant households are taking in response to the home energy reports. AEP Ohio should consider using these live audits in the future as a way to either 1) further investigate why some participant cohorts are generating less savings than others, or 2) gather quantifiable data on other actions that participating households may be taking to generate energy and demand savings, beyond the lighting and HVAC actions investigated during the 2014 evaluation.

1. INTRODUCTION

1.1 Program Description

The purpose of the Home Energy Report (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 either bi-monthly or quarterly. 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 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, and 2016 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 five cohorts of HU customers have been enrolled in the program. In 2010, OPower 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, and 62,338 in 2016.

- 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 Demon*stration 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, and 9,317 in 2016.

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 of the enrolled premise, 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 2016 program year, or at the time of enrollment for the 2016 cohorts.

Table 1-1. Number of Program Participants and Non-Participants

Customer Subgroup	Participants	Controls
High-use Customers	352,466	127,280
August 2010 Cohort	91,147	43,891
November 2011 Cohort	15,611	7,444
February 2013 Cohort	85,634	34,288
January 2014 Cohort	63,577	15,084
August 2014 Cohort	34,159	6,802
August 2016 Cohort	62,338	19,771
AMI Customers	66,411	31,746
August 2010/11 Cohort	33,340	10,052
February 2013 Cohort	4,398	3,567
February 2014 Cohort	8,142	6,056
November 2015 Cohort	11,214	9,189
July 2016 Cohort	9,317	2,882
Low-income Customers	10,322	9,393
Total	429,199	168,419

Source: Navigant Analysis

1.2 Evaluation Overview

This evaluation report presents the findings from the impact evaluation of the AEP Ohio Home Energy Report Program for 2016. 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.

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 Home Energy Report Program.

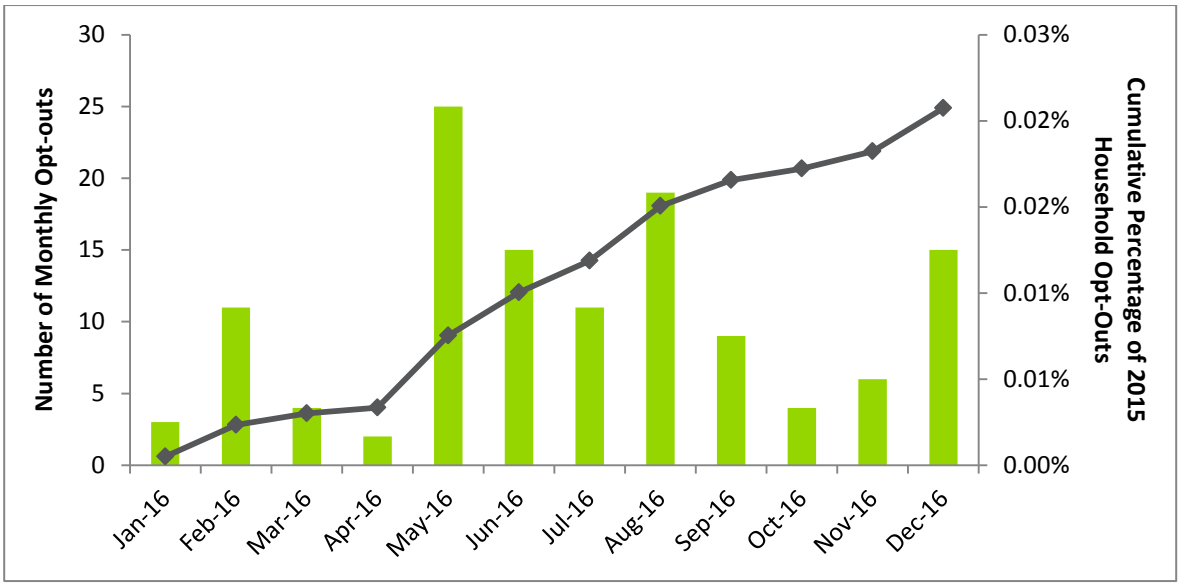
2.1 Description of the Data

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 January 2016. 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 2016 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 2016 program year. By the end of December 2016, 124 households had opted-out of the Home Energy Report Program during the program year, including some households that also moved out of AEP Ohio service territory during the year. Opt-outs represents 0.02 percent of 2016 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.

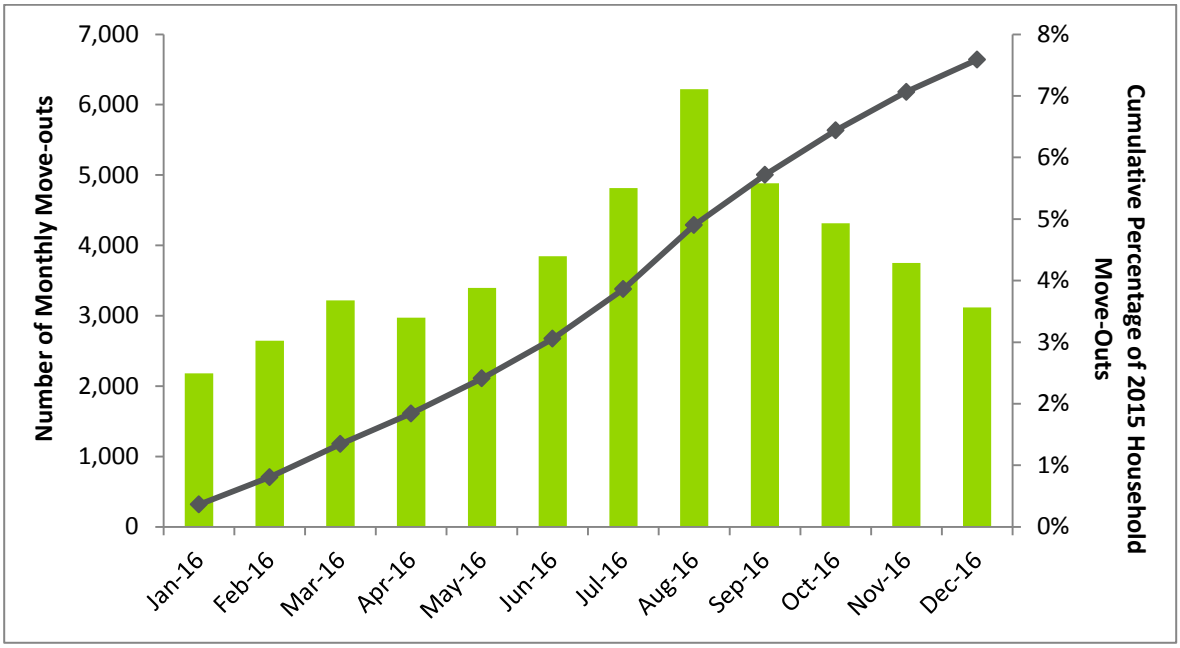
Figure 2-1. Frequency Distribution of Opt-Out Households, by Month and Cumulative Percentage



Source: Navigant Analysis

Navigant also included households that moved out of the premise enrolled in the HER program during 2016 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 45,000 AEP Ohio customers, or around 7.6% of the number of program participants at the start of 2016.

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 Home Energy Report Program, a randomized control trail (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 service territory as indicated by the weather station assigned to each customer.
- Distribution of energy use within each month in the twelve 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 2016 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 2016 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.[2] 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 randomized controlled trial (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 post-program regression (PPR) analysis with lagged controls, and (2) a linear fixed-effects regression (LFER) analysis. Navigant uses the PPR 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 PPR model for two reasons. One, the implementer is also using a post-only model for evaluation. Two, although both the LFER and PPR 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 PPR model tend to have lower standard errors than those from the LFER model, though the differences are usually very small.

The PPR model, also known as a lagged dependent variable (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.

[2] "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.

Equation 1. Post Program Regression Model

$$ADU_{kt} = \beta_1 Treatment_k + \sum_J \beta_{2j} Month_{jt} + \sum_J \beta_{3j} Month_{jt} \cdot ADUlag_{kt} + \varepsilon_{kt}$$

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
$ADUlag_{kt}$	is household *k*'s energy use in the same calendar month of the pre-program year as the calendar month of month *t*
$Month_{jt}$	is a binary variable taking a value of 1 when j = t and 0 otherwise[3]
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.[4]

The coefficient β_1 is the estimate of average daily kWh energy savings due to the program.

As with the PPR 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.

Equation 2. Linear Fixed Effects Regression Model

$$ADU_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Treatment_k \cdot Post_t + \varepsilon_{kt}$$

[3] 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.
[4] 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.

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 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. Post Program Regression 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.

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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 Home Energy Report 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, Efficient Products Rebate, and In-Home Energy Programs. Navigant investigated the effect of the HER Program on increasing participation in these four 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 2016 program 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.

2.4 In-depth Staff Interviews

Navigant conducted in-depth interviews in February 2017, 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 2017
	Implementation Contractor Program Staff	Contacts from AEP Ohio	AEP Ohio Client Success Manager	1	February 2017

3. DETAILED EVALUATION RESULTS

3.1 Impact Evaluation Results

The Home Energy Report Program reported *ex ante* 74,851 MWh of energy savings and energy 9,759 kW of demand savings in 2016. The verified *(ex post)* energy and demand savings for 2016 for all HU and PIPP customers combined were 68,807 MWh and 8,971 kW respectively. A comparison of *ex ante* and *ex post* HER Program savings are shown in Table 3-1.

Table 3-1. 2016 Overall Evaluation Results

	2016 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)	46,338	67,262	68,807	102%	148%
Demand Savings (kW)	6,178	8,744	8,971	103%	145%

Source: Navigant analysis of customer billing data provided by AEP Ohio.
AEP Ohio EE-PDR 2016 Performance Report 12-31-2016 Final.

[1] Volume 1: 2012 to 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.

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 6,044 MWh of energy savings and 788 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 2016.

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 2016.

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	PIPP	TOTAL
Number of Participants (beginning of 2016)	91,147	15,611	85,634	63,577	34,159	62,338	10,322	362,788
2016 Move-outs	4,614	906	7,632	6,414	5,554	8,275	1,167	34,562
2016 Opt-outs±	29	1	32	15	15	15	0	107
Number of Participants (end of 2016)	86,533	14,705	78,002	57,163	28,605	54,063	9,155	328,226
Average Daily Household kWh Used	46.9	61.5	41.9	36.6	36.8	40.8	39.3	N/A
Estimated Daily kWh Savings per participant	0.93	1.06	0.74	0.14	0.38	-0.03	0.77	N/A
(standard error)	(0.08)	(0.24)	(0.08)	(0.09)	(0.15)	(0.10)	(0.21)	N/A
Estimated Annual kWh Savings per participant	*341*	*386*	*271*	*53*	*139*	*-10*	*280*	N/A
(standard error)	*(29)*	*(87)*	*(28)*	*(33)*	*(54)*	*(37)*	*(78)*	N/A
Estimated Percentage Savings	1.95%	1.69%	1.74%	0.39%	1.03%	0.00%	1.91%	N/A
Estimated Total MWh Savings* (a)	30,397	5,875	22,253	3,182	4,368	0	2,732	68,807
Savings Counted in Other Programs (b)	-52	-60	104	-87	16	-131	47	-163
Total Savings (MWh) ** = (a)	30,397	5,875	22,253	3,182	4,368	0	2,732	68,807
Total Savings (kW) †	3,963	766	2,901	415	570	0	356	8,971

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 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 active participant count.

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 2016.

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	TOTAL
Number of Participants (beginning of 2016)	33,340	4,398	8,142	11,214	9,317	66,411
2016 Move-outs	2,944	871	1,260	3,383	2,342	10,800
2016 Opt-outs±	10	0	2	3	2	17
Number of Participants (end of 2016)	30,396	3,527	6,882	7,831	6,975	55,611
Average Daily Household kWh Used	29.4	28.9	30.8	24.4	26.5	N/A
Estimated Daily kWh Savings per participant	0.38	-0.61	0.34	0.12	0.19	N/A
(standard error)	(0.16)	(0.21)	(0.14)	(0.09)	(0.18)	N/A
Estimated Annual kWh Savings per participant	*139*	*-223*	*123*	*42*	*68*	N/A
(standard error)	*(57)*	*(76)*	*(51)*	*(31)*	*(65)*	N/A
Estimated Percentage Savings	1.28%	0.00%	1.08%	0.47%	0.70%	N/A
Estimated Total MWh Savings* (a)	4,454	0	925	397	268	6,044
Savings Counted in Other Programs** (b)	7	11	-3	31	2	47
Total Savings (MWh)** = (a)	4,454	0	925	397	268	6,044
Total Savings (kW)†	581	0	121	52	35	788

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 AMI 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 active participant count.

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 2013 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 three cohorts enrolled during 2015 and 2016 are estimated to have generated under one percent savings. Prior experience has shown once customers begin receiving Home Energy Reports, 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 2016 HU and AMI cohorts, but the 2015 AMI cohort was enrolled in the program for over a year prior to the beginning of the 2016 program year. However, this cohort has the lowest average daily usage of any cohort, and low energy users tend to produce lower savings.

Additionally, the 2013 AMI cohort has been in the HER Program for up to 35 months by the beginning of the 2016 program year. This cohorts 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. There may be a household characteristic or personality, either seen or unseen, which is more prevalent in this cohort that negatively impacts program savings. Depending on the outcome of these investigations, it may be possible it is not cost-effective to continue including this cohort in the HER Program.

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 Post-Only Difference (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, Efficient Products, and In Home-Audit. 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 four 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, Efficient Products, and In-Home Energy 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.

Navigant found a decrease in participation in the Appliance Recycling and Community Assistance programs that eclipsed the increased participation in Efficient Products and In-Home Energy. This was primarily due to the higher average savings per participant from Appliance Recycling and the Community Assistance program and resulted in a total of -163 MWh of double counted savings. Subtracting negative double counted savings from the billing analysis results would increase the total verified savings for the HER program, inaccurately attributing decreased participation as savings that would have occurred in absence of the program. Since savings that did not occur cannot be claimed, and these small decreases in participation were not statistically significant, Navigant calculates a total of 0 MWh of claimed savings from the four listed programs is due to channeling from the HER Program and, therefore, is considered double counted savings.

Table 3-4. Estimate of Energy Savings Attributable to Participation in Other Programs

	Appliance Recycling	Community Assistance Program	Efficient Products Rebates	In-Home	Total
Average Difference-in-Differences (DID) Statistic	-0.04%	-0.01%	0.04%	0.04%	N/A
Change in Program Participation due to HER Program (# of Participants)	-130	-85	129	150	64
Average Savings per Program Participant (kWh)	1,376	1,385	202	450	N/A
Total Savings (MWh)	-179	-72	27	61	-163

Source: Navigant Analysis

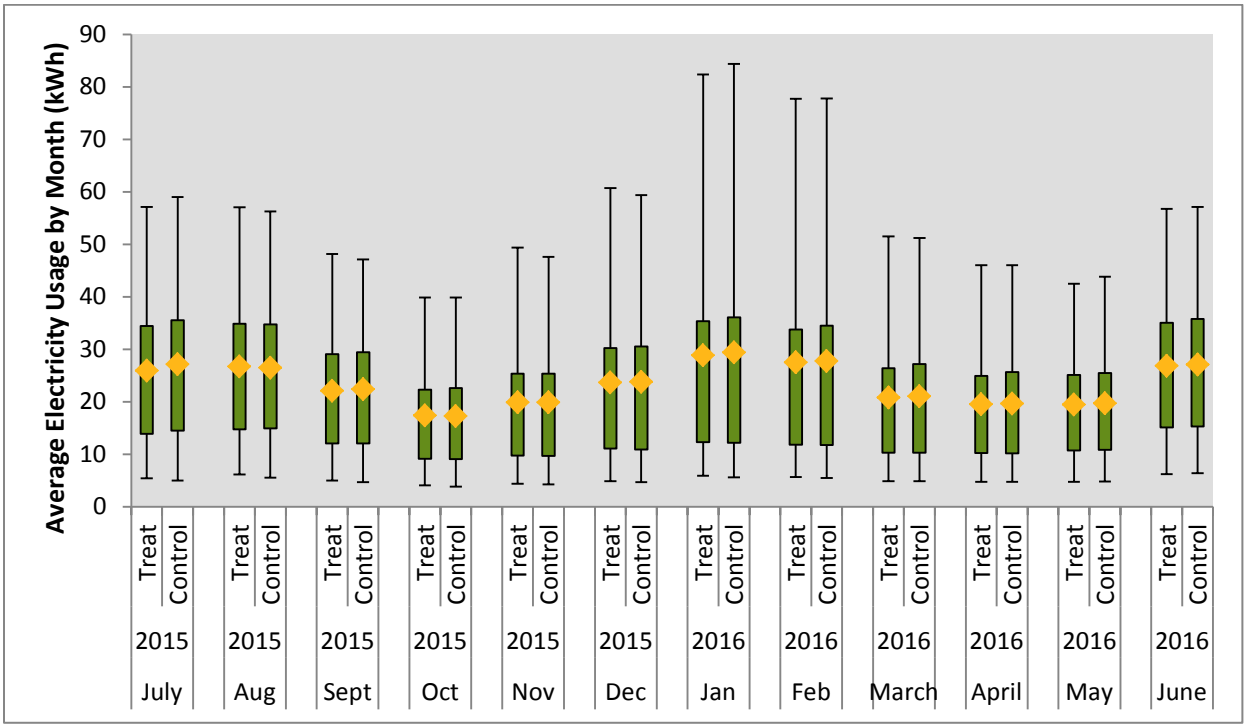
The amount of savings attributable to increased participation in other AEP Ohio EE/PDR programs due to participation in the HER Program is significantly lower than has been estimated in prior program years. This may be due to increased awareness of energy efficiency programs among the general population, and thus the control households in the HER Program. Additionally, the Appliance Recycling Program was inactive for the first half of 2016. The program lapsed between late 2015 and June 2016 due to the original implementation contractor filing for bankruptcy. This period of inactivity likely contributed to lower participation.

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 2016 program year to confirm the control households were randomly selected and are suitable for the purposes of the estimating program savings.

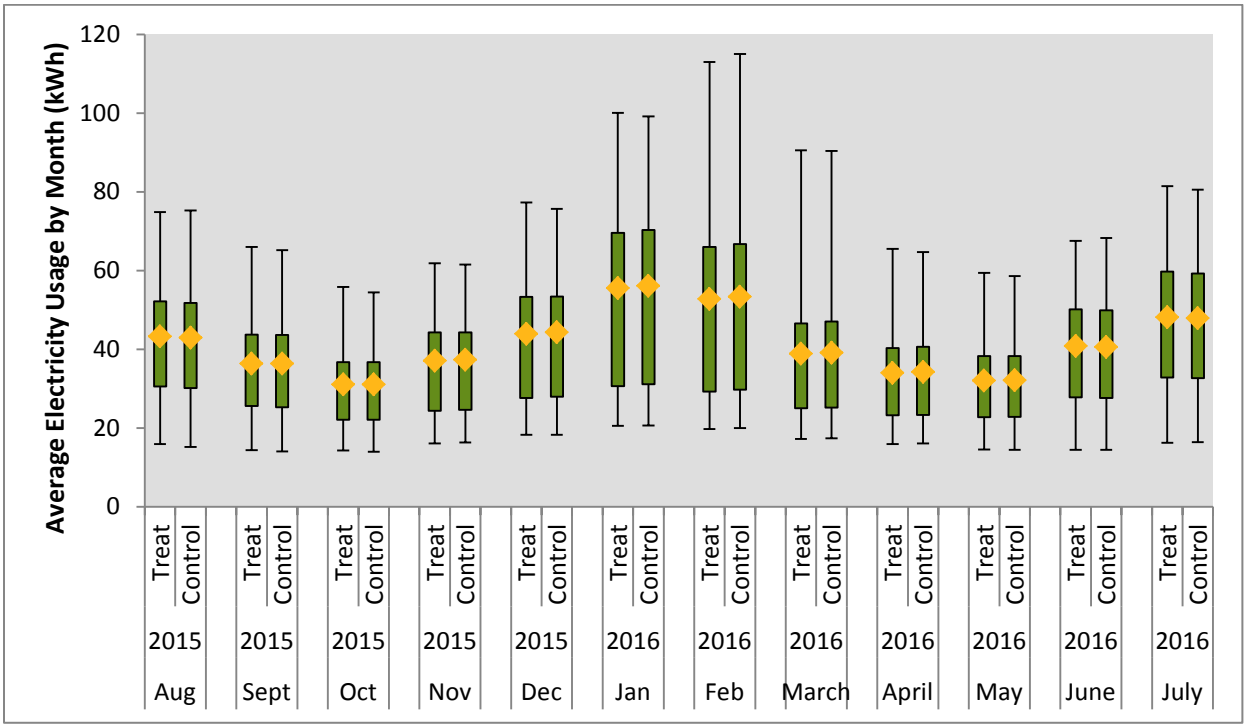
The primary comparison Navigant performed to assess the reasonableness of the control groups is to compare the energy used by households in the 12 months preceding enrollment of participating households in the HER Program. Navigant compared the distribution of energy use in each month for treatment and control households. Figure 3-1 shows box-and-whisker graphs comparing the monthly energy use for the July 2016 AMI cohort. Figure 3-2 shows box-and-whisker graphs comparing the monthly energy use for the August 2016 HU cohort. The comparability of the treatment and control customers for this new cohort is analyzed for the first time in this year's evaluation. (Graphs showing the results of this comparison for 2015 and older cohorts performed in previous evaluation years are presented in Appendix A). In the graphs, the yellow diamonds represent the average monthly electricity use of households in each customer group, the green 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 3-1. Average Daily Treatment/Control Household Energy Use by Month in July 2016 AMI Cohort



Source: Navigant Analysis

Figure 3-2. Average Daily Treatment/Control Household Energy Use by Month in August 2016 HU Cohort



Source: Navigant Analysis

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. 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 2015 AMI cohort. For all 12 t-tests performed on these monthly comparisons, 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 group was constructed appropriately.

3.2 Staff and Contractor Interviews

This section presents findings resulting from in-depth interviews with program staff and installation 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.

3.2.1 Program Coordinator Interview

The AEP Ohio Program Coordinator manages the HER program for AEP Ohio side 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.

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. The Program Coordinator noted one customer segment still receives four mailed reports a year, and customers without a verified email received two mailed reports a year.

3.2.2 Implementation Contractor Interview

The HER implementation contractor client success manager (CSM) was interviewed in February 2017. The current CSM took over the AEP Ohio HER account in early 2016. 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.

In 2016, the AEP Ohio HER reports included 12 promotional modules. The CSM considered this to be a high number of promotional modules and commended AEP Ohio's efforts to keep their report experiences fresh and engaging. The CSM believes these efforts contribute to the high savings AEP Ohio achieves relative to its goals.

The implementation contractor conducted an independent customer engagement survey in 2016 via telephone and interviewed both treatment and control HER customers. They found high report readership rates and high satisfaction among treatment customers. Compared to control customers, they found an increase in EE program awareness and stated participation, as well as an increase in the belief AEP Ohio wants to save its customers money. Overall, the CSM saw the AEP Ohio HER program as successful.

3.3 Cost Effectiveness Review

This section addresses the cost effectiveness of the 2016 Home Energy Report Program. Cost effectiveness is assessed through the use of 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 3-5 summarizes the unique inputs used in the TRC test.

Table 3-5. Inputs to Cost-Effectiveness Model for AEP HER Program

Item	Value
Measure Life	1
Participants	362,788
Annual Energy Savings (kWh)	68,807,281
Coincident Peak Savings (kW)	8,971
Third Party Implementation Costs	$686,000
Utility Administration Costs	$130,157
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 3.0, and the program is cost-effective. Table 3-6 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 3-6. Cost-Effectiveness Results for the HER Program

Cost-Benefit Test	Ratio
Total Resource Cost	5.4
Participant Cost Test	N/A
Ratepayer Impact Measure	0.5
Utility Cost Test	5.4

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.[5] 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 Home Energy Report Program reported *ex ante* 67,262 MWh of energy savings and 8,744 kW of demand savings in 2016. The verified *(ex post)* energy and demand savings for 2016 for all HU and PIPP customers combined were 68,807 MWh and 8,971 kW respectively, for a realization rate of 102 percent on energy savings and 103 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 6,044 MWh of energy savings and 788 kW of peak demand savings. Across all customer groups, Navigant estimates the HER Program saved 74,851 MWh and 9,759 kW during the 2016 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 2013 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 three cohorts enrolled during 2015 and 2016 are estimated to have generated under one percent savings. Prior experience has shown once customers begin receiving Home Energy Reports, 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 2016 HU and AMI cohorts, but the 2015 AMI cohort was enrolled in the program for over a year prior to the beginning of the 2016 program year. However, this cohort has the lowest average daily usage of any cohort, and low energy users tend to produce lower savings.

Navigant’s estimates of overall program savings were not reduced by double counted savings, as Navigant found no 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 no (zero) 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.

[5] “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.

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.

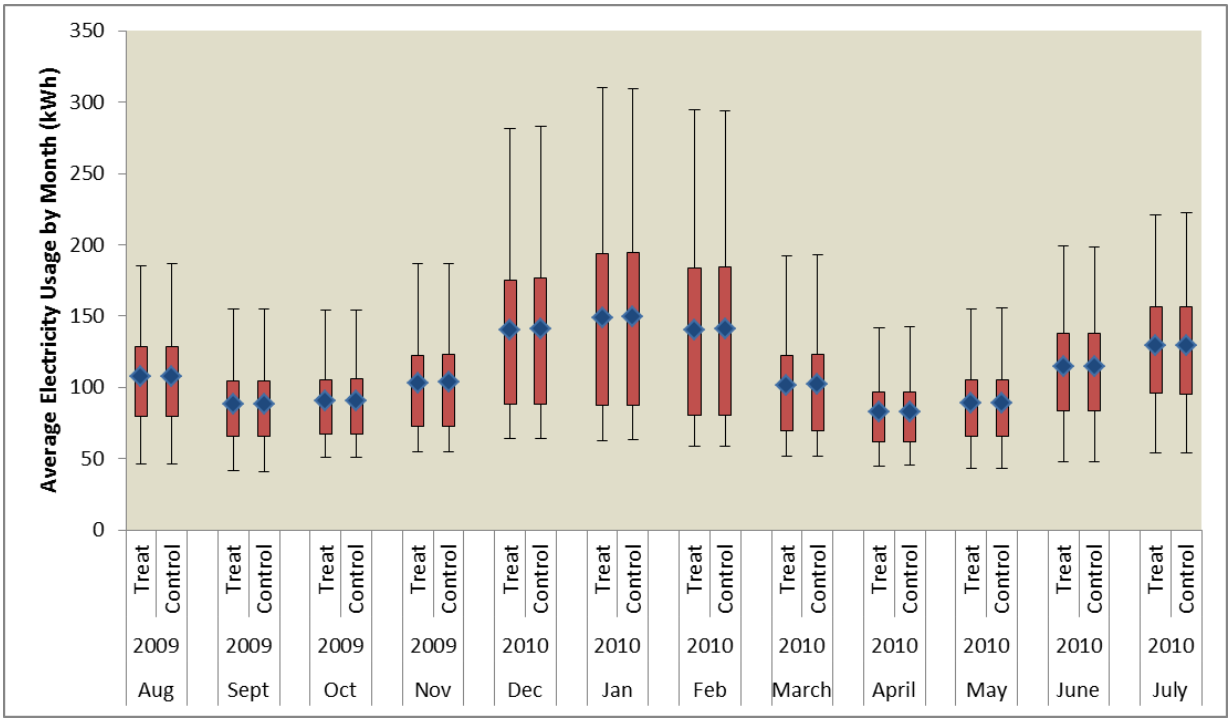
2. Further investigation into the construction of the 2013 AMI cohort may be warranted to determine if there are customer characteristics that are adversely impacting participant savings. There may be a household characteristic or personality, either seen or unseen, which is more prevalent in this cohort that negatively impacts program savings. Depending on the outcome of these investigations, it may be possible it is not cost-effective to continue including this cohort in the HER Program.

3. The program evaluation in 2014 included a live audit performed via telephone survey with program participants. This audit asked participants to report on the current state of lighting and thermostats settings in their household. This approach provided quantifiable evidence of specific actions participant households are taking in response to the home energy reports. AEP Ohio should consider using these live audits in the future as a way to either 1) further investigate why some participant cohorts are generating less savings than others, or 2) gather quantifiable data on other actions that participating households may be taking to generate energy and demand savings, beyond the lighting and HVAC actions investigated during the 2014 evaluation.

APPENDIX A. VERIFICATION OF CONTROL GROUPS

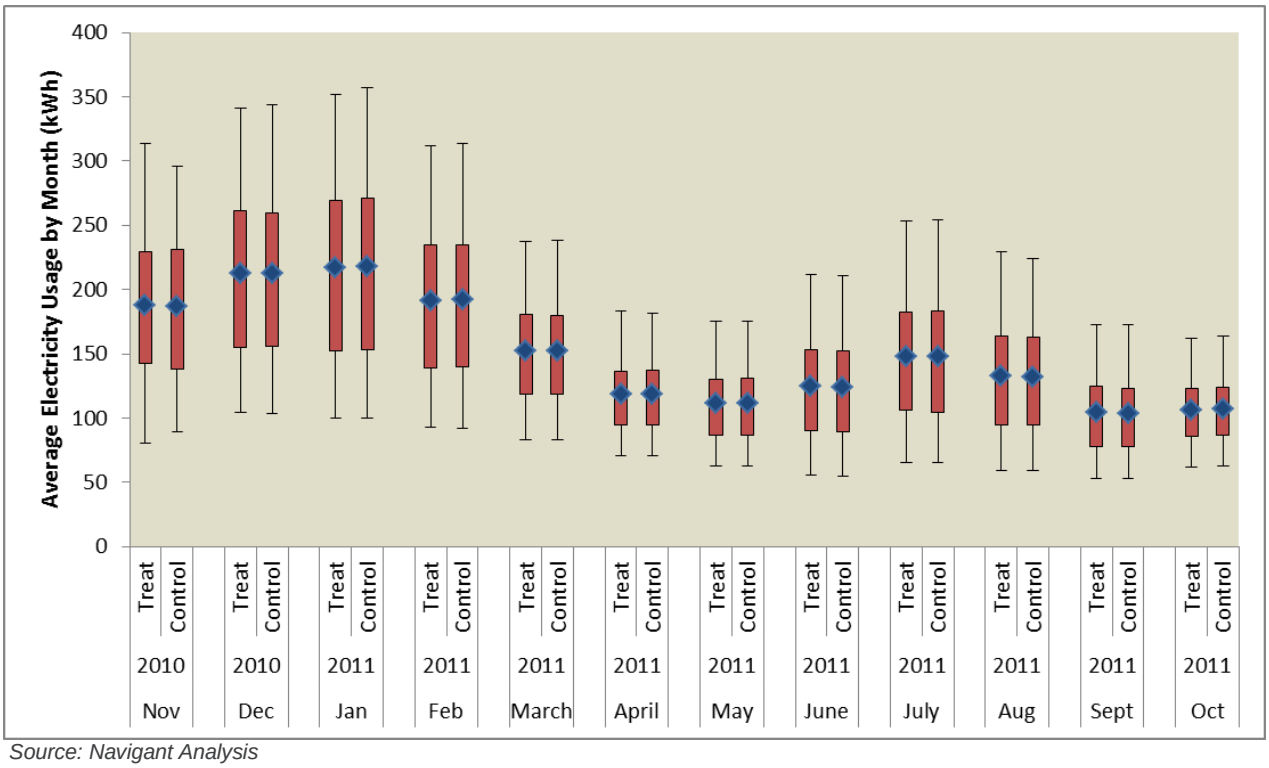
The following graphs present the distribution of energy use in the pre-program period for treatment and control households in each customer group and cohort. In the graphs, the blue diamonds represent the average monthly electricity use of households in each customer group, the red bars represent the 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-1. Average Daily Treatment/Control Household Energy Use by Month in 2010 HU Cohort



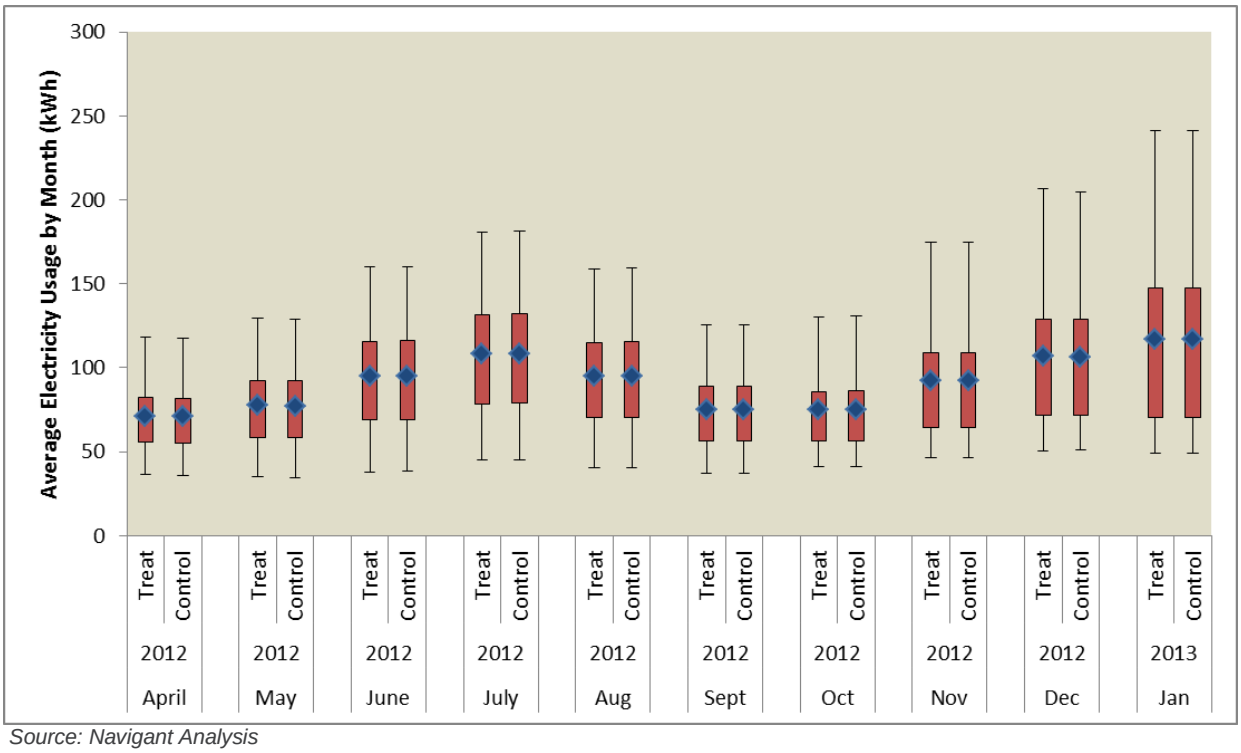
Source: Navigant Analysis

Figure A-2. Average Daily Treatment/Control Household Energy Use by Month in 2011 HU Cohort



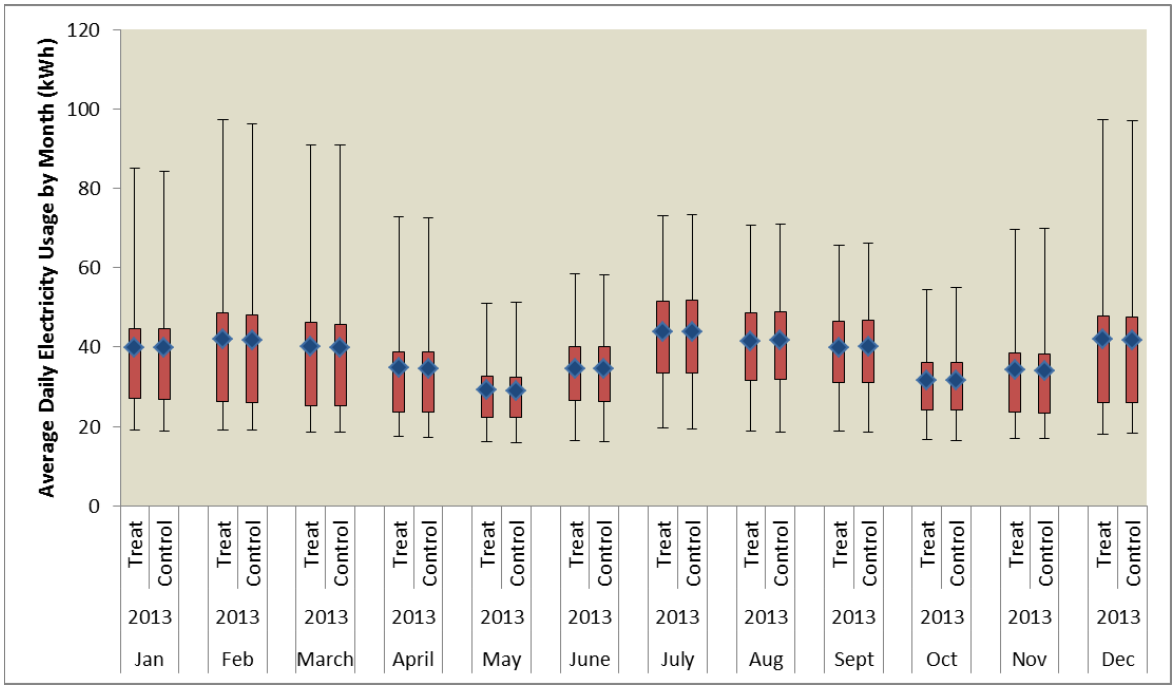
Source: Navigant Analysis

Figure A-3. Average Daily Treatment/Control Household Energy Use by Month in 2013 HU Cohort



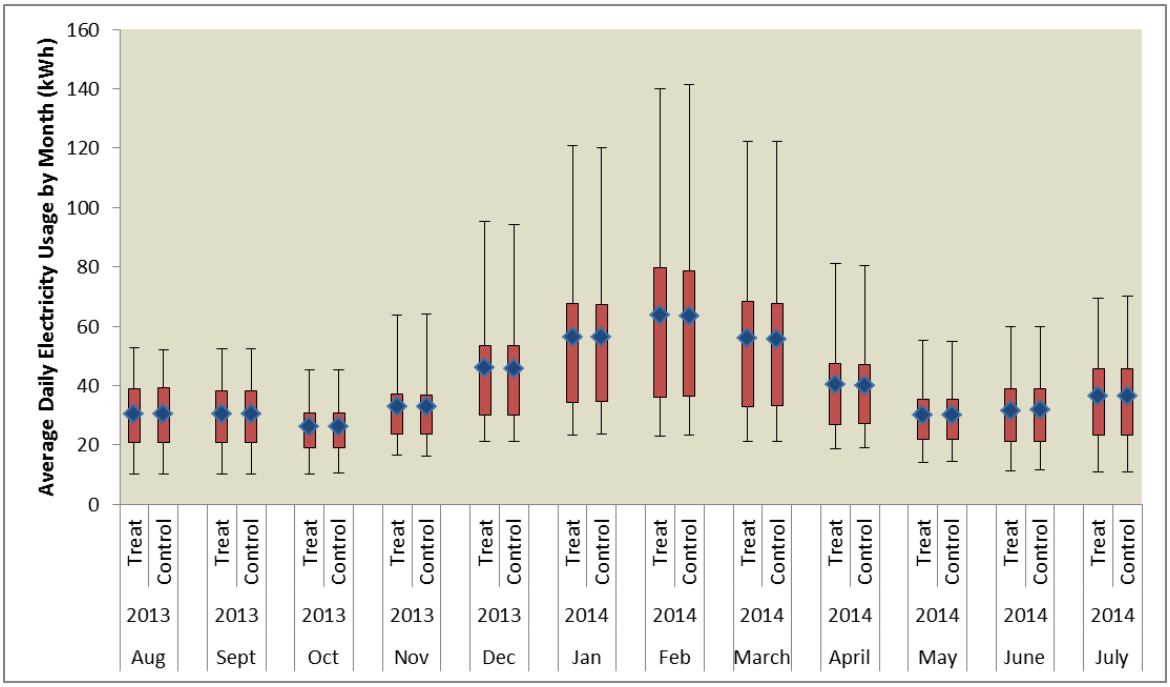
Source: Navigant Analysis

Figure A-4. Average Daily Treatment/Control Household Energy Use by Month in January 2014 HU Cohort



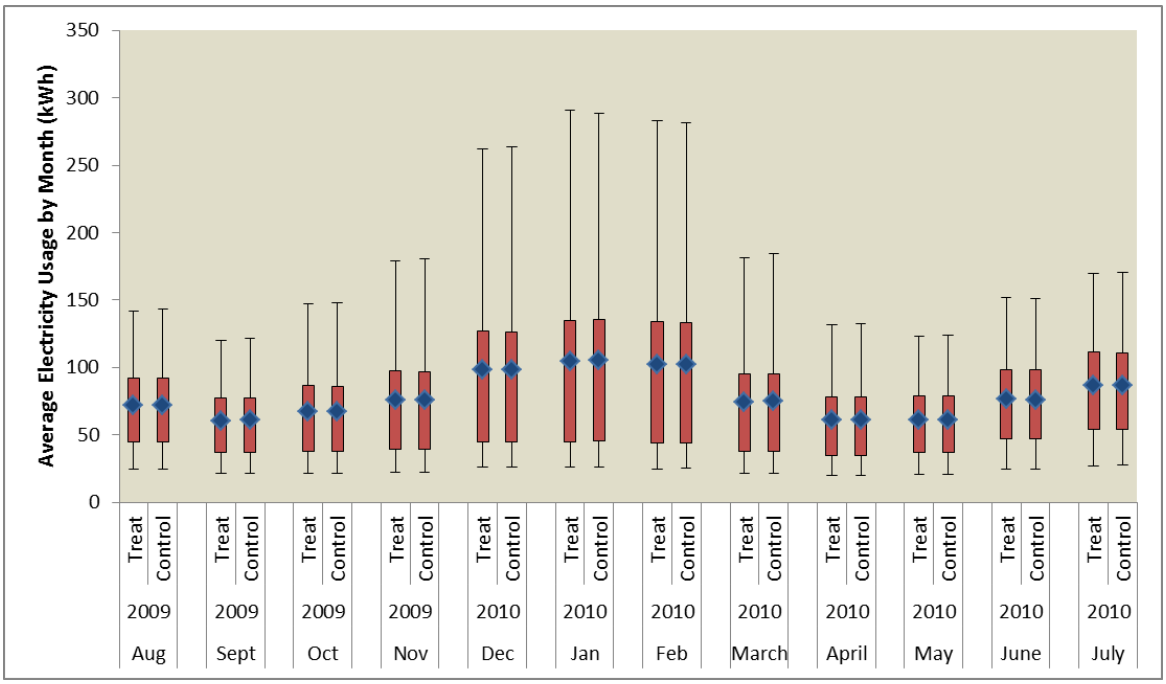
Source: Navigant Analysis

Figure A-5. Average Daily Treatment/Control Household Energy Use by Month in August 2014 HU Cohort



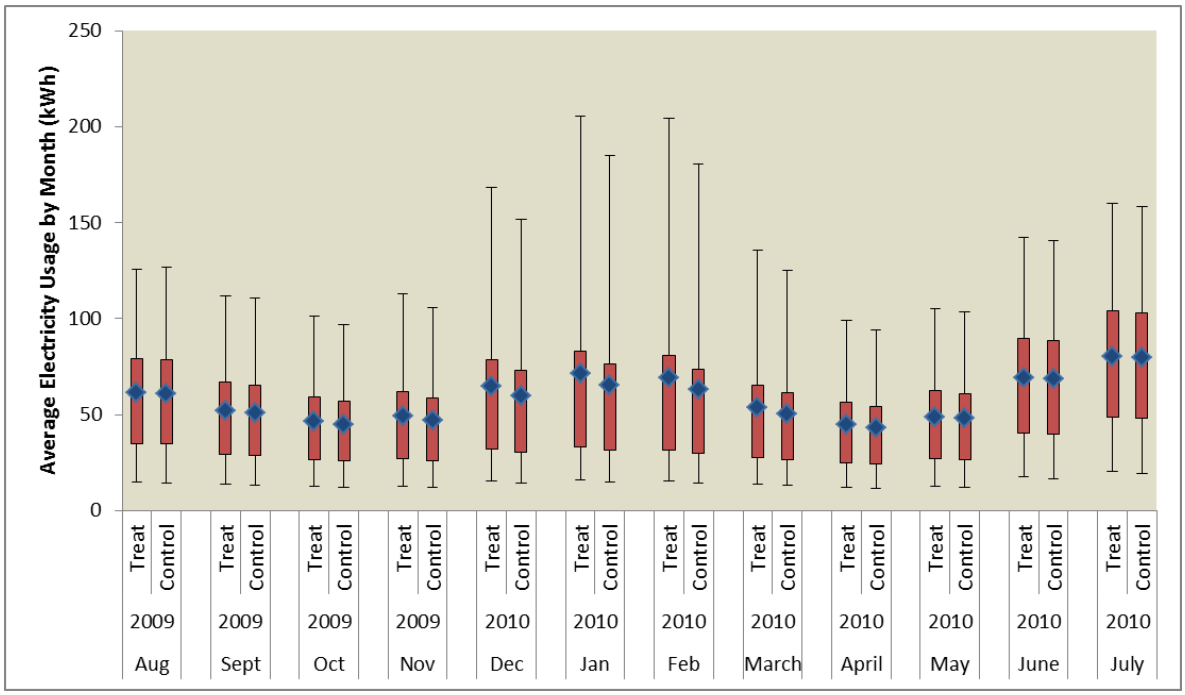
Source: Navigant Analysis

Figure A-6. Average Daily Treatment/Control Household Energy Use by Month in 2010 PIPP Cohort



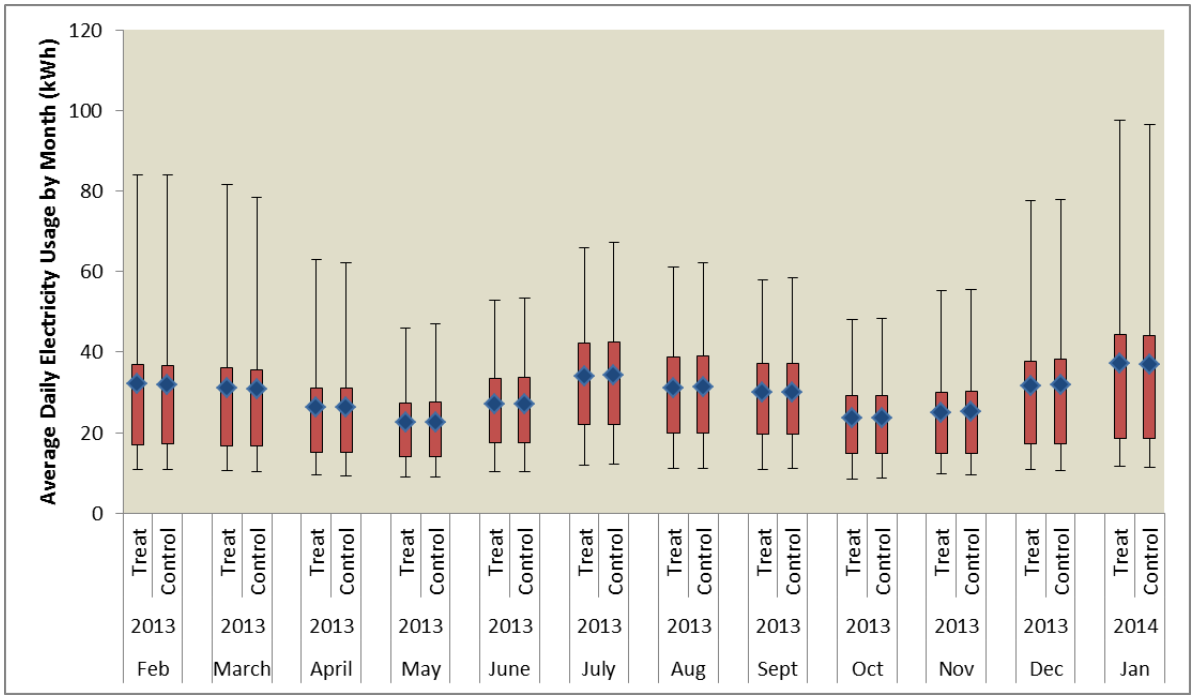
Source: Navigant Analysis

Figure A-7. Average Daily Treatment/Control Household Energy Use by Month in 2010 AMI Cohort



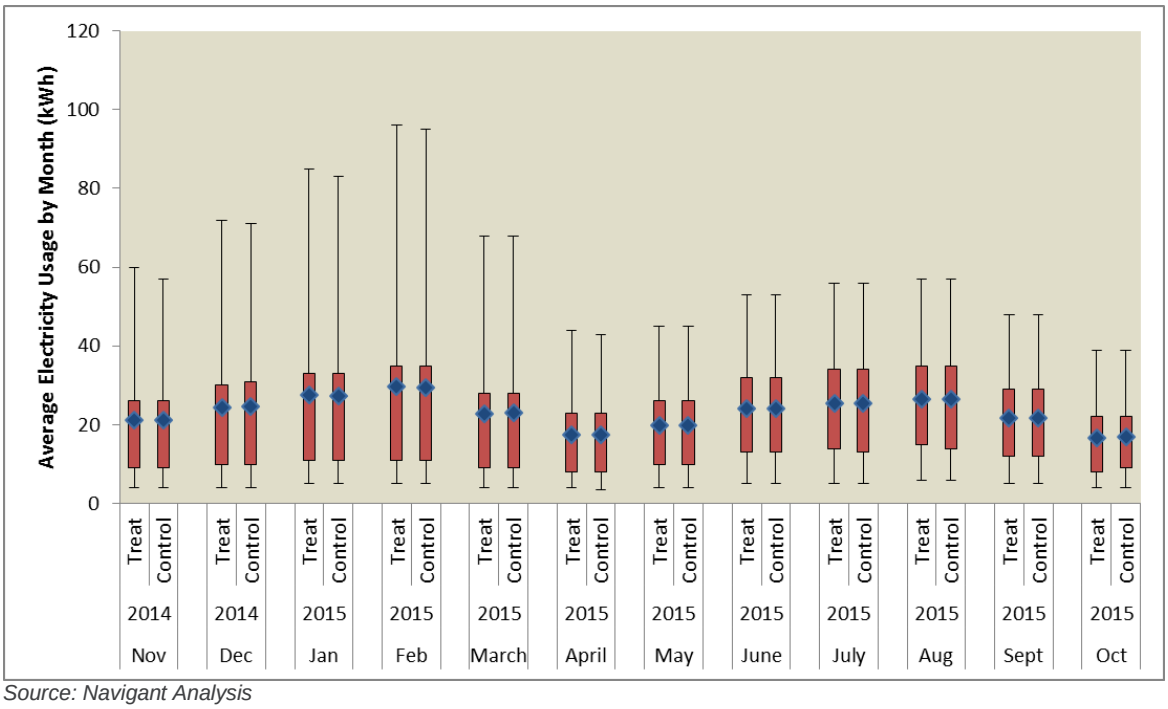
Source: Navigant Analysis

Figure A-8. Average Daily Treatment/Control Household Energy Use by Month in 2014 AMI Cohort



Source: Navigant Analysis

Figure A-9. Average Daily Treatment/Control Household Energy Use by Month in 2015 AMI Cohort



Source: Navigant Analysis

APPENDIX B. PER PARTICIPANT REGRESSION RESULTS

Table B-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-1. Per Participant Coefficients and Standard Errors by Program Cohort

Program Cohort	PPR Coefficient	PPR Clustered Standard Error	FE Coefficient	FE Clustered Standard Error
2010 HU	-0.9340	0.0799	-0.9183	0.0840
2011 HU	-1.0584	0.2381	-1.0086	0.2521
2013 HU	-0.7437	0.0760	-0.5051	0.0761
Jan 2014 HU	-0.1440	0.0898	-0.1838	0.0929
Aug 2014 HU	-0.3815	0.1487	-0.4039	0.1604
2016 HU	0.0267	0.1005	-0.0672	0.0834
PIPP	-0.7660	0.2140	-0.5835	0.2184
2010/11 AMI	-0.3822	0.1551	-0.4107	0.1659
2013 AMI	0.6119	0.2093	0.6778	0.2075
2014 AMI	-0.3376	0.1384	-0.4157	0.1427
2015 AMI	-0.1158	0.0852	-0.1201	0.0923
2016 AMI	-0.1856	0.1783	-0.1691	0.1653

Source: Navigant Analysis

APPENDIX C. SAMPLE HOME ENERGY REPORT

gridSMART℠ From AEP OHIO®

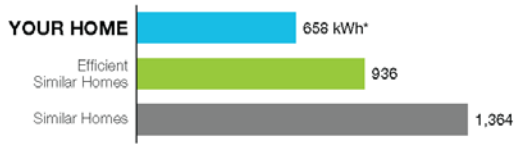
Home Energy Report
Account number:
Report period: 04/01/11 - 05/31/11

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.



* kWh: A 100-Watt bulb burning for 10 hours uses 1 kilowatt-hour.

How you're doing:
GREAT ☺☺
Good ☺
More than average

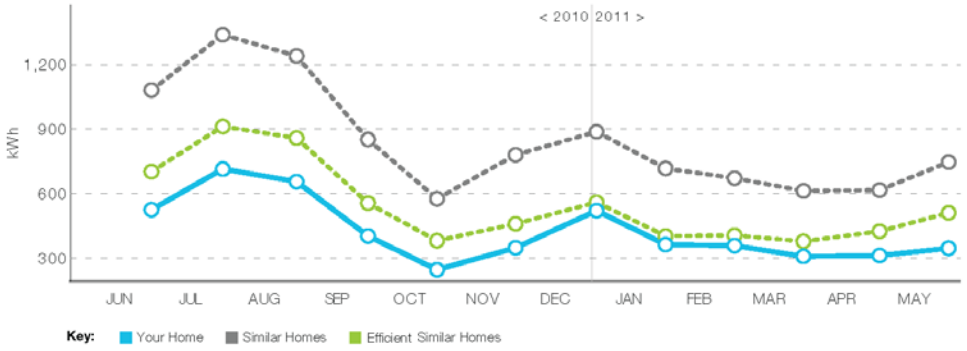
Similar Homes: Approximately 100 occupied, nearby homes (avg 0.09 miles away)

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

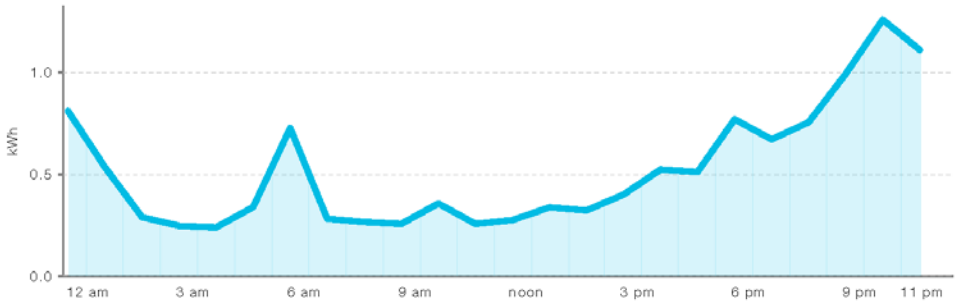
You used **50% LESS** electricity than similar homes.
This saves you about **$591** per year.



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

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APPENDIX I

PRESCRIPTIVE PROGRAM

2016 Evaluation Report

Prepared for:

AEP Ohio

A unit of American Electric Power

May 11, 2017

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Prescriptive Program
2016 Evaluation Report

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ES. EXECUTIVE SUMMARY

This report presents the results of the evaluation of the 2016 AEP Ohio Prescriptive Program. The Executive Summary provides a high-level description of the program, key impact findings, key process findings, and recommendations stemming from these findings. Detailed methodology and additional general findings are contained in the body of the report following the Executive Summary.

The Prescriptive Program offers incentives to nonresidential customers installing eligible high-efficiency electric equipment. The program provides a streamlined incentive application and quality control process intended to facilitate participation for customers interested in installing efficient technologies from a pre-qualified list. DNV GL (implementation contractor) delivers the program on behalf of AEP Ohio.

ES.1 Overview of Evaluation Results

As shown in Table ES-1, the 2016 Prescriptive Program paid incentives on 2,118 projects constituting 140,354 MWh of *ex ante* reported annual energy savings. As compared to the 2015 program year, this reflects a 3 percent increase in total project count; a 17 percent increase in reported MWh savings; and a 23 percent increase in *ex ante* kW savings.

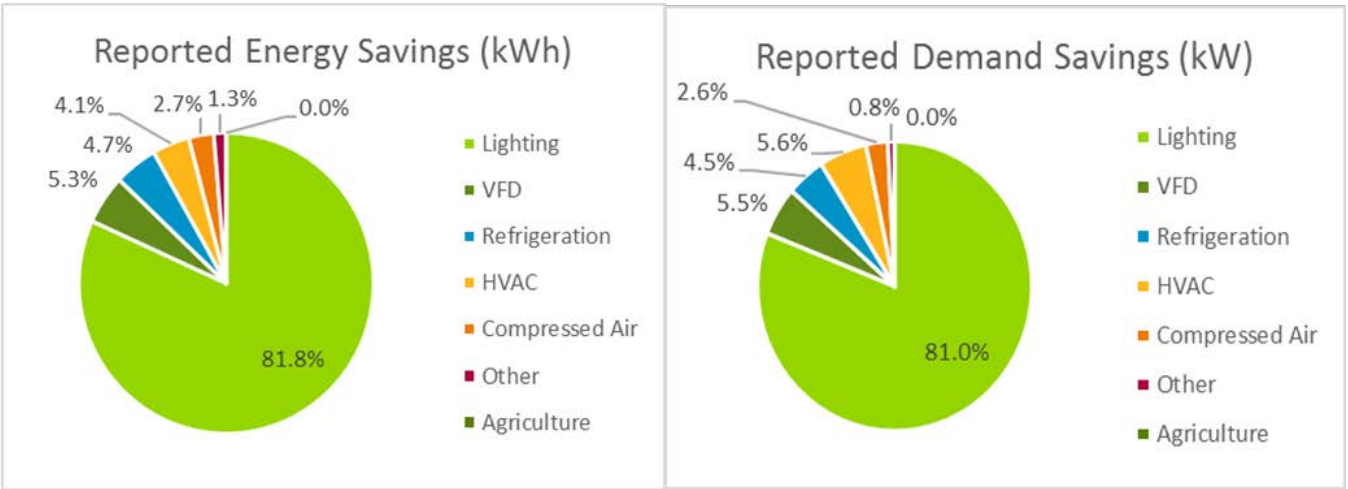
Table ES-1. 2016 Prescriptive Program Projects and *Ex Ante* Savings

Metric	*Ex Ante* Value
Number of Projects	2,118
Annual Energy Savings (MWh)	140,354
Peak Demand Savings (MW)	20.656

Source: Navigant Analysis of 2016 AEP Ohio Tracking Data

As shown in Figure ES-1, the majority of savings are attributed to lighting measures; in 2016 lighting measures comprise 82 percent of total *ex ante* program savings. An additional 2.2 percent of the program savings, just over half of the refrigeration measure savings, stem from LED case lights and lighting controls for refrigerated cases.

Figure ES-1. Percentage of Savings by Measure Category



Source: Evaluation Analysis of 2016 AEP Ohio Tracking Data

ES.2 Key Impact Evaluation Findings

Table ES-2 shows the *ex ante* savings claimed by the program, the verified (*ex post*) savings, the 2016 realization rates, and a comparison to program goals.

Table ES-2. 2016 Prescriptive Program Savings and Realization Rate

	2016 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)	219,589	140,354	132,171	0.94	60%
Demand Savings (MW)	36,598	20.7	17.2	0.83	47%

Source: [1] AEP Ohio VOLUME 1: 2012 TO 2014 Energy efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014; Evaluation Data Collection and Analysis.

The Prescriptive Program did not meet plan goals; however, the realization rates remain strong and the 10 percent year-over-year increase in verified energy savings indicates the program is continuing to grow. Total project count is up three percent compared to 2015, while *ex post demand* savings are consistent. In other words, in 2016, the Prescriptive Program delivered greater savings than 2015 with projects that are, on average, larger.

The primary contributors to the realization rate are lighting projects with logged hours of use that fall short of the default estimates in the implementation contractor's Appendix A: AEP Ohio Prescriptive Measures Protocols, Business Incentives Program. Baseline wattage is also a key driver for adjustment to both demand and energy savings. In several instances, the baseline watts for T12 measures assume

magnetic ballasts; the verified savings apply a T12 wattage consistent with electronic ballasts. Additional savings adjustments occurred due to projects found to have only been partially completed (e.g., all of the claimed lights could not be located on site) or the project was initially completed, but then the equipment was either temporarily or permanently removed due to subsequent renovations. For instance, in one of the VFD projects, the equipment was operational for a short period before building improvements took that particular system completely off-line for at least six to eight months, including during the evaluation period (it remains offline at the time of this report).

ES.3 Conclusions from 2016 Prescriptive Program Evaluation

The 2016 Prescriptive Program evaluation resulted in the following conclusions and recommendations:

Conclusions and Recommendations from Process and Impact Evaluation

1. **Finding 1:** The 2016 realization rates (defined as *ex post* savings / *ex ante* savings) are 0.94 for energy savings and 0.83 for demand savings.

   Finding 1a: The relative precision at the two-tailed 90 percent confidence interval is ± 10.4 percent for energy savings. One of the primary drivers of this precision bound falling so close to our target is nine of the 55 sampled projects have a realization rate of 50 percent or less, in combination with four projects with a realization rate of 150% or greater. Projects from all three strata (Large, Medium, and Small) are included in these counts of extremely high/low realization rates. Further contributing to the number of projects with significant variance in project level realization rate is the team's extensive use of data logging to verify lighting hours of use.

   Finding 1b: The relative precision at the two-tailed 90 percent confidence interval is 21 percent for demand savings. These larger than expected error bounds are primarily driven by differences in reported vs verified fixture counts; corrected coincidence factors (per logged data); as well as adjustments to baseline wattage for T12 fixtures. There is also a VFD project that was taken offline, thereby contributing zero verifiable savings.

   - **Recommendation 1a:** The implementation contractor should review and continue to refine the prescriptive savings for lighting measures, in particular the default hours of use by building type.

   - **Recommendation 1b:** When the baseline is a T12 fixture, the wattage for that equipment should reflect an electronic ballast.

2. **Finding 2:** Lighting measures continue to dominate the program, with 83 percent of the reported energy savings and 81 percent of the reported demand savings; not including the additional 2.5 percent of the total program kWh savings that stem from lighting in refrigerated cases. The largest non-lighting end-uses were VFDs, heating, ventilation and air-conditioning (HVAC) and refrigeration.

   - **Recommendation 2:** To diversify the program and ensure long term stability, program staff, the implementation contractor, and Solution Providers should look for opportunities to promote non-lighting measures.

3. **Finding 3:** Except for one instance where the equipment is temporarily out of service due to site renovations, VFDs continue to outperform expectations at the project level. Yet, in aggregate, VFD projects and the associated energy savings are the lowest since 2012.

- **Recommendation 3a:** AEP Ohio should leverage account representative and customer relationships, the implementation contractor, and Solution Providers to promote and reinvigorate the VFD measure.
- **Recommendation 3b:** Prescriptive savings for this measure would benefit from an iterative process whereby annual verification results based on metered data are used to update savings estimates.
- **Recommendation 3c:** Consider switching the savings estimation approach for this measure from a purely prescriptive (per hp) value, to a simple analysis tool that helps refine the baseline operation and load reduction or energy savings, in order to improve the accuracy of the initial savings estimates for this measure.

4. **Finding 4:** 2016 participant survey respondents indicated dissatisfaction with the application process. Improving the application process was the most common response when participants were asked for suggestions to improve the program.

   - **Recommendation 4:** Streamline the application process. Because customers have identified complex and burdensome paperwork and an overly time-consuming application process as key drawbacks to the program, the program should make changes to the application process to streamline and simplify the process faced by customers. One approach to this would be to offer the current application for participants seeking incentives for a wide variety of measures in one project; but also offer measure specific applications for participants seeking incentives for only one type of measure within a given project.

5. **Finding 5:** The program tracking database does not currently include a field for tracking PJM winter peak impacts from eligible measures.

   - **Recommendation 5a**: Add a field to the program tracking database in order to capture and monitor PJM Winter peak demand savings.
   - **Recommendation 5b**: Investigate options to reverse engineer PJM Winter Peak impact estimates from the currently available values. Specifically, AEP Ohio could back out the Summer AEP Ohio coincidence factor (CF) and then apply PJM Summer and PJM Winter CFs to estimate the PJM demand reduction at the alternate times of day and year.

6. **Finding 6:** The implementation contractor's Appendix A provides Summer CF for lighting measures. However, this reference does not include CF-specific to the PJM Winter peak. Similarly, the Appendix does not have winter specific, heating HVAC Interactive Factors.

   - **Recommendation 6:** The implementation contractor's Appendix A prescriptive savings need to include a winter CF and interactive factor (IF). In particular, exterior fixtures previously did not contribute to AEP Ohio's summer peak demand reduction, but now should be assessed for potential contributions to PJM winter peak savings.

7. **Finding 7:** During an interview with a large customer-participant, the interviewee mentioned the company is actively discussing plans to opt out of the program in the near future. As part of a separate conversation, AEP Ohio staff mentioned several other, large customer-participants have opted out starting in 2017. Additionally, this concern was also raised during the implementation contractor interview.

   - **Recommendation 7a:** Ensure AEP Ohio key account representatives are properly matched to their respective accounts and that these AEP Ohio reps have the bandwidth to establish and maintain good communication with their key accounts.

- **Recommendation 7b:** Ensure AEP Ohio key account representatives continue to debrief previous participants that have since opted out to develop a complete picture of why these companies have elected to opt out.

1. INTRODUCTION

This section provides a description of the AEP Ohio Prescriptive Program, as well as a brief discussion of the underlying program theory and logic. In addition, this section includes a comparison of activity between the 2016 and 2015 program years.

1.1 Program Description

The Prescriptive Program offers incentives to nonresidential customers installing eligible high-efficiency electric equipment. The program provides a streamlined incentive application and quality control process intended to facilitate ease of participation for customers interested in installing efficient technologies from a pre-qualified list. The Prescriptive Program is marketed, administered, and delivered as a single program by AEP Ohio. The program is managed by an implementation contractor, in coordination with AEP Ohio.

1.1.1 2016 Program Differences Compared to 2015

AEP Ohio kept the Prescriptive Program relatively stable from 2015 to 2016. The measures included, as well as the incentives offered for those measures, are mostly unchanged.

The one notable update is applicable only to Advanced Lighting projects which combined multiple lighting measures under a separate application and strongly encourage participants to achieve the maximum impact from these projects.

In 2016, the Advanced Lighting portion of the Prescriptive Program revised the incentive levels down from the pilot program values. These changes adjusted the incentives from $1.50 per square foot to $0.75 for low-lumen, high-fixture-density projects; and from $0.75 to $0.30 per square foot for high-lumen, low-density projects.

Evaluation Objectives
This report presents the findings from the impact and process evaluations of the AEP Ohio Prescriptive Program for 2016. The objectives of the evaluation were to: (1) quantify energy and peak demand savings impacts, (2) quantify program demand impacts eligible for PJM bid, (3) determine key process-related program strengths and weaknesses, and (4) provide recommendations to improve the program.

The evaluation sought to answer the following key research questions:

Impact Questions

1. Did AEP Ohio's implementation contractor appropriately calculate the annual energy (kWh) and summer peak demand (kW) impacts for the program?
2. What were the energy and demand realization rates[1]?
3. How effective is the program as measured by various, industry standard cost-benefit tests?

[1] The realization rate is defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings.

Process Questions

Marketing and Participation

1. How effective was the outreach to the Solution Providers for this program? Is this effort increasing market penetration in targeted groups?
2. Is there a difference in the effectiveness of Solution Providers based on the type of business, i.e., contractor vs. distributor vs. energy service company (ESCO)? Are there differences in the effectiveness of Solution Providers based on the types of customers they generally serve?
3. Are Solution Providers experiencing programmatic barriers to participation?

Program Characteristics and Barriers

1. What areas could be improved to create a more effective program for customers and Solution Providers and help increase the energy and demand impacts?
2. Are Solution Providers satisfied with the aspects of program implementation in which they have been involved?

Administration and Delivery

1. Are the program administrative and delivery processes effective for smoothly moving through the application and incentive processing?
    a. Program tracking and information management systems
    b. Internal and external program communications
    c. Program delivery organization and staffing
    d. Skill levels needed to implement the program
2. Do AEP Ohio and the implementation contractor program managers have a consistent understanding of their roles in the delivery of the program? Are their responsibilities and goals clearly stated? Are steps implemented daily to reach the goals?
3. How do program managers assess the efficiency of the delivery of the program? What changes should be implemented to make the program more efficient?
4. What are the verification procedures for the program? Have these been implemented in a manner consistent with design?

2. METHODOLOGY

This section describes the methodology used to conduct the impact and process evaluations. 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
Review of Project Documentation	Sampled projects	Impact Evaluation
On-Site Data Collection and Analysis	Sampled projects	Impact Evaluation
In-depth Interviews	Program staff and implementer	Process Evaluation
On-Site Survey	Program participants	Process Evaluation
Program Documentation Review	Project Management Plan, Quality Plan, and other program documents	Process Evaluation

2.1 Tracking Data Review

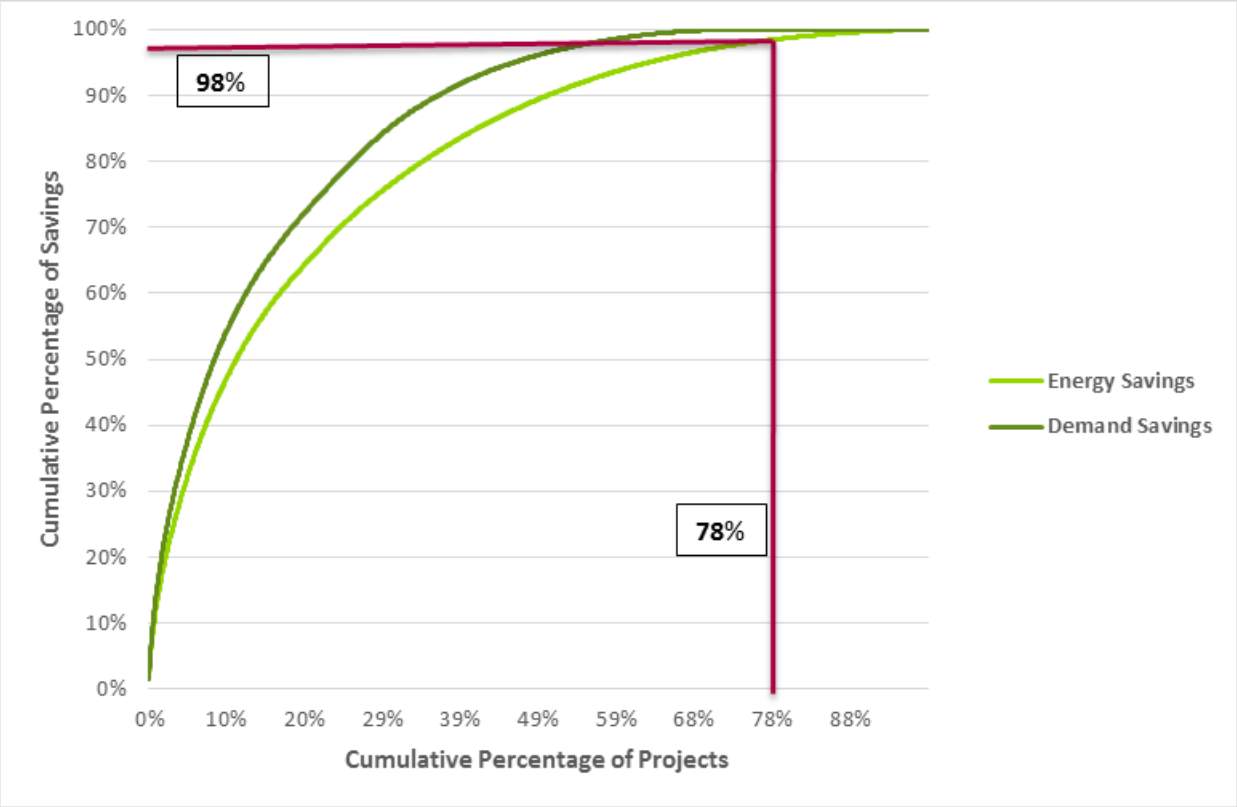
First, Navigant reviewed the data provided by AEP Ohio. This review was conducted for evaluation purposes only, not for corporate auditing or regulatory purposes. The evaluation team identified key tracking fields, including project number, participant name and contact information, project status, building type, measure type, and savings. Next, the team summarized data to identify the sectors and measures contributing the majority of savings. The high-savings, non-lighting measures were targeted during the review of deemed savings parameters, and the savings summary assisted the sample design.

2.2 Impact Evaluation Sample Design

The evaluation team sampled a portion of projects from the *ex ante* database to verify savings on a project-by-project basis. This process includes a technical review of project documentation (described in Section 2.3) and on-site data collection and analysis (described in Section 2.4). The sample design used stratified ratio estimation to reduce the number of sample points required to meet the precision targets, thus providing accurate results at reduced overall cost.

The savings summaries from the Tracking System Review task revealed the top 78 percent of projects, based on individual project *ex ante* savings, accounted for approximately 98 percent of the program's energy savings, see Figure 2-1 for a visual representation of this analysis.

Figure 2-1. Cumulative Percentage of Savings vs. Cumulative Percentage of Projects



Source: Analysis of 2016 AEP Ohio Tracking Data

The evaluation team subsequently set a minimum threshold of 10,000 kWh per project; if a project did not meet this criterion, it was removed from the sample frame. This key step increases the sampling efficiency, since the cost of evaluating projects with very small savings exceeds the value of the information gleaned. Navigant also defined the sample strata by magnitude of reported savings. Stratifying by project size reduces the overall number of required sample points by taking advantage of the concentrations of savings when relatively few projects contribute to a large fraction of total impacts.

The sample frame for the 2016 evaluation included only those projects reported as paid during 2016. The sample sizes within each stratum were calculated to provide 10 percent relative precision at the two-tailed 90 percent confidence interval (90/10) for Prescriptive Program annual energy (kWh) savings.[2] Table 2-2 shows the strata definitions, the number of projects within each stratum, and the calculated sample sizes.

[2] The Navigant team analyzed sample results from the 2012, '13, '14, and '15 evaluations to determine an appropriate starting point for the coefficient of variation (CV) on the *ratio* of verified to *ex ante* savings. The final CVs used in the sample design are between 0.4 and 0.5 depending on strata.

Table 2-2. Strata Definitions and Sample Sizes

Stratum Number	Stratum Name	Lower kWh Threshold	Sample Frame Projects	Sample Size
1	Large	300,000	68	13
2	Medium	100,000	280	18
3	Small	0	1,770	24
Total			**2,118**	**55**

Source: Evaluation Analysis of 2016 AEP Ohio Tracking Data

Finally, Navigant selected the samples within each stratum randomly.[3] Table 2-3 shows the final sample claimed savings that were evaluated as a percentage of the sample frame.

Table 2-3. Reported Savings by Strata

Stratum Number	Stratum Name	MWh Savings			kW Savings		
		Sample Frame (SF)	Sample	Percent of SF	Sample Frame (SF)	Sample	Percent of SF
1	Large	35,549	10,047	28%	5,429	1,390	26%
2	Medium	48,734	3,028	6%	6,887	428	6%
3	Small	56,071	751	1%	8,341	128	2%
Total or Overall Value		**140,354**	**13,825**	10%	**20,656**	**1,947**	9%

Source: Evaluation Analysis of 2016 AEP Ohio Tracking Data
Note: Totals may not sum perfectly due to rounding.

2.3 Technical Review of Project Documentation

Navigant received complete project documentation for each of the 55 sampled projects from the implementation contractor and conducted a detailed technical review of each. The assessment included a review of the tracking databases, customer applications, invoices, and equipment specifications. Adjustments were made to project-specific savings wherever project documentation clearly showed different values from the database, or where obvious calculation mistakes were present.

2.4 On-Site Data Collection and Analysis

Navigant contracted with Crawford and Associates (an Ohio-based firm) in order to collect supporting data on-site (in person) for each of the 55 projects initially reviewed as part of the technical review sample. To ensure the success of this step, a project-specific measurement and verification (M&V) plan was developed for each sampled project. These plans detailed the reported measures and expected operating characteristics, as well as the data collection plan for the project. The M&V plans all followed a

[3] The sample was compared to the sample frame in a few key categories, including building type and trade ally, to ensure the sample was sufficiently representative of the population as a whole (sample frame).

common template, but the data collection tasks within each were custom-designed to target any key uncertainties in the reported savings analysis. On-site M&V tasks included:

1. Visual verification of measure installation and operation
2. Verification of reported measure quantities
3. Verification of measure nameplate data, including manufacturer and model number, capacity (watts, Btu/h, tons, etc.), and efficiency
4. Verification of measure operating characteristics, including the participant's self-reported schedule of operation, loading, and, as needed, electrical spot readings
5. Confirmation of the appropriate baseline technology and measure counts

In addition, the evaluation team installed temporary data loggers on incentivized equipment for a subset of projects. This additional rigor in data collection was used primarily for lighting projects, especially those including occupancy sensors or otherwise express a high probability of significant variability in hours of use (HOU). Similarly, temporary data loggers were also deployed for motor and HVAC projects whenever this was safe and actionable during the site visit.

The temporary data loggers measured either current (amps) at the electrical panel for a significant portion of the lighting load, or lighting time-of-use (on/off timestamp) for a sample of lighting circuits. Navigant analyzed the logger data for each site to calculate operating hours and coincidence factors for the lighting measures.

In some instances, on-site energy management systems (EMS) were leveraged in lieu of temporary data loggers. Energy management systems generally allow for primary data collection to extend beyond the typical evaluation data collection window, occasionally including direct baseline measurements. When safe to do so, at the time of the site visit, EMS calibration is confirmed with direct spot readings of the incentivized equipment.

All data collected in the field was summarized and converted into analysis inputs. Once on-site verification was completed for the sampled projects, those findings and associated data were used to calculate ex-post energy savings.

2.5 Program Savings Analysis

In the final step of the impact evaluation, Navigant combined the outputs from all previous steps to determine program-level verified energy and demand savings. Specifically, the evaluation team used project-specific results to determine strata level realization rates. These strata level results are then extrapolated to the population of program participants for that stratum. The extrapolation procedure followed the structure specified by the sample design, and used stratified ratio estimation to determine program-level verified (i.e., realized) savings. Finally, Navigant compared the program-level realized savings to the *ex ante* program savings to determine the Prescriptive Program realization rate. This final program level results roll-up is also used to determine the final achieved statistical precision.

2.6 Process Evaluation

The evaluation team conducted a comprehensive process evaluation including primary data collection and analysis, to evaluate the effectiveness of program processes currently in place, and to inform improvements to program processes.

2.6.1 Overview of Process Evaluation Approach

The purpose of the process evaluation is to assess how program structure and implementation affect performance and other key metrics, such as customer satisfaction. The evaluation team's process efforts provide insights and recommendations to support the continued success of the Prescriptive Program and enable continuous program improvement.

There are several key components to the process evaluation:

- Conducting Program Coordinator and Implementation contractor interviews
- Conducting in-person interviews with program participants and reviewing and analyzing the results
- Reviewing tracking data for insights into key performance indicators (e.g., length of time to process incentive payments to customers, uptake of new measures, incentive to savings ratio, and incentive to cost ratio)
- Reviewing program documentation for completeness and to assess whether program protocols are handled in a manner consistent with program documentation

All process activities are designed and carried out with process recommendations from the previous year's evaluation report and process questions from the current year's evaluation plan in mind. The process evaluation team's primary goal is to develop a set of relevant findings informing actionable recommendations to help maintain effective processes already in place, and to foster new and improved processes to enhance program effectiveness and efficiency moving forward.

2.6.1.1 On-site Survey of Program Participants

While conducting on-site impact verification, an in-person process interview was administered. The survey was short in length, aiming to collect information from the participant regarding participation in other AEP Ohio EE/PDR programs either in the past or the future, and overall satisfaction with the Prescriptive Program and the utility. Thirty-eight interviews were conducted, approximately one quarter of the number of surveys conducted in 2015. The participant survey instrument is included in Appendix A.

2.6.1.2 Program and Implementer Staff In-depth Interviews

In-depth interviews were conducted with the AEP Ohio Prescriptive Program Manager and Business Programs Manager, and with the implementation contractor Operations Manager and Engineering Team Lead. Interviews were designed to provide insights into program function, identify program strengths and areas for improvement, document changes to the program in 2016 and the effects of these changes, and identify how, and to what extent, process recommendations from the 2015 evaluation report have been addressed during 2016. These interviews were conducted between September and October, 2016, by the program process evaluation lead, and were recorded and transcribed verbatim for reference. The interview guides used for these interviews are included in Appendix A. Section 3.3.1 provides detailed findings from program staff and implementer in-depth interviews.

2.6.1.3 Program Documentation Review

Program documents play an essential role in ensuring all parties involved in implementing a program have adequate resources to understand intended program design and protocols. As part of its evaluation activities, the process evaluation team acquired all relevant and available documentation for the

Prescriptive Program from AEP Ohio and the implementation contractor, and reviewed this material to see that the documents were up to date and sufficient. Findings and results of the program documentation analysis are provided in Section 3.3.3.

3. DETAILED EVALUATION FINDINGS

This section presents the detailed findings from the 2016 Prescriptive Program evaluation related to (1) program activity, foundational documents and data tracking, (2) impact evaluation findings, (3) process evaluation findings, and (4) cost effectiveness review.

3.1 Program Activity

Table 3-1 presents reported program results for 2016.

Table 3-1. 2016 Prescriptive Program Projects and Reported *Ex Ante* Savings

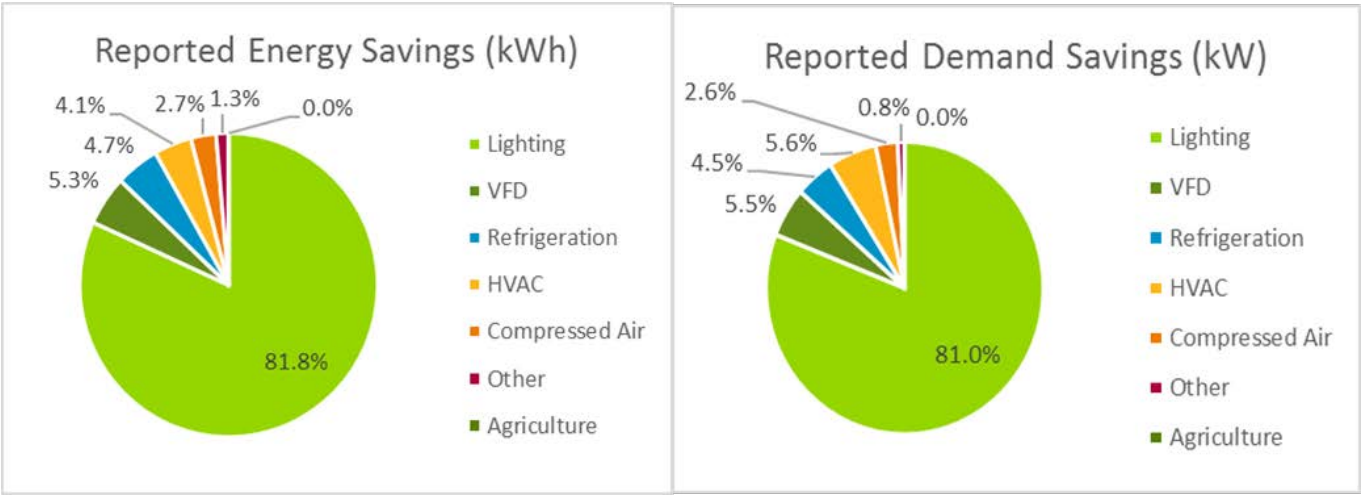
Metric	Reported Value
Number of Projects	2,118
Annual Energy Savings (MWh)	140,354
Peak Demand Savings (MW)	20.656

Source: AEP Ohio Portfolio Status Report

As shown in Figure 3-1, the vast majority of savings are attributed to lighting measures. Traditional lighting measures (T8s, LED, etc.) contribute 81.8 percent of the *ex ante* savings; plus, over half of the savings attributed to refrigeration projects are for case-lighting and case-lighting controls. These refrigeration specific lighting measures contribute an additional two and a half percent of total program savings (3.51 GWh).

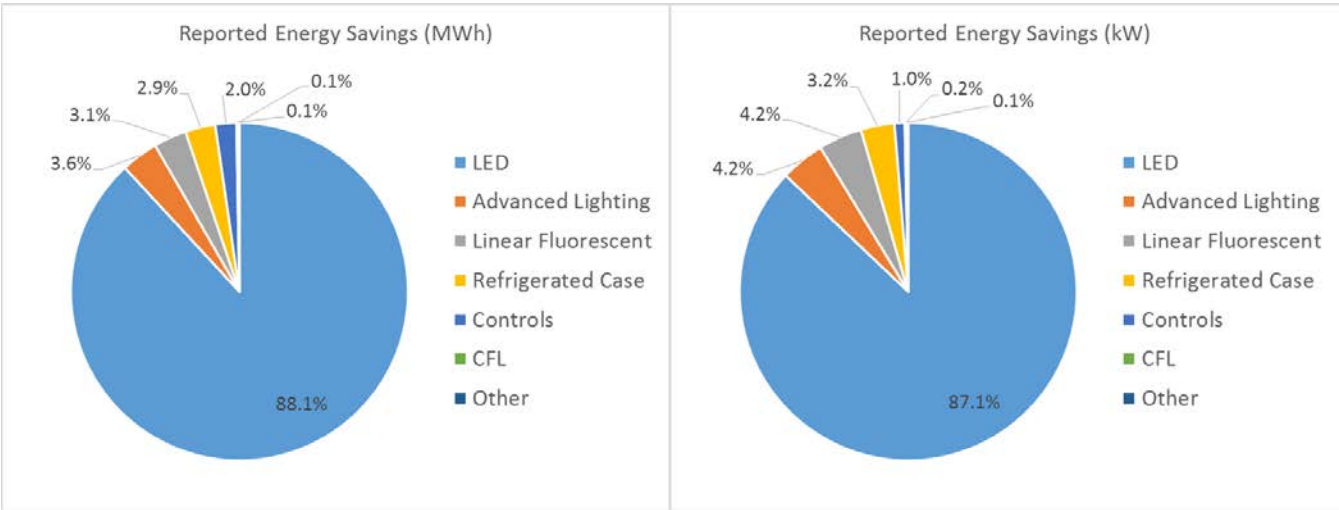
Also of note in Figure 3-1, the variable frequency drive (VFD) measure group (including process applications, HVAC, and compressed air systems) is the second leading measure, encompassing 5.3 percent of total program savings. This is a marked reduction in VFD savings versus 2015, when 10 percent of program savings were from VFDs. Although *ex ante* program savings in 2016 are greater than in 2015, there is a year-over-year drop of approximately 5.6 GWh in savings from VFD projects.

Figure 3-1. Percentage of Measures Installed by Measure Category



Source: Evaluation Analysis of 2016 AEP Ohio Tracking Data

Figure 3-2. Percentage Lighting Savings by Sub-Measure



From Figure 3-2 it is apparent LEDs used for area illuminance are contributing 88 percent of the lighting measure savings from the total lighting measure contribution; or 76.5[4] percent of the total reported program energy savings. In terms of demand reduction, LEDs contribute 75.3 of total program savings. When we include LEDs and LED lighting controls for refrigerated cases in these totals, the program level savings are 79 percent for energy and 78 percent for demand. Further details about the program composition and contributors is provided in as part of the Process Evaluation findings in Section 3.3.3.

[4] These percentages of the total program are based on total reported kWh and kW savings. The 88.1 percent from Figure 3-2 cannot be used in direct conjunction with the 81.8 percent from Figure 3-1 in determining this value, because the 88.1 percent shown in Figure 3-2 includes in the denominator, the lighting component of the Refrigeration measure shown in Figure 3-1.

3.2 Impact Evaluation Findings

This section provides a detailed description of impact findings for the 2016 Prescriptive Program, including findings from the deemed savings review, technical review of project documentations, and on-site analysis.

3.2.1 Findings from Program Documentation Review

The evaluation team reviewed current program documentation provided by the implementation contractor. The Prescriptive Program implementation contractor maintains a comprehensive, accessible and navigable set of program documents, the most important of which are the 2016 AEP Ohio Quality Plan, formally called the Policy and Procedures Manual, and the 2016 AEP Ohio Project Management Plan, formally called the Operations Manual.

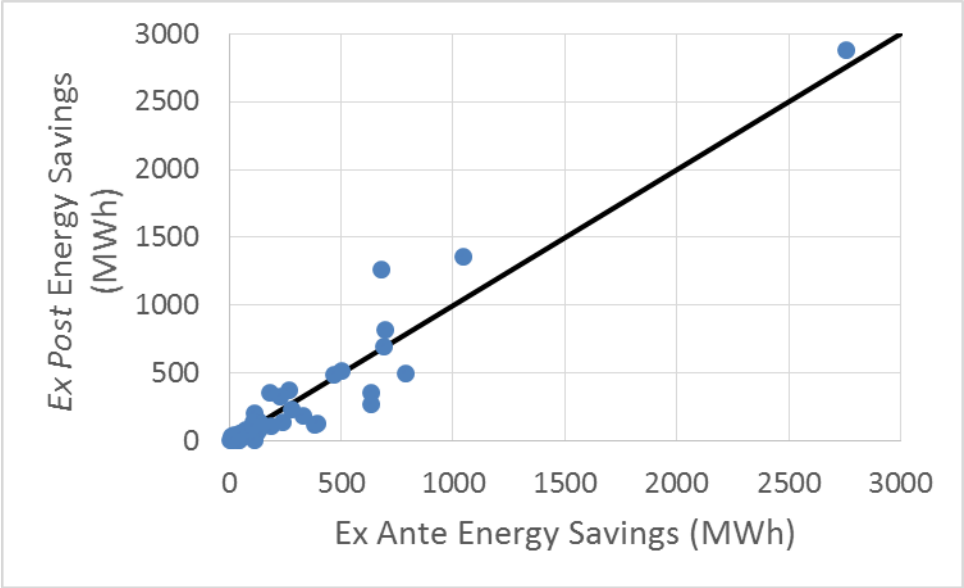
The Quality Plan is most likely customer facing; however, this is not explicitly stated in the document itself. The document outlines customer eligibility, project requirements, incentive caps and limits, incentive amounts per measure, measure descriptions and base cases, and required supporting documentation. The document provides a distinction between the four business sector programs covered, Prescriptive, Self Direct, Custom, and New Construction. Some sections within the document provide clickable links which is a useful tool. For example, there is a link to the online application. Additionally, the document links to equipment specifications and program terms and conditions.

The Project Management Plan looks largely unchanged from the Operations Manual reviewed in 2015. This document looks to serve as an internal reference and compendium of guidelines and processes. The Project Management Plan is an extensive guide containing the purpose of the manual, program overview and goals, purpose of the program, eligible customers/projects/measures, incentive limits, summary of program steps, roles and responsibilities of the implementer and AEP Ohio, key positions, operations, application processing, program controls, complain resolution, invoicing, acceptable calculation methods, specific measure guidelines, quality control process, safety requirements, and EM&V requirements. This document is thorough and comprehensive. Review of this document assures there are processes in place to handle potential issues in an effective manner.

3.2.2 Evaluation Sample Level Impact Results

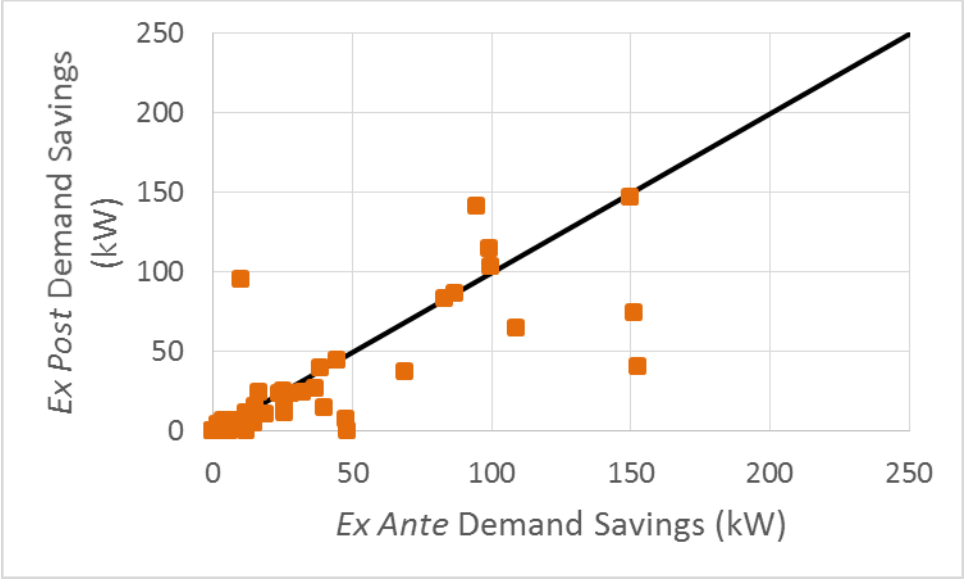
Figure 3-3 and Figure 3-4 show the *ex ante* and *ex post* savings of each sampled project for energy and demand savings, respectively. The data points above the diagonal line represent projects with realization rates greater than one, while data points below the line represent those with realization rates less than one.

Figure 3-3. Comparison of *Ex Ante* and *Ex Post* Energy Savings



Source: Evaluation Analysis of Tracking Data and Sample Results

Figure 3-4. Comparison of *Ex Ante* and *Ex Post* Demand Savings



Source: Evaluation Analysis of Tracking Data and Sample Results

Note, Appendix B of this report contains additional exhibits that focus in on the smaller projects to provide greater resolution on the clusters of projects found in Figure 3-3 and Figure 3-4.

The primary driver for the fluctuations in project level realization rates for lighting projects is deviations in verified hours of use as compared to the deemed values found in the implementation contractor's Appendix A. Verified hours of use are determined most often using between six to ten temporary lighting loggers per site. These loggers track each time a given light is cycled on or off. Logger deployment is

generally leveraged to ensure redundancy in the largest zones with a period of deployment a minimum of two weeks (longer if the deployment period includes a holiday or other atypical period.) Anomalies in occupancy (e.g., holidays or outage events) during the logger period are accounted for in the post-processing. In some cases, when logging is not practical, the evaluation team relies on the customer self-reported hours of use for each of the space types and schedules impacted by the project. Exterior, photocell controlled fixtures are given a fixed hours of use based on a custom analysis of daily Civil Twilight times for Columbus, Ohio.

Additional common contributors to changes in project level results are lighting fixture counts and wattages. Fixture counts tend to be low for projects only partially completed. The primary driver of wattage adjustments is with baseline T12; the reported baseline wattages for these fixtures are regularly identified as having magnet ballasts. Electronic ballasts are sufficiently prevalent in the current market such that these are now cheaper than the old, outdated magnetic ballasts (economy of scale). Therefore, verified baseline watts allow for continued use of the T12 fixture, but the ballasts are assumed to be electronic, as this upgrade is part of routine maintenance when T12s remain in service.

To illustrate these impacts, the two most extreme lighting realization rates are seven percent and 245 percent. These projects are difficult to spot on Figure 3-3 and Figure 3-4 because both are in the Small strata and somewhat obscured by the cluster of projects on the low end of the scale. However, the seven percent kWh realization rate is applied to a lighting project at a church with very low hours of use, which is significantly below the average values found for Assembly in the implementation contractor's Appendix A. The verified hours of use are determined based on temporary data loggers installed at the site for a period of just over two weeks. By contrast, the lighting project with a 245 percent realization rate was found to have two compounding reasons for this extreme adjustment. Here too, temporary lighting loggers were deployed, which confirmed greater hours of use than prescribed to a typical industrial manufacturing site. Also, a typo in the original analysis file underreported the wattage reduction for switching from 458w HID to 86w LED fixtures.

There are also a few key observations for non-lighting projects. Most notable is 2016 VFD projects are highly variable relative to the prescriptive values in the implementation contractor's Appendix A. For the three sampled VFD projects that have continued in operation as planned, the average realization rate is 108 percent. These projects were all process related applications; one from each of the three strata (Small, Medium, and Large). The individual realization rates were 100%, 120%, and 104%, respectively.

However, this VFD average result of 108 percent does not include one project that was temporarily removed from service due to ongoing construction at the site; nor does it include two other projects that blended VFDs with other measures[5]. The VFD temporarily out of service will be back on line after a more than one year of on-going renovations. On balance, for another VFD project the measure is combined with other compressed air system auxiliary components (cycling dryer and low pressure prefilters) and due to much longer runtimes at low speed, this project came in at nearly double the reported savings (in Figure 3-2, this project is represented by the dot located at (682, 1260) equal to a 185% realization rate).

Including all five noted VFD projects, the simple average realization rate is 102 percent. A weighted approach is not appropriate for this relative context, as this is an anecdotal perspective on the projects

[5] Projects are generally evaluated as a whole unit; particularly with multi-faceted HVAC retrofits where multiple measures have interactive impacts on each other's savings. Therefore, with these two blended VFD projects, the VFD specific Realization rate is not available for this measure level call-out.

within the sample and is not intended to represent the ultimate realization rate for this measure within the entire population of projects.[6]

3.2.3 Program Level Impact Evaluation Results

Table 3-2 shows the realization rates and relative precision at the two-tailed 90 percent confidence interval for energy and demand savings. Overall, the impact evaluation substantiated 94 percent of the reported energy savings and 83 percent of the reported demand savings. The relative precision on the sample results was ± 10.4 percent for energy and ± 21.1 percent for demand.

The primary drivers of the precision bounds coming in slightly wider than the 90/10 target is the prevalence and magnitude of variance within project savings are: 1) the use of project specific hours of use; 2) adjustments to the installed and baseline lighting wattages; and 3) the identification of some projects either only partially completed, or taken off-line for an extended period. These three influences combine to cause greater scatter among project level results, both greater than and less than the prescriptive values.

Table 3-2. Energy and Demand Realization Rates and Relative Precision

Stratum Number	Stratum Name	Energy Savings Statistics		Demand Savings Statistics	
		kWh Realization Rate	Relative Precision @ 90% Conf. Int.	kW Realization Rate	Relative Precision @ 90% Conf. Int.
1	Large	0.94	26%	0.83	31%
2	Medium	1.04	13%	0.93	45%
3	Small	0.86	19%	0.75	33%
Overall Value		0.94	10%	0.83	21%

Source: Evaluation analysis of tracking data and sample results

Table 3-3 provides a breakdown of reported and verified savings, both for projects processed through the standard Prescriptive Program, as well as the smaller sub-set of projects that were submitted and processed through the Bid4eficiency program track.

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

Metric	Energy Savings (kWh)	Demand Savings (kW)
Ex Ante Savings Standard Track	129,059,595	18,856
Ex Ante Savings Bid4Efficency	11,294,603	1,800
Ex Ante Savings Total	140,354,197	20,656
Ex Post Savings Standard Track	121,271,806	15,630.7

[6] The sample is designed for statistical validity at the Program level; NOT the measure level.

Ex Post Savings Bid4Efficency	10,898,930	1,538.7
Ex Post Savings Total	132,170,736	17,169
Realization Rate Standard Track	0.94	0.83
Realization Rate Bid4Efficency	0.96	0.85
Realization Rate Overall Program	0.94	0.83

Source: Evaluation Analysis of Tracking Data and Sample Results

As shown in Table 3-4, AEP Ohio achieved 60 percent and 47 percent of the annual program goals for energy savings and demand reduction, respectively.

Table 3-4. 2016 Program Goals, *Ex Post* Savings and Realization Rates

	2016 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)	219,589	140,354	132,171	0.94	60%
Demand Savings (MW)	36,598	20.7	17.2	0.83	47%

Source: [1] AEP Ohio VOLUME 1: 2012 TO 2014 Energy efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014; Evaluation Data Collection and Analysis.

The Prescriptive Program did not meet plan goals; however, the realization rates remain strong and the 10 percent year-over-year increase in verified energy savings indicates the program is continuing to grow. Total project count is up three percent compared to 2015, while *ex post demand* savings are consistent. In other words, in 2016, the Prescriptive Program delivered greater savings than 2015 with projects that are, on average, larger.

The primary contributors to the realization rate are lighting projects with logged hours of use that fall short of the default estimates in the implementation contractor's Appendix A: AEP Ohio Prescriptive Measures Protocols, Business Incentives Program. Baseline wattage is also a key driver for adjustment to both demand and energy savings. In several instances, the baseline watts for T12 measures assume magnetic ballasts; the verified savings apply a T12 wattage consistent with electronic ballasts. Additional savings adjustments occurred due to projects found to have only been partially completed (e.g. all of the claimed lights could not be located on site) or the project was initially completed, but then the equipment was either temporarily or permanently removed due to subsequent renovations. For instance, in one of the VFD projects, the equipment was operational for a short period before building improvements took that particular system completely off-line for at least six to eight months, including during the evaluation period (it remains offline at the time of this report).

3.3 Process Evaluation Findings

This section provides a detailed description of process findings for the 2016 Prescriptive program.

3.3.1 Findings from In-depth Interviews with Program and Implementer Staff

Between September and October of 2016, Navigant conducted interviews with AEP Ohio's Prescriptive Program Coordinator, Business Sector Manager, and the implementation contractor's Operations Manager and Engineering Team.

Application. The 2015 evaluation report included one key process recommendation, to streamline the application process. However, the application remains mostly unchanged from 2015 to 2016. Participants continued to report confusion regarding the application and paperwork required to participate in the program. The existing application is accessible online, but is not an "online" application; an applicant can populate the PDF electronically or print it out and populate manually. AEP Ohio and the implementer have made changes in the past, separating the guidelines and requirements from the measures section, which greatly reduced the length of the application. However, the implementer prefers keeping as many measures as possible in the prescriptive application, which may be overwhelming to customers. Reviewing the existing application with a few customers to identify specific difficulties and comparing the application to other utilities to identify best practices are two key recommendations.

Additionally, there is a surge of applications toward the end of the year annually, what the implementer calls the "hockey stick effect", which is viewed as something it cannot control.

Measures. The majority of savings continue to come from lighting. The advanced lighting controls pilot has been successful according to the AEP Ohio Program Coordinator, resulting in the majority of all lighting projects to include controls. To diversify measure uptake, the program should encourage uptake in non-lighting measures, including compressed air, AC, and motors. Also, the Custom Program Coordinator recommended moving VFDs of a certain size from the Custom Program to the Prescriptive Program. A discussion between program managers and assessment of measures to move from Custom to Prescriptive should occur on an annual basis. Navigant recommends coordinating with the Custom Program staff to identify an ideal break point for which size (hp) VFDs to move to the Prescriptive Program.

Participant diversification. Interviews with both the AEP Ohio Program Coordinator and the implementer indicated savings opportunities in additional market segments, including midsize retail, family-owned grocery stores and restaurants, hospitality, and specific sections of the manufacturing industry. From 2015 to 2016, the tracking data show the number of projects submitted from segments other than industrial/manufacturing greatly increased.

Service Providers. According to interviews with the implementer, there is one Solution Provider who is responsible for approximately a quarter of program savings. This Solution Provider has so many projects in progress at the same time that the implementer is in constant communication with it. In addition, they have biweekly check-in calls and the implementer provides this Solution Provider with a weekly report for them, specifically about their projects. This type of partnership ensures program delivery is smooth for the customer. The implementer should offer other participating Solution Providers the same opportunity.

Key Performance Indicators. Energy savings is the most important performance indicator and the prescriptive program delivered greater *ex ante* savings in 2016 than in 2015. A second important

performance indicator mentioned by the AEP Program Coordinator was customer satisfaction. According to our limited in-person interview conducted in 2016, program satisfaction is high. There are many other performance indicators which the implementer and AEP Ohio should track, including turnaround times and application errors. The implementer mentioned turnaround times to be challenging, and AEP Ohio is considering removing turnaround times from its contract. Additionally, the implementer said application errors have been consistent for the last four years and have not decreased. These are two opportunities to improve application processing, which should improve customer satisfaction.

3.3.2 Findings from On-Site Participant Surveys

Program participants were surveyed as part of the on-site impact evaluation. Navigant performed in-person interviews with 38 program participants. Satisfaction with the Prescriptive Program was high, scoring 9.5 on a 0 to 10 rating scale. Utility satisfaction was 8.8 on the same scale. Reasons for the lower utility satisfaction score included power reliability issues, communication of outages, and issues with receiving rebates. Positive comments included having a great account representative and receiving reliable power.

The majority of participants reported first hearing about the program from a contractor (56%), followed by an AEP Ohio representative (22%), word of mouth (15%), and corporate (7%). These percentages show the program is marketed as designed. Additionally, the majority of respondents had participated in the program prior to 2016 (71%) and plan to participate in the program again in the future (95%). This is a good indicator participants have been satisfied with the program and have the intent to continue participating in the future. However, the high percentage of repeat participants indicates the program may not be reaching new customers.

Participants reported numerous reasons for participating, including but not limited to, receiving a rebate (42%), saving money (22%), saving energy (22%), installing better equipment (7%), and reducing maintenance (3%). Responses were closely aligned for the main benefits of participating, but also included reducing their carbon footprint and knowledge of new technology. The majority of customers see no drawbacks to participating in the Prescriptive Program. A few respondents mentioned first cost (6%), and rebate processing time, contractor trust, and lack of a point of contact (all at 3% each) as possible drawbacks. The most common perceived barrier for lack of participation (a quarter of participants reported) is issues with first cost and having the capital to invest. Recommendations included offering financing opportunities to all prescriptive participants.

3.3.3 Findings from Program Tracking Data Review

The evaluation reviewed the tracking data for completeness and overall quality and analyzed the tracking data to answer process-related research questions. Findings from this analysis follow.

3.3.3.1 Tracking Data Quality and Completeness

Prescriptive Program tracking data is relatively complete and high quality. Entries are entered and formatted in a uniform manner, and the dataset as a whole is well-organized. Visual inspection of the data did not reveal any entries that were clearly in error, such as text recorded in numerical fields, inconsistent spelling or naming conventions, etc. Contractor contact and email were missing for approximately ten percent and twenty percent of projects, respectively. The ability to identify the contractor for a given project is critical. If, for instance, AEP Ohio needs to analyze differences in some aspect of project performance between contractors, missing information would not allow for complete evaluation.

3.3.3.2 Participation Characteristics

Participation in 2016 (1,067 customers completed 2,118 projects) was fairly consistent with 2015 (954 customers completed 2,070 projects). However, Small Retail/Service and Large Retail/Service completed more projects in 2016 than in 2015, surpassing Industrial/Manufacturing as the generators of the largest number of projects. No single business type dominated the program in 2016, and projects were spread between a large number of business types, as shown in Figure 3-5. Miscellaneous businesses, schools, grocery, large office, multifamily, and restaurants each generated 100 or more projects in 2016.

Energy savings were also spread out this year with the concentration of savings coming from industrial/manufacturing, followed by large retail/service (Figure 3-6). Industrial/manufacturing firms generated over 30 GWh of savings through the program in 2016, while the next largest business type, large retail/service businesses contributed over 20 GWh. The diversity in project participants and distribution of savings improved from 2015.

Figure 3-5. Project Count by Business Type

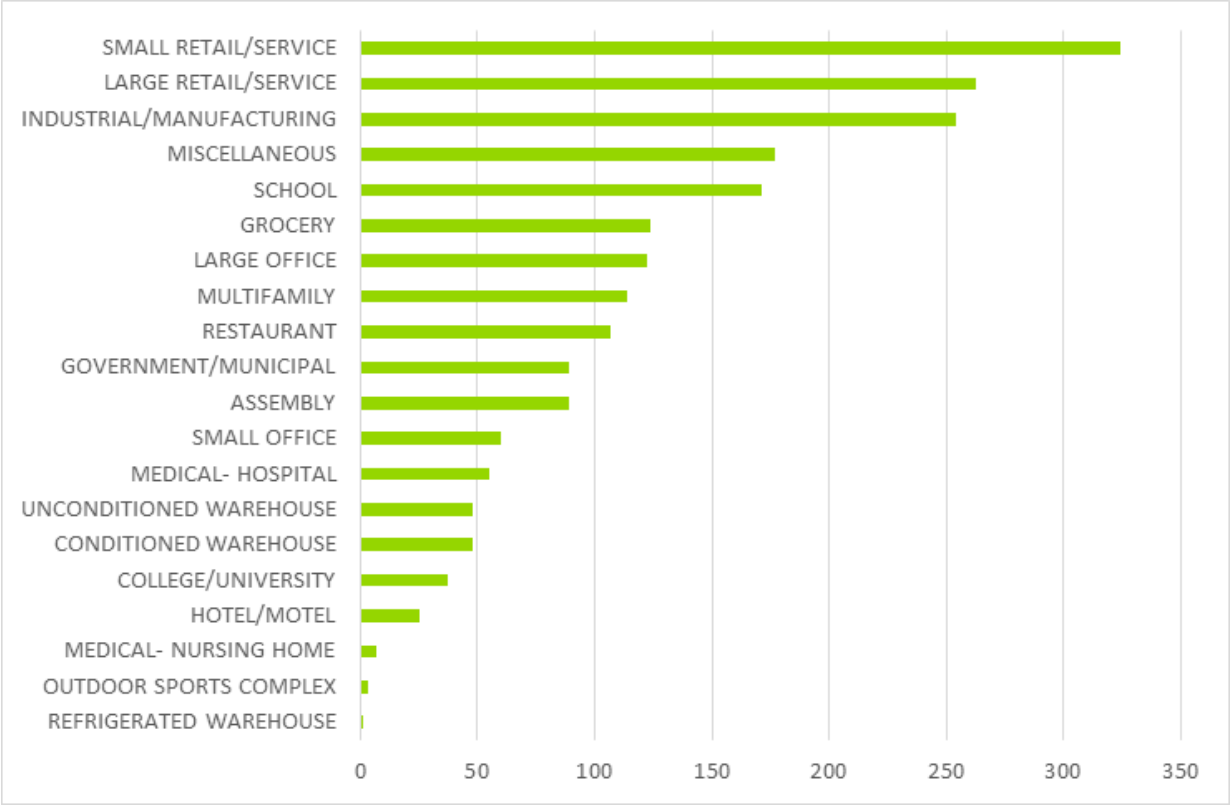
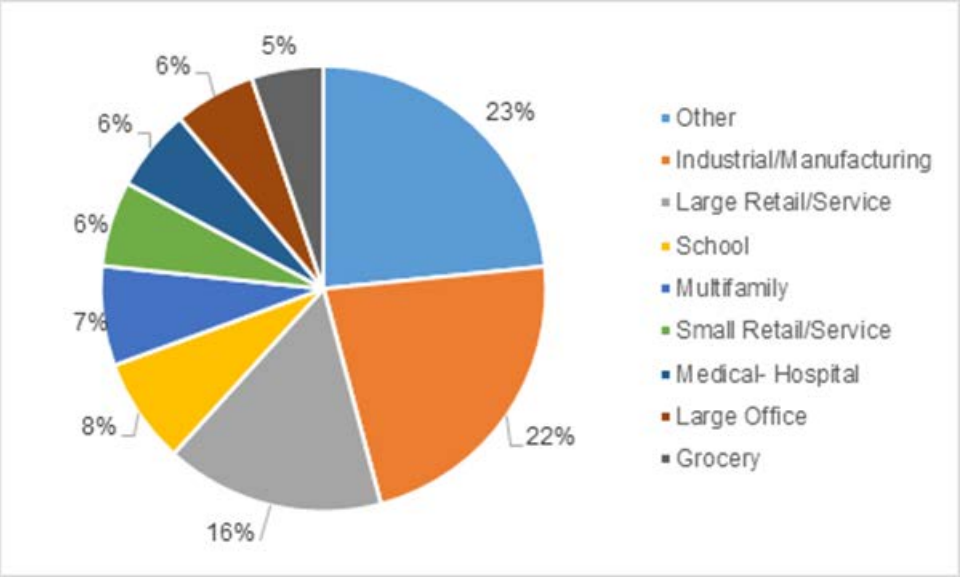


Figure 3-6. Percentage of *Ex Ante* Energy Savings by Business Type



In Figure 3-6, the "Other" category contains: Conditioned Warehouse (3%), College/University (3%), Unconditioned Warehouse (3%), Government Municipal (2%), Assembly (2%), Restaurant (1%), Hotel/Motel (1%), Small Office (1%), and Miscellaneous (6%). Total might not equal 100% due to rounding.

3.3.3.3 Post Inspection by Implementer

One of the guidelines defined in the program's Project Management Plan is that a given percentage of projects will be visually verified by the implementation contractor during a post-inspection. Per these program implementation guidelines, the post inspection targets by strata are: 90 percent of large projects, 25 percent of medium sized projects, and 10 percent of small projects.

The evaluation team attempted to confirm the achieved rate of post inspections from three different directions. The first was by checking the project level supporting documents provided for the Impact evaluation for a post inspection report. The second approach was through the "PostInspectionRequired" field in the program database. A third point of reference is derived from the "PostInspectionPassedDate" field in the program database. Based on these points of reference, the findings shown in Table 3-5 indicate that the implementation contractor is not meeting the stated post-inspection targets.

Table 3-5. 2016 Post-Inspection Goals vs. Achieved

Stratum Name	Implementation Contractor Post-Inspection Target	Sample Size for Supporting Document Review	Percent of Sampled Projects with Post Inspection Forms	Records in Program Database	Percent of Projects Flagged as Post Inspection Required	Percent of Projects with Post Inspection Date in Database
Large	90%	14	43%	68	21%	21%
Medium	25%	24	4%	280	9%	10%

Small	10%	32	3%	1770	3%	4%

3.4 Cost Effectiveness Review

This section addresses the cost effectiveness of the Prescriptive Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-6 summarizes the unique inputs used in the TRC test.

Table 3-6. Inputs to Cost-Effectiveness Model for Prescriptive Program

Item	Value
Average Measure Life	9
Projects	2,118
Annual Energy Savings (kWh)	132,170,736
Coincident Peak Savings (kW)	17,169
Third Party Implementation Costs	$2,968,311
Utility Administration Costs	$1,285,176
Utility Incentive Costs	$11,545,416
Participant Contribution to Incremental Measure Costs	$44,418,298

Based on these inputs, the TRC ratio is 1.4. Therefore, the program passes the TRC test. summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-7. Cost Effectiveness Results for the Prescriptive Program

Test Results for Prescriptive	Ratio
Total Resource Cost	1.4
Participant Cost Test	2.2
Ratepayer Impact Measure	0.7
Utility Cost Test	4.3

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 2016 realization rates (defined as *ex post* savings / *ex ante* savings) are 0.94 for energy savings and 0.83 for demand savings. The 2016 Prescriptive Program evaluation resulted in the following conclusions and recommendations.

Conclusions and Recommendations from Process and Impact Evaluation

1. **Finding 1a:** The relative precision at the two-tailed 90 percent confidence interval is ± 10.4 percent for energy savings. One of the primary drivers of this precision bound is nine projects with a realization rate of 50 percent or less, in combination with four projects that have a realization rate of 150% or greater. Projects from all three strata (Large, Medium, and Small) are included in these counts of extremely high/low realization rates. Further contributing to the number of projects with significant variance in project level realization rate is the team's extensive use of data logging to verify lighting hours of use.

   - **Recommendation 1:** The implementation contractor should review and continue to refine the prescriptive savings for lighting measures, in particular the default hours of use by building type.

2. **Finding 2:** The relative precision at the two-tailed 90 percent confidence interval is 21 percent for demand savings. These larger than expected error bounds are primarily driven by differences in reported vs verified fixture counts; corrected coincidence factors (per logged data); as well as adjustments to baseline wattage for T12 fixtures.

   - **Recommendation 2:** When the baseline for a lighting measure is a T12 fixture, the wattage for that baseline equipment should reflect an electronic ballast.

3. **Finding 3:** Lighting measures continue to dominate the program, with 83 percent of the reported energy savings and 81 percent of the reported demand savings; not including the additional 2.5 percent of savings from lighting in refrigerated cases. The largest non-lighting end-uses were VFDs, heating, ventilation and air-conditioning (HVAC) and refrigeration.

   - **Recommendation 3a:** To diversify the program and ensure long term stability, program staff, the implementation contractors, and Solution Providers should look for opportunities to promote non-lighting measures. For example, program staff and implementation contractor can partner with HVAC contractors to teach them how to apply and underscore the benefit to their business.

   - **Recommendation 3b**: Identifying and targeting under participating markets, including, but not limited to: hospitality, family owned restaurants and grocery stores and others identified in the program staff's segmentation effort.

   - **Recommendation 3c**: Leverage the data currently available in the tracking database, in combination with GIS software to identify areas of greatest and least program activity. Use this map to strategically target new areas and recruit additional trade allies in those areas.

4. **Finding 4:** Except for one instance where the equipment is temporarily out of service due to site renovations, VFDs continue to outperform expectations at the project level. Yet, in aggregate, VFD projects and the associated energy savings are the lowest since 2012.
   - **Recommendation 4a:** AEP Ohio should leverage account representative and customer relationships, implementation contractors, and Solution Providers to promote and reinvigorate this measure.
   - **Recommendation 4b:** Prescriptive savings for this measure would benefit from an iterative process whereby annual verification results based on metered data are used to update savings estimates.
   - **Recommendation 4c:** Consider switching the savings estimation approach for this measure from a purely prescriptive (per hp) value, to a simple analysis tool that helps refine the baseline operation, load reduction, and energy savings estimate, in order to improve the accuracy of the initial savings estimates for this measure.
5. **Finding 5:** The program tracking database does not currently include a field for tracking PJM winter peak impacts from eligible measures.
   - **Recommendation 5a**: Add a field to the program tracking database in order to capture and monitor PJM Winter peak demand savings.
   - **Recommendation 5b**: Investigate options to reverse engineer PJM Winter Peak impact estimates from the currently available values. Specifically, AEP Ohio could back out the Summer AEP Ohio coincidence factor (CF) and then apply PJM Summer and PJM Winter CFs to estimate the PJM demand reduction at the alternate times of day and year.
6. **Finding 6:** The implementation contractor's Appendix A provides Summer CF for lighting measures. However, this reference does not include CF-specific to the PJM Winter peak. Similarly, the implementation contractor's Appendix A does not have winter specific, heating HVAC Interactive Factors.
   - **Recommendation 6:** The implementation contractor's Appendix A prescriptive savings need to include a winter CF and interactive factor (IF). In particular, exterior fixtures previously did not contribute to AEP Ohio's summer peak demand reduction, but now should be assessed for potential contributions to PJM winter peak savings. These Winter Peak impacts can be retroactively applied to eligible measures incentivized during PY2016.
7. **Finding 7:** For lighting measures the implementation contractor's Appendix A provides estimates of HVAC interactive impacts for the summer period, which are subsequently used to adjust savings. However, this reference does not include HVAC interactive factor values specific to the PJM Winter peak.
   - **Recommendation 7:** The implementation contractor's Appendix A should expand to include a Winter HVAC Interactive Factor (IF) distinct from the Summer Interactive Factor values currently in use. This estimate needs to be sensitive to the saturation of non-electric heating technologies.
8. **Finding 8:** Bid for Efficiency (B4E) projects outperform projects submitted via the standard track. Given the relatively small number of B4E projects (59 in 2016), these projects were not allocated to their own strata for evaluation purposes. Therefore, this finding could be an artifact of the variance in realization rate by strata in combination with the ratio of these projects per strata vs. the overall program. In other words, B4E projects are typically on the larger side; therefore, if the large strata

has a higher realization rate than the other strata, then the slightly higher average realization rate for B4E projects are artificially inflated.

- **Recommendation 8:** in subsequent evaluations, the evaluation team should consider assigning B4E projects to their own strata to ensure the ability to draw more statistically valid conclusions about how projects implemented via the B4E tract.

4.2 Key Process Evaluation Findings and Recommendations

The following section details the evaluation team's key observations from participant interviews, conversations with the implementation contractor, as well as feedback from program staff. These process related recommendations can also stem from direct review of supporting documents and other program files that occurs as part of the impact evaluation data review process.

9. **Finding 9:** Participant survey respondents indicated dissatisfaction with the application process. Improving the application process was the most common response when participants were asked for suggestions to improve the program.

   - **Recommendation 9:** Streamline the application process. Because customers have identified complex and burdensome paperwork and an overly time-consuming application process as key drawbacks to the program, the program should make changes to the application process to streamline and simplify the process faced by customers. One approach to this would be to offer the current application for participants seeking incentives for a wide variety of measures in one project; but also offer measure specific applications for participants seeking incentives for only one type of measure within a given project.

10. **Finding 10:** During an interview with a large customer-participant, the interviewee mentioned the company is actively discussing plans to opt out of the program in the near future. As part of a separate conversation, AEP Ohio staff mentioned several other, large customer-participants have opted out starting in 2017. Additionally, this concern was also raised during the implementation contractor interview.

    - **Recommendation 10a:** Ensure AEP Ohio key account representatives are properly matched to their respective accounts and that these AEP Ohio reps have the bandwidth to establish and maintain good communication with their key accounts.
    - **Recommendation 10b:** Continue to debrief previous participants that have since opted out to develop a complete picture of why these companies have elected to opt out.
    - **Recommendation 10c:** Ensure both the incentive for participation, and penalty for opting out are complimentary.

11. **Finding 11:** It appears the implementation contractor is not meeting its post inspection targets.

    - **Recommendation 11:** The implementation contractor and program managers should discuss the reasonableness of the stated post-inspection targets and develop a strategy for reaching those targets.

12. **Finding 12:** The implementation contractor hosts biweekly calls and provides daily reporting to one high performing Solution Provider.

    - **Recommendation 12:** Navigant recommends the implementation contractor expand these offerings to other high performing Solution Providers. The implementation contractor should also pursue opportunities to provide all participating Solution Providers with feedback on their performance.

13. **Finding 13**: A large number of projects were submitted at year end, resulting in a crunch for the utility, implementer, and evaluator.
    - **Recommendation 13a**: Implement an incentive structure which better paces applications throughout the program year. Utilizing a project reservation system could act as a gate keeper for who is completing projects and when they are completing them. Additionally, instituting a contractor rating and performance feedback system would influence the timeliness of project completion and deter project submission at the last minute
    - **Recommendation 13b:** Other methods to space project across the year include providing an incentive bonus during certain times of the year that are typically lower volume for applications, or heavily promoting certain end uses at particular times of year.
14. **Finding 14**: The implementation contractor has not reduced its number of application errors over the years.
    - **Recommendation 14**: Navigant recommends a review of application errors, the causes and frequency, and setting a goal to reduce the errors ultimately resulting in improved processing times.
15. **Finding 15**: Certain measures in the Custom Program are more appropriate for the Prescriptive Program.
    - **Recommendation 15**: Conduct an annual review of measures and decide which measures to shift from the Custom Program to the Prescriptive Program. For example, the Custom Program Coordinator recommended shifting variable speed drive applications that are larger (for example over 200hp) from Custom to Prescriptive.
16. **Finding 16**: The most common perceived barrier for lack of participation (a quarter of participants reported) is issues with first cost and having the capital to invest.
    - **Recommendation 16:** The program may want to consider offering financing opportunities to Prescriptive Program participants.

APPENDIX A. PARTICIPANT INTERVIEW GUIDE

A.1 AEP Ohio Evaluation for the Self-Direct Program

2016 Participant In-Depth Interview Guide

Name: Date:

Title: Company:

Contact Info: Project Number:

Interviewer:

Participation and Other Programs

P1. How did you first hear about the AEP Ohio Prescriptive Program?

P2. Have you participated in the AEP Ohio Prescriptive Program or any other AEP Ohio Energy Efficiency programs before 2016?

P3. What was the primary reason you participated in the AEP Ohio Prescriptive Program?

Program Improvements

PI1. On a scale of 1 to 10, where 1 is very dissatisfied and 10 is very satisfied, how would you rate your satisfaction with the AEP Ohio Prescriptive Program?

PI2. And using the same scale, how would you rate your satisfaction with AEP Ohio overall?

PI3. What do you see as the main benefit(s) to participating in the AEP Ohio Prescriptive Program?

PI4. What do you see as the drawbacks to participating in the program?

PI5. What do you think are reasons companies like yours may not participate in the program?

PI6. Do you plan to participate in the program again in the future? (If no, why not?)

PI7. How would you improve the AEP Ohio Prescriptive Program?

PI8. What additional measures or types of equipment would you like to see added to the program?

Thank you for your time, if there is anything else you would like to share, let me know.

A.2 Program Manager Interview Guide

AEP-Ohio Evaluation for Business Prescriptive and Self Direct Programs

2016 Program Staff In-Depth Interview Guide

Name of Interviewee: Date:

Title: Company: AEP Ohio

Contact Information:

[Note to Interviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff and implementation contractors. 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. The interviews will be audio taped and transcribed. Interviews in every case will be conducted by Navigant's process evaluation lead for the program to ensure full context and understanding for the interview, and to enable the interviewer to probe for the most meaningful questions and responses.

Roles and Protocols (Please answer with respect both to your role managing the Prescriptive Program and the Self Direct Program)

1. Has your role changed over time and if so, how?

2. With respect to DNV GL, AEP OHIO staff and the solution providers, do you think there have been any substantial changes in the roles and people assigned to these programs in the past year compared to previous program years? If so, what were they?

3. How often do you meet with the implementation contractors of each program, and in what manner? Do you feel information between you and the implementation contractors is shared in a timely manner? If not, what can be done to improve this situation? Last year you responded that more face to face meetings might help for the Prescriptive program. Has anything changed on this front?

Program Changes, New Measures, Measure Mix and Incentives

4. [PRESCRIPTIVE] Have there been any changes to measures offered in 2016? Are there any planned changes on the horizon? What does the current mix of measures look like from your perspective (lighting versus HVAC versus VSDs, etc.)?

5. [PRESCRIPTIVE] Do you have any suggestions for measures that should be added?

6. Have you made any changes to incentive levels in 2016, and do you plan to make any in 2017?

7. Have there been any other significant changes to the program (delivery, components, etc.) in 2016, and do you have any significant changes planned for 2017? Why were/are these changes made, and how do they affect program performance?

8. [SELF DIRECT] Have you seen any changes to the mix of measures being claimed through the Self Direct program in 2016 relative to previous years?

Overall Goals and Objectives

9. Do you expect to meet the program savings goals in 2016 (for instance are the number of rebate applications on track)?

10. Of course, energy savings goals are primary, but how are the Prescriptive program and Self Direct program doing with respect to other goals and objectives? (Ohio jobs, outreach and participation levels, customer satisfaction, cost effectiveness, etc.)

Program Theory, Market Barriers and Barriers to Participation

11. In your own words, what are the market barriers addressed by the Prescriptive and Self Direct programs, and how do these programs overcome them? (We are looking for cause and effect relationships)

12. What do you see as the key barriers to program participation for the Prescriptive and Self Direct programs, and how is the program overcoming these? Have Solution Providers and AEP Account Executives been successful at removing these barriers to participation? If so, how, if not, why?

Marketing and Promotion

13. [BOTH] Please describe the Prescriptive program and Self Direct program marketing approaches in your own words. Include all relevant components, and describe how effective you think they are.

14. [BOTH] Is the current level of marketing sufficient and does it address all measure end-use categories equally well, or are some over or under represented? (E.g. lighting, HVAC, refrigeration, motors, etc.)

15. [BOTH] How could marketing for the Prescriptive program and Self Direct program be improved?

Program Process Overall

16. What processes work really well in the Prescriptive program and Self Direct program, and what processes need improvement? (e.g., communication, time processing applications, customer interaction, marketing, relationship between utility and implementation contractor, etc.)

17. What do you think is the biggest process area for improvement going forward? (i.e., —what processes could be changed that would have the biggest positive impact on program functioning and performance?)

18. How is QA/QC currently handled for this program, and what improvements could/should be made?

Solution Providers

19. Do you have a sense of Solution Providers' overall satisfaction with their participation in the Prescriptive program and Self Direct program in 2016 and in working with the implementation contractors? Have you noticed or heard any changes from past years?

20. Are Solution Providers and the implementation contractor meeting your expectations for the Prescriptive Program and Self Direct program? If not, what could be improved?

21. Did AEP Ohio offer trainings or marketing materials in 2016 to help support Solution Providers market the programs? Was there a Solution Provider bonus in 2016?

Customer Interest, External Factors, Strengths and Weaknesses

22. Based on your experience with implementing the program and communicating with customers, how did interest in the programs in 2016 compare to interest in 2015?
23. Are economic conditions affecting the program? If so, how?
24. In your opinion, what is working best in the Prescriptive program and Self Direct program, and what needs the most improvement?

Wrapping Up

25. Are there any questions I didn't ask that you think I should be asking? I would love to hear any insights you have that have not come up during the course of our interview.

Thank you very much for talking with me today. If additional questions arise, would it be alright to contact you by email?

A.3 Implementation Contractor Interview Guide

AEP-Ohio Evaluation for Prescriptive, Custom and Self Direct Programs
2016 Implementation Contractor In-Depth Interview Guide

Name of Interviewee: Date:

Title: Company:

Contact Information:

[Note to Interviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff and implementation contractors. 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. The interviews will be audio taped and transcribed. Interviews in every case will be conducted by Navigant's process evaluation lead for the program to ensure full context and understanding for the interview, and to enable the interviewer to probe for the most meaningful questions and responses.

Roles and Protocols (Please answer with respect both to your role managing the Prescriptive Program and the Self Direct Program)

1. [ALL] Has your role changed over time and if so, how?

2. [ALL] With respect to AEP OHIO staff and the solution providers, do you think there have been any substantial changes in the roles and people assigned to these programs in the past year compared to previous program years? If so, what were they?

3. [ALL] How often do you meet with AEP Ohio staff for each program, and in what manner? Do you feel information between DNV GL and AEP Ohio is shared in an efficient manner? If not, what can be done to improve communication?

Program Changes, New Measures, Measure Mix and Incentives

4. [P AND C] Have there been any changes to measures offered in 2016 across the three programs? Are there any planned changes on the horizon? What does the current mix of measures look like from your perspective (lighting versus HVAC versus VSDs, etc.)?

5. [P AND C] Do you have any suggestions for measures that should be added?

6. [ALL] Have you made any changes to incentive levels in 2016, and do you plan to make any in 2017?

7. [ALL] Have there been any other significant changes to the programs (delivery, components, etc.) in 2016, and do you have any significant changes planned for 2017? Why were/are these changes made, and how do they affect program performance?

Overall Goals and Objectives

8. [ALL] Do you expect to meet the program savings goal in 2016 (for instance are the number of rebate applications on track)?

9. [CUSTOM] The end of the year can be crunch time as customers rush to get applications in. The Custom program manager mentioned that you'd brought extra engineers on board to handle the volume. Are you on track to get all these end-of-year applications processed? What about projects in final review? The program manager also mentioned a large cue of projects in final review. Do you expect to have these finalized before the end of the year? Is there anything you feel DNV GL could do in future years to ease the number of projects still waiting in final review at the year's end?

Program Theory, Market Barriers and Barriers to Participation

10. [ALL] In your own words, what are the market barriers (i.e., things preventing people from taking the same actions without the program) addressed by these programs—in other words, why is there a need for the program—and how does the program overcome these barriers? (We are looking for cause and effect relationships)

11. [ALL] What do you see as the key barriers to program participation for the Prescriptive program, and how is the program overcoming these?

12. [ALL] What is the status of an online application system for these programs?

Marketing and Promotion

13. [ALL] Please describe the marketing approach to each of these programs in your own words. Include all relevant components, and describe how effective you think they are.

14. [ALL] How could marketing for these programs be improved?

Program Process Overall

15. [ALL] What processes work really well in each program, and what processes need improvement? (e.g., communication, time processing applications, customer interaction, marketing, relationship between utility and implementation contractor, etc.)

16. [ALL] What do you think is the biggest process area for improvement going forward? (i.e., —what processes could be changed that would have the biggest positive impact on program functioning and performance?)

17. [ALL] How is QA/QC currently handled for this program, and what improvements could/should be made?

18. [ALL] We like to review program materials the implementation contractor has in place as part of our overall review. Would you be able to share with us a copy of the Operations Manual, QA/QC guidelines, process flow diagrams or other documents that help guide program implementation?

Solution Providers

19. [ALL] Do you have a sense of Solution Providers' overall satisfaction with their participation in these programs in 2016? Have you noticed or heard any changes from past years?

20. [ALL] Are Solution Providers meeting your expectations for the Prescriptive Program? If not, what could be improved? Are Solution Provider's spread across the territory well, or are some areas less well represented?

21. [ALL] Did AEP Ohio offer trainings or marketing materials in 2016 to help support Solution Providers market the program? Was there a Solution Provider bonus in 2016? How does the bonus affect program participation?

Customer Interest, External Factors, Strengths and Weaknesses

22. [ALL] Based on your experience with implementing the program and communicating with customers, how did interest in these programs in 2016 compare to interest in 2015?
23. [ALL] Are economic conditions are affecting these programs? If so, how?

Wrapping Up

24. [ALL] Are there any questions I didn't ask that you think I should be asking? I would love to hear any insights you have that have not come up during the course of our interview.

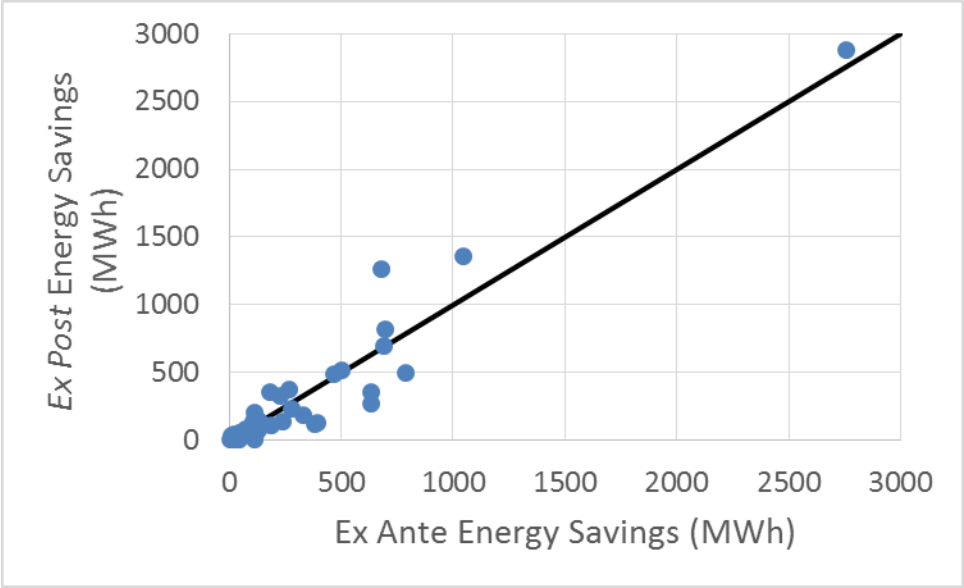
25. [ALL] I have heard, talking to several people about examples recently of Solution Provider s taking so long to submit paperwork for the Prescriptive or Custom programs that projects ultimately get submitted and claimed under Self Direct instead. Do you have a sense of how common this is, if at all?

Thank you very much for talking with me today. If additional questions arise, would it be alright to contact you by email?

APPENDIX B. DISTRIBUTION OF REALIZATION RATES FOR SAMPLED PROJECTS

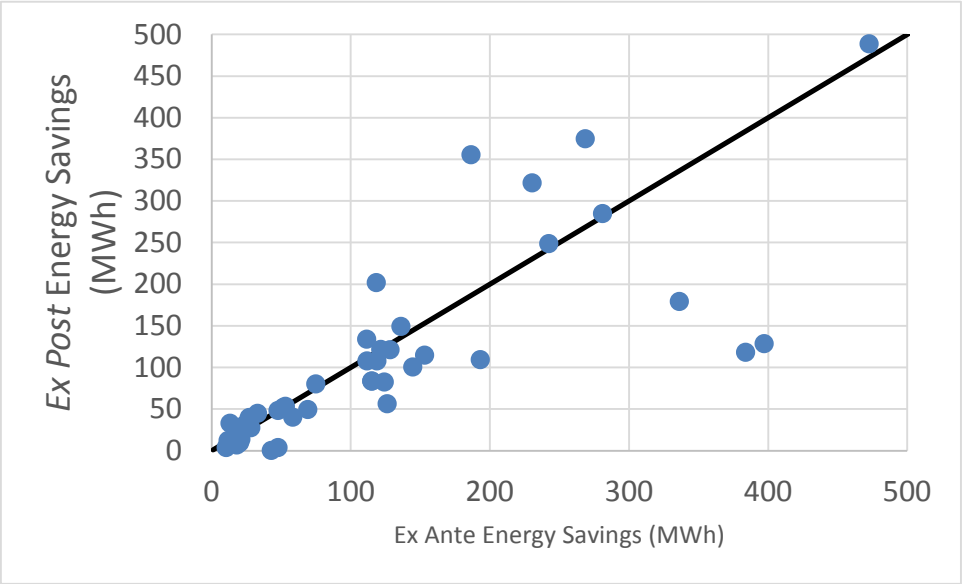
The following Appendix is a supplemental look at the data provided in Section 3.2.2. Specifically, these exhibits provide a higher resolution look at the realization rates for projects sampled in the Small stratum.

Figure 4-1. Comparison of *Ex Ante* and *Ex Post* Energy Savings for All Sampled Projects



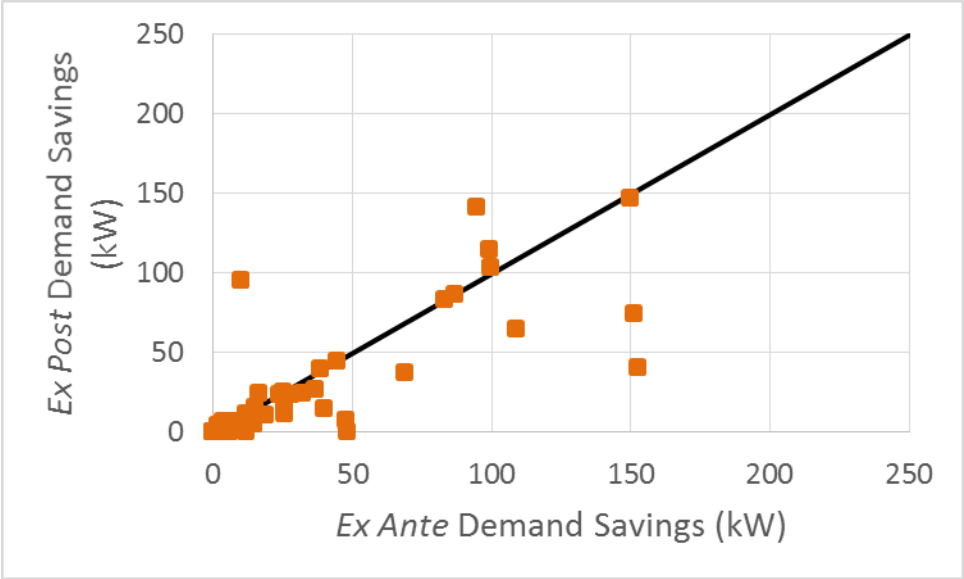
Source: Evaluation Analysis of Tracking Data and Sample Results

Figure 4-2. Comparison of *Ex Ante* and *Ex Post* Energy Savings for Smaller Projects



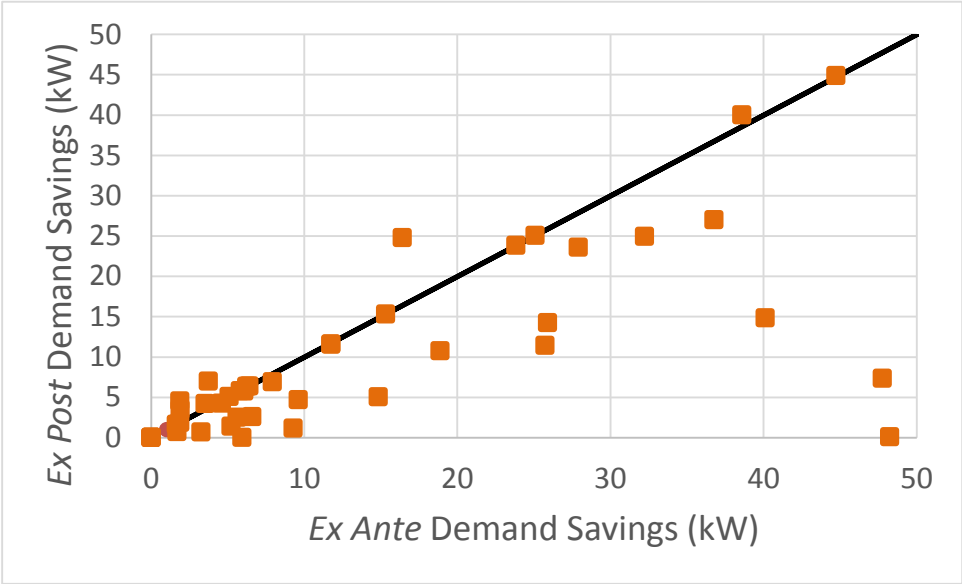
Source: Evaluation Analysis of Tracking Data and Sample Results

Figure 4-3. Comparison of *Ex Ante* and *Ex Post* Demand Savings for All Sampled Projects



Source: Evaluation Analysis of Tracking Data and Sample Results

Figure 4-4. Comparison of *Ex Ante* and *Ex Post* Demand Savings for Smaller Projects



Source: Evaluation Analysis of Tracking Data and Sample Results

There are too many individual projects with Realization Rates that vary by more than +/- 20 percent from unity to justify detailed explanations of why each specific project was adjusted. However, Section 3.2 provides insight into the primary drivers for these savings adjustments across the sample as a whole.

APPENDIX J

CUSTOM PROGRAM

2016 Evaluation Report

Prepared for:

AEP Ohio

A unit of American Electric Power

May 11, 2017

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2016 Evaluation Report

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ES. EXECUTIVE SUMMARY

This document presents a summary of the findings and results from the evaluation of the AEP Ohio 2016 Custom Program for the period January 1, 2016 through December 31, 2016.[1]

ES.1 Program Summary

The Custom Program provides a streamlined incentive application and quality control process intended for non-residential customers interested in purchasing and installing efficient technologies not included on the pre-qualified list of measures employed by the Prescriptive Program. Custom equipment includes controls, variable speed air compressors and other compressed air measures, cooling or heating coil replacement, insulation, process efficiency improvements and other miscellaneous measure installations. Custom Program applications can also include prescriptive measures receiving incentives as though these were submitted through the Prescriptive Program.

ES.2 Program Participation

In 2016, the AEP Ohio Custom Program completed 72 projects, installing 115 measures at 66 locations for 62 unique AEP Ohio customers. Participation in 2016 is similar to 2015 participation by both project count and *ex ante* energy savings, although *ex ante* demand savings are significantly higher in 2016.

Each project contained at least one custom measure which placed the project in the Custom Program. Applications could also contain Prescriptive measures that were co-submitted and are also counted only through the Custom Program. The Prescriptive measures included in the Custom Program are evaluated as though these were submitted through the Prescriptive Program by applying prescriptive realization rates to those measures. Table ES-1 provides a summary of 2016 Custom Program reported results. Custom Program projects enrolled through two different incentive channels, custom incentives and Bid4efficiency incentives.

Table ES-1. 2016 Custom Program Projects, Measures, and *Ex Ante* Savings

Metric	Custom Track	Bid4efficiency Option	Prescriptive Co-Submitted	Total Custom *Ex Ante* Value‡
Number of Projects	52	20	15*	72
Number of Measures	51	20	44	115
Annual Energy Savings (MWh)	18,522	33,481	1,479	53,482
Peak Demand Savings (MW)	1.952	2.566	0.147	4.665

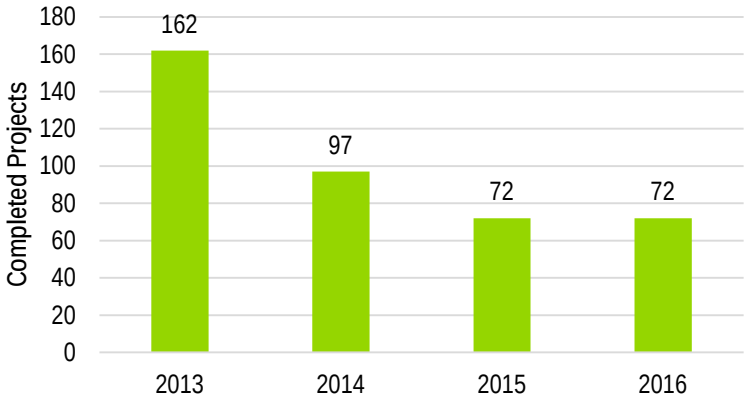
[1] 2016 program participation is based on an implementation contractor payment mailed date between January 1, 2016 and December 31, 2016.

* Note these projects are a subset of the Custom and Bid4efficiency tracks.

Source: Evaluation analysis of AEP Ohio tracking data from January 19, 2017.
‡Excludes Combined Heat and Power Projects filed and approved by PUCO.

The number of 2016 Custom Program projects stayed the same as 2015. Compared to the 2015 Custom Program, there were no significant changes to the 2016 program design and administration.

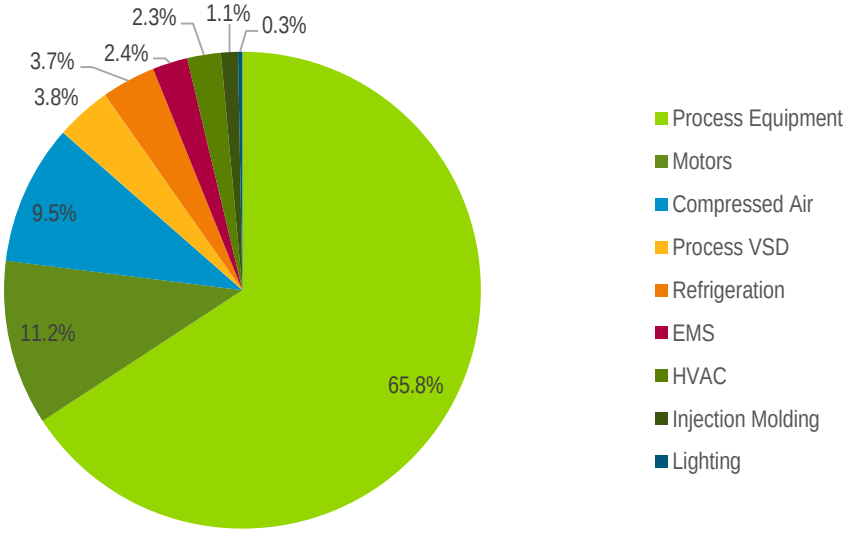
Figure ES-1. Custom Program Projects by Year



Source: Evaluation analysis of AEP Ohio tracking data from January 19, 2017.

Measures submitted through the Custom Program reflect a broad variety of energy efficiency and conservation measures. Figure ES-2 shows program energy savings by end-use. Several industry-specific measures form the largest savings end-use, including Process Equipment (61 percent), Motors (13 percent), and Compressed Air (11 percent). Additional measures comprising the remaining 15 percent of program savings are Process VSD, Refrigeration, EMS, HVAC, Injection Molding, and Lighting.

Figure ES-2. 2016 Custom Program Energy Savings by End-Use



Source: Evaluation analysis of AEP Ohio tracking data from January 19, 2017.

ES.3 Key Evaluation Findings and Recommendations

ES.3.1 Key Impact Findings and Recommendations

The impact results for the 2016 Custom Program are shown in Table ES-2, which shows the *ex ante* savings claimed by the program, the evaluated savings, and the 2016 realization rates. In 2016, the program achieved *ex post* savings of 43 GWh energy and 3.89 MW peak demand. The realization rate for 2016 was 80 percent for energy and 83 percent for demand savings. Reasons for adjustments to savings estimates varied between projects, but generally included one or more of the following themes.

- The evaluation team interpreted the baseline differently, including technology adjustments and adjustments to the baseline period.
- Supplemental production and energy data acquired by the evaluation team modified some results.
- Differences in methodology used to calculate savings, especially for peak demand savings calculations.

Table ES-2. Program Savings and Realization Rates for 2016

	2016 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)	67,456	53,482	43,003	0.80	64%
Demand Savings (MW)	8.99	4.67	3.89	0.83	43%

Sources: *AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.* Evaluation analysis of AEP Ohio tracking data from January 15, 2016.

The 2016 Custom Program impact evaluation resulted in several findings and recommendations. The key findings and recommendations to increase program realization rates are highlighted below.

1. **Finding 1:** Several large projects that relied on whole building monthly energy use and production received low realization rates due to significant month-to-month variation and seasonal effects. The pre- and post- data presented in the original application often did not represent steady state usage, and the addition of more post- data resulted in significant savings reductions. In one instance, Navigant questioned whether a project should be considered an energy efficiency project.
   - **Impact Recommendation 1a:** For energy intensity projects, ensure process improvements can be quantified, make sense from an engineering perspective, and do not simply reflect production or yield increases. Require additional pre- and post- data to ensure seasonal trends are accounted for. Consider a brief period of hourly data logging to understand detailed system performance. Use pre-retrofit production levels rather than post-production levels, where appropriate, based on counterfactual options for production increases to calculate final energy savings, and consider a dual baseline for increased production.

- **Impact Recommendation 1b:** The program should enforce its requirement to submit a pre-application prior to purchasing equipment or otherwise committing to a project, which will help ensure viable projects move forward in an orderly manner. Encourage Solution Providers to work with large customers on a proactive basis to assist in creating value for customers through energy efficiency. This action has the additional benefit of encouraging additional pre-retrofit data logging, and a better understanding of the baseline conditions.
- **Impact Recommendation 1c:** Quantify other efficiency improvements and load changes in both the pre- and post- conditions. These efforts can have significant impact on monthly energy intensities.

2. **Finding 2:** Demand savings should be characterized based on average savings during the various peak periods, including AEP Ohio peak, PJM summer peak and PJM winter peak. Errors include using maximum peak load rather than coincident peak load, and incorrect hours for the coincident peak definitions.
   - **Impact Recommendation 2a:** Ensure demand savings are recorded in the tracking data separately for AEP Ohio, PJM summer, and PJM winter. This will improve the accuracy of PJM estimates and reduce uncertainty.
   - **Impact Recommendation 2b:** For projects with hourly data, especially energy intensity improvements associated with increased production, ensure the correct coincident time period is used in the calculations.

ES.3.2 Key Process Findings and Recommendations

The 2016 evaluation resulted in several findings and recommendations.

1. **Finding 1:** The 2016 *ex ante* and *ex post* energy and demand savings fell short of program goals. Prior evaluations have demonstrated the year-to-year success of the program relies on a few very large projects, but more projects, even if smaller, will tend to reach more commercial and industrial participants who can benefit from the program. Correspondingly, large projects are important for program goals, but over-reliance on large projects can impede the program from broad-based participation, appeal and acceptance.
   - **Process Recommendation 1a:** Keep a steady, modest pipeline of very large projects to support the program and ensure close tracking to program savings goals. Enhance outreach to enroll more diverse projects and participants that can deliver more projects of all sizes. Encourage Solution Providers to submit applications in a steady flow throughout the year. This might include additional outreach during the first quarter.
2. **Finding 2:** Industrial and manufacturing sector projects continued to dominate the program in 2016. The AEP Ohio Program Coordinator indicated interest in expanding marketing efforts, including increasing outreach and targeted marketing to other customer segments outside of industrial and manufacturing.
   - **Process Recommendation 2a:** There is an opportunity to diversify the participating customer base by implementing Solution Provider requirements. Currently, a few Solution Providers brings in the majority of the savings and specialize in industrial/manufacturing customers. By encouraging different Solution Providers to participate and grow their businesses, either through training, additional research on barriers to entry, and creating limited-time incentives, the customer type and measure type could diversify.

- **Process Recommendation 2b.** The program marketing team should develop case studies highlighting successful projects and opportunities, and piloting initiatives with industry professional groups similar to the initiative with the wastewater management group. AEP Ohio should publish these case studies in a new version of the Energy Efficiency Today magazine.

1. INTRODUCTION

This evaluation report chapter covers the Custom Program element of the AEP Ohio Energy Efficiency and Peak Demand Reduction (EE/PDR) Portfolio.

1.1 Program Description

The Custom Program offers incentives to non-residential customers who install eligible high-efficiency electric equipment not covered under the Prescriptive Program. The Custom Program provides a streamlined incentive application and quality control process intended to facilitate ease of participation for customers interested in installing eligible efficient technologies.

The AEP Ohio Business Sector Programs are marketed, administered, and delivered as an integrated program by AEP Ohio. The Custom Program is managed by an implementation contractor in coordination with AEP Ohio.

1.2 Key Program Elements

The goals of the 2016 Custom Program were to exceed the MWh targets in AEP Ohio's Energy Efficiency/Peak Demand Reduction (EE/PDR) Plan at or below the program budget, improve customer satisfaction with the program, and increase outreach to customers. The program savings goals and critical elements are unchanged from 2015 to 2016. The following section provides a summary of critical program elements.

1.2.1 Performance Incentive

Custom incentives are available based on the project's first year kilowatt-hour (kWh) savings. The structure of the incentive is the same as in 2015, and the incentive regimens for the base incentive is shown in Table 1-1.

Table 1-1. Incentive Parameters

Energy Incentive	Incentive Cap
$0.08 / kWh	50% of total incremental project cost (materials + external labor)

Incentive Limits.
For projects approved in 2016, incentives were limited as follows:

- Project-level incentives are capped at $25,000 or 50% of project incremental costs.
- Projects, which would exceed the $25,000 incentive cap, can apply for additional incentives through the new Bid4Efficiency (B4E) process.

The Bid4efficiency option is an online reverse auction for financial incentives aimed for large projects with an incentive more than $25,000. During the auction, pre-qualified customers and Solution Providers can submit bids to deliver energy savings at a price per annual kilowatt hour saved or Watts reduced. The pre-qualified bidder(s) with the lowest bid prices will be eligible for incentive awards ranging from $50,000 to $1,000,000 for the completion of energy efficiency projects.

1.2.2 Participation Milestones

Custom projects are tracked against key program milestones and requirements, including requirements for pre-approval, pre-installation and post-installation inspections based on project size, incentive reservation and payment and project cancellation. These milestones have not changed for several years.

1.2.3 Measures and Incentives for 2016

Eligible equipment includes process improvements reducing gross energy consumption or consumption per unit produced, HVAC measures such as VFDs and chillers, equipment controls, variable speed air compressors, process insulation, and other miscellaneous energy efficiency measure installations. Most of these measure installations are “True Custom” measures, in the sense that simple deemed savings and/or simple-to-apply algorithms do not already exist for this heterogeneous set of measures. Lighting projects are also eligible for custom incentives when non-standard equipment is installed.

1.2.4 Solution Provider Participation

AEP Ohio and the implementer maintain a Solution Provider (trade ally) network of contractors. These contractors have been trained on the program, applied to market the program, and are listed on the AEP Ohio website as a registered contractor for AEP Ohio’s business sector programs.

1.3 Evaluation Overview

The three major objectives of the evaluation are to: (1) quantify energy savings and summer peak demand reduction from the 2016 Custom Program; (2) determine key process-related program strengths and weaknesses and identify ways in which the program can be improved; and (3) provide data to determine program cost effectiveness. The evaluation sought to answer the following research questions.

1.3.1 Impact Questions

1. Were the impacts reported by the program achieved?
2. What were the realization rates? [Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings]. Do measures interact with other systems to affect gross energy savings?
3. Have measure costs and incentives been calculated according to the program design?
4. What are the benefits, costs and cost effectiveness of this program?

1.3.2 Process Questions

Marketing and Participation

1. Is the marketing effort sufficient to meet current and future program participation goals?
2. What type of support is the program providing to Solution Providers? Is it sufficient?
3. Is the program outreach to customers effectively increasing awareness of the program opportunities?

Administration and Delivery

4. Has the program, as implemented, changed from 2015? If so, how, why, and was this an advantageous change? Were more measures moved to the Prescriptive Program?
5. Do the program processes effectively provide incentives to customers and motivate the Solution Providers to participate? Has the program made progress in reducing the project approval and review time for more complex projects?
6. Have the verification procedures been implemented in a manner consistent with program design? Is the implementation contractor meeting the verification goals?
7. What are the opportunities for program improvement?

To answer these questions, the evaluation included four main activities: (1) desk review of project files and savings estimates, (2) on-site post-installation inspections for impact evaluation, (3) in-depth interviews with program coordinators and program implementers and (4) participant interviews during on-site inspections.

2. METHODOLOGY

This section describes the methodology used to conduct the impact and process evaluations for the Custom Program. Table 2-1 summarizes the various activities undertaken for the impact and process evaluation. The evaluation team reviewed program tracking data, which contains information on projects implemented through the Custom Program. Navigant reviewed program documents and the technical documents for sampled projects. Primary data collection efforts included in-depth telephone interviews and follow-up emails questions with program staff at AEP Ohio and the program implementer, as well as on-site inspections and supplementary data collection.

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	Project Management Plan, Quality Plan and other program documents	Process Evaluation
Application Technical Review	Sampled projects	Impact Evaluation
On-site Verification and interviews	Selected projects from the Sample	Impact and Process Evaluation
Telephone Verification	Selected projects from the Sample	Impact Evaluation
In-depth Interviews	Program staff and implementer	Process Evaluation

2.1 Tracking Data Review

The impact evaluation reviews the tracking data to identify potential adjustments to *ex ante* reported savings for measures due to outliers, missing information, or tracking system data entry or calculation errors. However, the evaluator did not address whether the tracking system is adequate for regulatory prudency reviews or corporate requirements. Evaluation adjustments identified through the Tracking System savings review would have been made to all measures in the population where the adjustment was found to be applicable. The assessment of the tracking data and program activity is discussed in Section 3.2.1. The process evaluation also includes review of the tracking data for process-related purposes. A detailed description of process-related tracking data system review is provided in Section 2.7.

2.2 Program Documentation Review

For the 2016 program, the evaluation team reviewed the following documents to understand the details of the 2016 program and to inform the evaluation.

- AEP Ohio Custom Program website
- DNV GL AEP Ohio Project Management Plan
- DNV GL AEP Ohio Quality Plan

2.3 Project Verification

Project verification for a sample of sites is the basis of the impact evaluation. Navigant used a variety of techniques, including project file reviews, on-site verification, and telephone verification, to calculate verified project savings. The specific technique applied was dependent on the quality of data presented, the presence of missing data points, and engineering judgement.

2.3.1 Engineering Review

Navigant conducted application documentation and engineering reviews on a sample of projects randomly selected according to protocol from the customer participant population. For each selected project, Navigant performed an in-depth review of project documentation to assess the engineering methods, parameters and assumptions used to generate the *ex ante* reported savings and estimated incentives. When possible, measure quantities were verified by comparing these to invoices from contractors or suppliers. If a post-inspection site visit was carried out, measure quantities and specifications from the inspection were used.

For each custom measure in the sampled project, Navigant estimated *ex post* savings based on the review of project documentation and engineering analysis. *Ex post* adjustments to *ex ante* savings were based on building-specific information, invoices, additional billing history, additional project and site data, specification sheets and other documentation to the extent it was judged more representative of the project than *ex ante* or default measure savings assumptions. Prescriptive measures filed with Custom Program applications were treated as other Prescriptive Program measures. The Prescriptive Program realization rates for energy and demand savings were applied to all prescriptive measures, as in previous program evaluations.

Reasons for changes to *ex ante* reported savings could include the following:

- Hours of use
- Coincidence factor
- Baseline equipment specifications
- Post-retrofit equipment specifications
- Additional post-installation data
- Other changes, such as analysis methodology

Engineering-based energy and demand reduction algorithms were followed to compute *ex post* savings. Program incentive algorithms were followed for verifying incentives.

2.3.2 On-site Verification

In the Custom Program 2016 Evaluation Plan, Navigant projected five on-site inspections based on 80 estimated program participants, with sites selected from the application documentation review sample.

Navigant conducted three on-site inspections to obtain additional information used to calculate *ex post* project savings. A major factor contributing to the relatively low number of on-site inspections was the number of high-value sites that had extensive post-installation data in the project files. Navigant was able to supplement post-installation data without going on-site, and additional on-site research would not have contributed more value for these sites.

A site-specific measurement and verification (M&V) plan was developed for each project scheduled for on-site data collection. Each plan explains the general impact approach, provides an analysis of the current inputs (based on the application and other available sources at that time), and identifies sources that will be used to verify data or obtain newly identified inputs for the *ex post* impact approach. For most projects, on-site sources include interviews completed at the time of the on-site visit, visual inspection of the systems, equipment and spot measurements, and supplementary energy use and production data.

After all field data were collected, annual energy and demand impacts were developed based on the on-site data, monitoring data, application information, and, in some cases, billing or interval data. Each project engineering analysis was based on calibrated engineering models that made use of review and on-site gathered information. Once the *ex post* impacts were developed for each project in the sample, the results were reviewed at the project-level by an experienced engineer familiar with the evaluation. Using *ex post* savings results, Navigant estimated an *ex post* realization rate (which is the ratio of the *ex post* savings to *ex ante* reported savings) for each stratum. The stratum-level realization rates were then applied to the population of *ex ante* reported savings by strata. The result is an *ex post* estimate of savings for the program.

2.3.3 Telephone Verification

In some cases, there is a critical, simple piece of information Navigant can obtain via a telephone call to the customer. This process is analogous to the process used to determine if a specific project review warrants an on-site visit to obtain additional information. Navigant completed three telephone verification inspections to supplement the impact analysis.

2.4 In-depth Program Staff Interviews

In-depth interviews were conducted with key staff from AEP Ohio and implementation contractor, DNV GL, as described in Table 2-2. Interviews were designed to provide insights into program function, identify program strengths and areas for improvement, document changes to the program in 2016 and the effects of these changes, and identify how, and to what extent, process recommendations from the 2015 evaluation report have been addressed during 2016. Interviews were conducted between September and October, 2016 by the program process evaluation lead, and were recorded and transcribed verbatim for reference. The interview guides used for these interviews are included in an Appendix. Detailed findings from these interviews are provided in Section 3.3.1.

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	Program Key Staff	Custom Program Coordinator and Business Sector Manager	2	September 2016
	DNV/GL Program Staff	Program Key Staff	Operations Manager and Engineering Team Lead	2	October 2016

2.5 Process Evaluation Tracking Data Review

While tracking data is essential to impact evaluation, it can also contribute important insights to the process evaluation. For instance, the process evaluation is concerned, in part, with how satisfied customers are with their experience in the program, and the wait time between submitting an application and receiving an incentive rebate may influence satisfaction. This is an example of a process-related metric that can be explored by reviewing program tracking data. Another useful example is that, in some cases, the evaluation team might need to analyze a particular variable in the tracking data and find entries for that field are mostly missing or incomplete. This result would lead to a recommendation to improve data entry and recorded as a process improvement for the program.

The process evaluation team completed a thorough review of the tracking data and system with process-related questions in mind. The findings and results of this analysis are presented in Section 3.3.3.

2.6 Program Documentation Review

Program documents play an essential role in ensuring all parties involved in implementing a program have adequate resources to understand intended program design and protocols. Even if a program is well designed and has adequate documentation, how the program is administered in reality may not conform to how program administration is intended. For this reason, program documentation is also essential for comparing against current practice to ensure program procedures and protocols are adhered to, and the program is implemented in accordance with its design.

As a critical part of its evaluation activities, the process evaluation team acquired all relevant and available documentation for the Custom Program from AEP Ohio and the implementation contractor, and reviewed this material both to determine the documents were up to date and sufficient, and to compare against observed current practice in the program. Findings and results of the program documentation analysis are provided in Section 3.3.4.

2.7 Data Sources Summary

The data collected for evaluation of the 2016 Custom Program was gathered during a number of activities including:

- In-depth telephone interviews with AEP Ohio program coordinators and the implementation contractor
- Tracking system data review
- Documentation technical review of a sample of projects
- On-site measurement and verification at customer sites for a subset of projects sampled from the application documentation technical review

Table 2-3 provides a summary of these data collection activities including the targeted population, the sample frame, and the time frame in which data collection occurred.

Table 2-3. Data Collection Activities for 2016 Evaluation

Data Collection	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis	Custom Program projects approved for payment for 2016	AEP Ohio Tracking Database	-	All	November 2016 to April 2017
In-depth Interviews	AEP Ohio Program Staff	Key Program Staff	Custom Program Coordinator and Business Sector Manager	2	September 2016 to October 2016
	DNV GL Staff	Key Program Staff	Operations Manager and Engineering Team Lead	2	
Application File Review	Tracking Database	Stratified Random Sample by Project-Level kWh	Stratified Random Sample by Project-Level kWh	18	December 2016 to April 2017
On-site Verification	Application File Review Sample	Application File Review Sample	Key issue sites	3	March 2017 to April 2017
Telephone Verification	Application File Review Sample	Application File Review Sample	Key issue sites	3	January 2017 to April 2017

2.8 Sampling Plan

The sample design and selection process for custom projects targeted a relative precision of ±10% or better at a 90% level of confidence. The program-level *ex ante* reported savings data were analyzed by

measure type, project size, and number of projects by individual companies to inform sample design. After analysis, the sample design selected for the Custom Program evaluation was stratified by project size. Project size is defined as the sum of all *ex ante* installed custom kWh within an individual project, as defined by unique project IDs assigned by AEP Ohio. Navigant excluded Custom Program prescriptive measures from the sampling frame and applied Prescriptive Program realization rates for the final program realization rates.

Navigant sorted projects from largest to smallest kWh savings and placed these into strata, attempting to achieve a relatively even distribution of cumulative standard deviation in energy savings between strata and minimize overall sample size.

- Stratum 1 equates to projects with large reported energy savings (more than 2.5 GWh)
- Stratum 2 is medium-sized projects (less than 2.5 GWh and more than 0.5 GWh)
- Stratum 3 is for the smallest projects (less than 0.5 GWh)

This approach resulted in a total sample of 18 projects for application documentation and engineering review. Navigant directly sampled 69 percent of the reported program MWh savings and 71 percent of custom measure savings. Table 2-4 provides a profile of the impact measurement and verification (M&V) sample in comparison with the populations within each stratum. The estimated relative precision of this sample at 90% confidence is ± 9.7% based on a CV of 0.5, although final relative precision values may differ depending on project variation.

Table 2-4. Profile of the Impact M&V Sample by Strata – Custom Measures Only

	Population Summary			Sample	
Sampling Strata	Number of Projects (N)	*Ex Ante* Savings (MWh)	n	*Ex Ante* Savings (MWh)	Sampled Percent of Population
Strata 1 (Large)	5	26,016	5	26,016	100%
Strata 2 (Medium)	13	15,199	7	9,353	62%
Strata 3 (Small)	54	10,787	6	1,331	12%
Total or Value	72	52,003	18	36,700	71%

Source: Evaluation analysis of program tracking data and Navigant analysis.

3. DETAILED EVALUATION FINDINGS

This section presents the detailed findings from the 2016 Custom Program evaluation related to (1) program activity, (2) impact findings, (3) process evaluation findings, and (4) cost effectiveness review.

3.1 Program Activity

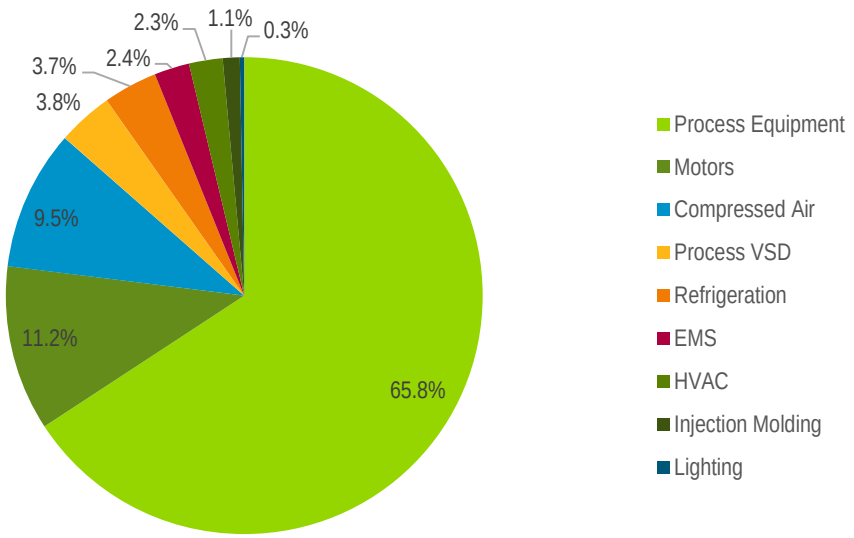
The evaluation team analyzed data delivered by AEP Ohio on January 19, 2017. As shown in Table 3-1, the 2016 Custom Program paid incentives on 72 projects constituting 53,482 MWh of *ex ante* reported annual energy savings. About three percent of Custom Program savings are from prescriptive measures submitted on the same applications. Among the prescriptive measures co-submitted with Custom, more than 60 percent are lighting. The balance of prescriptive measures is split between air compressors and VFDs. The Custom Program demonstrates adequate measure diversity in terms of affected end-uses. The distribution of savings among end-uses is shown in Figure 3-1.

Table 3-1. 2016 Custom Program Projects, Measures, and *Ex Ante* Savings

Metric	Custom	Prescriptive Co-Submitted	Total Custom *Ex Ante* Value[‡]
Number of Projects	72	15	72
Number of Measures	71	44	115
Annual Energy Savings (MWh)	52,003	1,479	53,482
Peak Demand Savings (MW)	4.518	0.147	4.665

Source: Evaluation analysis of AEP Ohio tracking data from January 19, 2017
[‡]Including Bid4Efficiency

Figure 3-1. 2016 Custom Program Energy Savings by End-Use



Source: Evaluation analysis of AEP Ohio tracking data from January 19, 2017

Large process improvement projects dominate the breakdown of program energy savings by end-use. Process improvement projects at primary metals and other industrial sites were holistic and encompass several end-uses that cannot be disaggregated. Motors comprise 13 percent of program savings. Compressed air projects, including compressor replacement, VFD retrofits, controls and optimization comprise 11 percent of program savings. All the other measure types contribute less than five percent of program savings each.

Table 3-2 shows a profile of 2016 Custom Program participation by market segment. Participation was highest within the Industrial and Manufacturing sector, which accounted for 81 percent of program reported energy savings and 77 percent of the reported demand savings. Each of the non-manufacturing business types has only modest participation in the Custom Program.

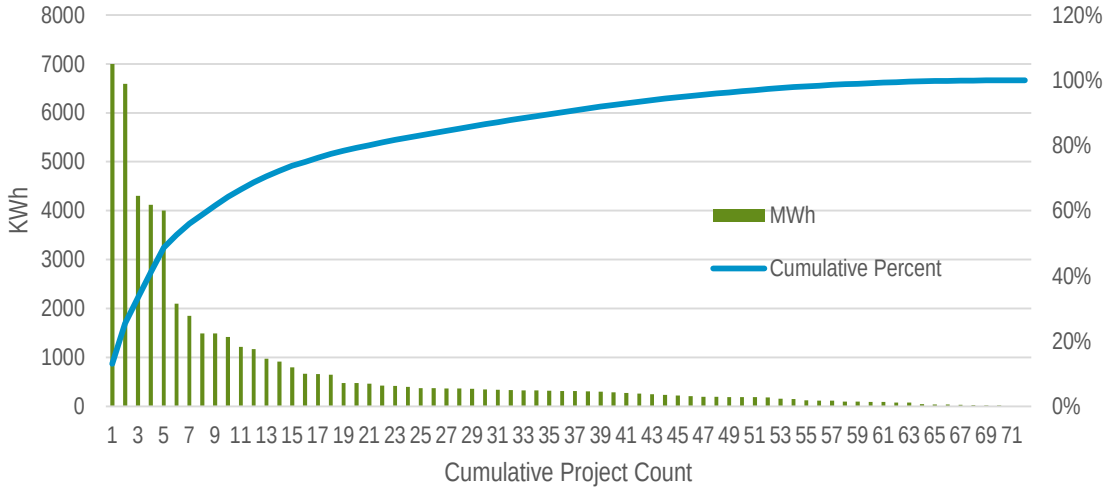
Table 3-2. 2016 Custom Program Participation by Business Type

Business Type	Project Count‡		*Ex Ante* Reported Savings (MWh)		*Ex Ante* Reported Savings (kW)	
College/University	2	3%	479	1%	55	1%
Conditioned Warehouse	1	1%	311	1%	0	0%
Government/Municipal	5	7%	5,417	10%	440	9%
Grocery	4	6%	811	2%	10	0%
Hotel/Motel	1	1%	477	1%	25	1%
Industrial/Manufacturing	47	65%	43,250	81%	3,595	77%
Large Office	4	6%	337	1%	137	3%
Large Retail/Service	1	1%	4	0%	0	0%
Medical- Hospital	3	4%	1,681	3%	268	6%
Restaurant	1	1%	22	0%	9	0%
School	2	3%	328	1%	85	2%
Unconditioned Warehouse	1	1%	364	1%	42	1%
Total	72	100%	53,482	100%	4,665	100%

Source: Evaluation analysis of tracking data from AEP Ohio database exports from January 19, 2017.
‡Excludes Combined Heat and Power projects that were filed & approved by PUCO.
Note: Totals may not sum due to rounding.

Figure 3-2 shows five projects account for just under 50 percent of program savings and 16 projects encompass 75 percent of the savings. The 51 smallest projects comprise 25 percent of program savings. Projects are sorted by descending Custom Measure savings.

Figure 3-2. 2016 Distribution of Savings by Project



Source: Evaluation analysis of tracking data from AEP Ohio database exports from January 19, 2017.

3.2 Impact Evaluation Findings

This section presents the results and findings from the impact evaluation of the 2016 Custom Program.

3.2.1 Program Impact Results

The statistical method of ratio estimation was used for combining individual realization rates from the sample projects into an estimate of *ex post* energy savings for the population.[2] In the case of a separate ratio estimator, a separate energy savings realization rate is calculated for each stratum and then combined – and weighted by savings in each stratum. These steps are matched to the stratified random sampling method used to create the sample for the program[3]. The standard error was used to estimate the error bound around the estimate of *ex post* energy savings and demand reduction.

The realization rate (defined as *ex post* savings divided by *ex ante* reported savings) is 80 percent for energy savings, and 83 percent for demand reduction. Relative precision values for the 90 percent confidence interval are 11.1 percent and 15.1 percent for energy and demand, respectively.

In general, the project-level energy realization rates across strata were loosely grouped around 1.00 with a few notable exceptions. Exceptions were instances where evaluators disagreed with the estimation methods used in the *ex ante* calculation or additional post-installation data changed the annual savings estimates. The electric demand realization rate is driven by two projects which had significant claimed ex ante demand savings, which was not apparent with preliminary post-installation production data.

Based on the impact parameter estimates described in the following section, Navigant estimated the *ex post* program impacts resulting from the 2016 Custom Program, as shown in Table 3-3. No further adjustments were made to evaluated savings.

Table 3-3. Savings Estimates for 2016 Custom Program

	2016 Program Goals[1] (a)	*Ex Ante* Savings[2] (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goals = (c) / (a)
Energy Savings (MWh)	67,456	53,482	43,003	0.80	64%
Demand Savings (MW)	8.99	4.67	3.89	0.83	43%

Sources: [1]*AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014.* [2]Evaluation analysis of AEP Ohio tracking data from January 19, 2017

The 2016 *ex post* energy and demand savings fell short of program goals. Several large projects contributed significantly to the program impacts. Prior evaluations have demonstrated the year-to-year

[2] A full discussion of ratio estimation can be found in Sampling: Design and Analysis, Lohr, 2010 2nd Edition, pp. 144-145.

[3] The Zone 1 Non-Lighting 1 stratum had only three projects, and only one of these was sampled. Rather than calculate a realization rate for this stratum separately, the evaluation team combined Zone 1 Non-Lighting projects into one stratum for the statistical extrapolation.

success of the program relies on these large projects, but more projects, even if smaller, will tend to reach more commercial and industrial participants who can benefit from the program. Many projects have energy impacts that occur off-peak and several related to productivity improvements, thus energy savings may be proportionally larger than demand savings.

3.2.2 Realization Rate Driving Factors

Navigant estimated *ex post* program impacts based on engineering review, on-site verification, and telephone verification, following the methodology outlined in Section 2.3. Observations from the verification experience were that the implementation team and AEP Ohio have a quality control approach that appears sufficient to prevent systemic inaccuracies, ensures energy savings are realized, processes applications in a fair manner, and ensures rebate payments are appropriate. Several large projects, however, received low energy and demand realizations rates, as explained later in this section. Table 3-4 shows project verified savings and realization rates for all 18 projects sampled for the impact evaluation.

Table 3-4. Project Evaluated Savings and Realization Rates

Project	*Ex Ante*		*Ex Post*		Realization Rate	
	MWh	kW	MWh	kW	MWh	kW
Industrial 1	7,000	799	2,438	0	35%	0%
Industrial 2	6,590	0	5,466	0	83%	-
Industrial 3	4,306	248	4,569	248	106%	100%
Government 1	4,117	339	3,715	424	90%	125%
Industrial 4	4,002	499	3,219	0	80%	0%
Industrial 5	1,964	163	1,985	163	101%	100%
Industrial 6	1,849	215	1,849	215	100%	100%
Industrial 7	1,490	173	1,509	175	101%	101%
Industrial 8	1,488	0	1,498	0	101%	-
Industrial 9	977	0	0	0	0%	-
Industrial 10	916	110	923	114	101%	103%
Industrial 11	669	145	638	139	95%	96%
Industrial 12	372	25	371	59	100%	235%
Industrial 13	340	48	340	48	100%	100%
Grocery 1	330	4	31	4	9%	89%
Industrial 14	100	9	99	25	100%	276%
Grocery 2	96	1	10	1	10%	112%
Office 1	94	17	93	9	100%	55%

Figure 3-3 and Figure 3-4 below show a comparison of *ex ante* and *ex post* savings for all of the sampled projects. This gives a graphical representation of the realization rates:

- Projects above the line have a realization rate above 100 percent.

- Projects below the line have a realization rate below 100 percent.

Figure 3-3. *Ex Post* vs *Ex Ante* Energy Savings

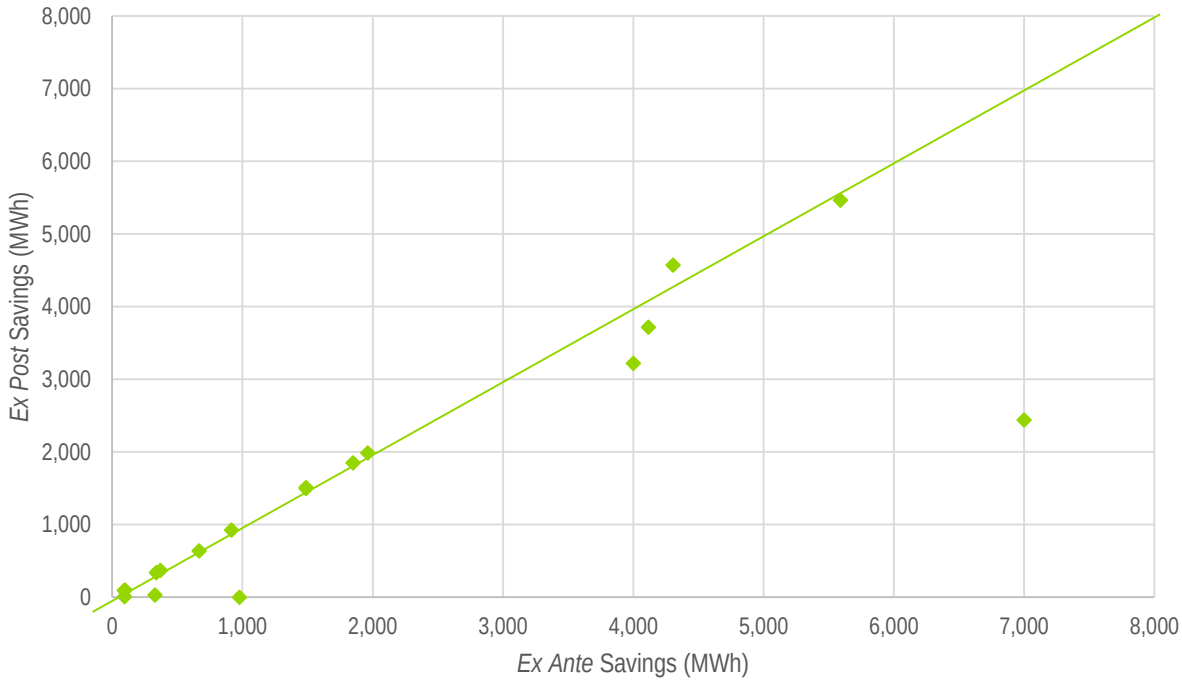


Figure 3-4. *Ex Post* vs *Ex Ante Demand* Savings

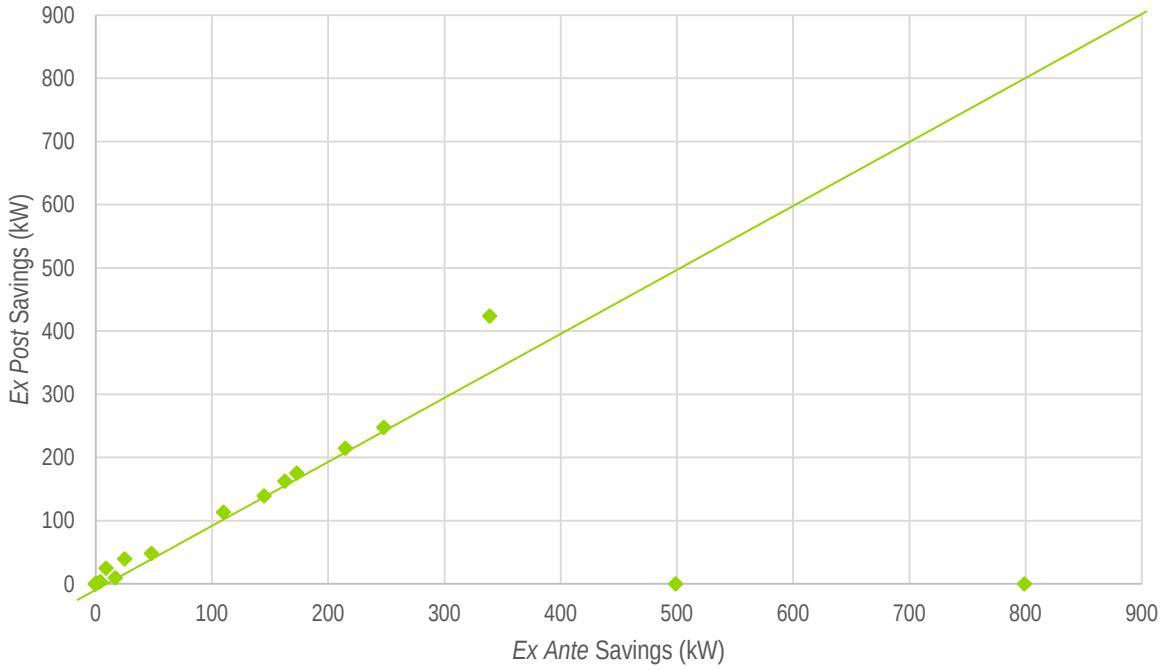


Table 3-5 provides a high-level summary of the changes made to the *ex post* savings. Reasons for changes reflect primarily one-off changes or interpretation of the data and project context, and are explored in further detail below for the sites that were identified as major contributors to the program level realization rates.

Table 3-5. Project Explanation for Changes in Estimates

Site	Explanation
Industrial 1	Additional post-data lowered energy intensity improvement estimates. Seasonal component was not captured in the ex *ante* estimates, which further reduced verified savings. Seasonality resulted in increased usage in the summer, zeroing out demand savings.
Industrial 2	Incorporated baseline production that was left out of original analysis.
Industrial 3	Minor adjustments
Government 1	Minor adjustments
Industrial 4	Adjustments to production rate to use pre-production values rather than post-production. Demand savings methodology not based on coincident peak definition.
Industrial 5	Minor adjustments
Industrial 6	Minor adjustments
Industrial 7	Minor adjustments
Industrial 8	Minor adjustments

Industrial 9	Navigant did not consider this an energy efficiency project. Machine shop purchased additional equipment to use alongside existing equipment to increase throughput. New equipment is not inherently efficient, and existing processes were not altered.
Industrial 10	Minor adjustments
Industrial 11	Minor adjustments
Industrial 12	Minor adjustments
Industrial 13	Minor adjustments
Grocery 1	Refrigeration VFDs only applied to trim compressors already designed for staged operation, not entire refrigeration load.
Industrial 14	Adjusted demand savings methodology; *ex ante* estimates did not account for coincident peak definition in the pre-retrofit period.
Grocery 2	Refrigeration VFDs only applied to trim compressors already designed for staged operation, not entire refrigeration load.
Office 1	Minor adjustments

Navigant identified several key drivers of differences in verified savings that warrant additional discussion.

1. **Energy Intensity Projects**. Several large projects used monthly energy use and production data to calculate an energy intensity. This energy intensity was calculated for several months pre- and post-, and was used to justify the projects. This method is applicable in some cases, but should not be used when there are seasonal effects and significant differences month-to-month. There is significant risk that the data periods selected for the analysis are not representative of long-term operation.
2. **Questionable Projects**. Navigant did not consider one project as an energy efficiency project. Energy intensity improvements alone do not necessarily constitute energy efficiency, for example, if there is simply load growth at a lower energy intensity that reduces facility averages.
3. **Refrigeration Projects**. Two grocery projects involved refrigeration compressor VFDs. For both of these projects, the savings from the VFD were extrapolated to the entire refrigeration system capacity. In practice, the systems used in these stores already contained multiple compressors that are staged to meet the refrigeration load. Additionally, the data logging performed on the compressor banks was performed in different seasons and it was not possible to normalize the energy use to the actual refrigeration load.
4. **Demand Savings**. Several projects did not calculate coincident demand savings accurately. In some cases, demand was simply recorded as the average of energy savings during the facility open hours, which does not account for operational differences month-to-month and hour-by-hour. In other cases, maximum demand savings were recorded, even when they did not occur during the peak period. While this may be useful to track for the customer and may affect their utility bill, this is not the same as coincident demand savings. For projects with capacity increases or reduced operational time required to meet production, the time of day is important, and often no demand savings can be realized (e.g., customer was able to eliminate the night shift to meet production requirements)

Navigant identified several key projects with significant realization rate adjustments, which are explored in additional detail below.

1. **Industrial 1.** This project claimed energy and demand savings from a capacity expansion project at a chemical production facility. The *ex ante* savings were derived from only six months of post-retrofit data, and normalized pre-retrofit data provided without explanation of adjustments. While the customer demonstrated the capacity expansion project was also designed to reduce energy intensity, Navigant found seasonal variations not accounted for in the original six months of post-retrofit data after obtaining 17 months of post-retrofit data from the customer. This data was normalized for actual weather conditions during the pre- and post- monitoring periods, and extrapolated to TMY3 data to develop annual energy savings. Additionally, due to seasonality, Navigant found energy intensities actually increased slightly during the summer months, reducing the demand savings to zero. Hourly data was not available, so it was assumed performance during the AEP Ohio coincident demand period was consistent with average usage during the month. The energy realization rate was estimated at 35 percent.
2. **Industrial 2**. This project claimed energy savings from enhancing a polymer production process to enable continuous rather than batch operation. The *ex ante* savings were derived from monthly energy intensities from 2013 as the baseline period, and 2015 as the post-production period. 2014, however, was omitted even though normal operation was maintained throughout the year. Incorporating this data, as well as additional post-retrofit monthly data, resulted in an energy realization rate of 83 percent.
3. **Industrial 4**. This facility implemented lean manufacturing as well as motor controls to streamline processes, increase production, and reduce energy intensity per unit of production. Navigant used additional post-data and confirmed the pre- and post-energy intensities, but applied pre-production volume to calculate *ex post* energy savings rather than post-retrofit production values. The demand savings methodology used to derive *ex ante* demand savings was wholly incorrect and did not take into account the time of day or the relevant months, and instead used a simple maximum demand function. This resulted in a demand realization rate of zero, due to shifts in production to account for the efficiencies gained from the project.
4. **Industrial 9**. This project involved a fabrication shop that received incentives for additional machining equipment. The equipment did not replace any existing equipment, and was used to increase the capacity and capabilities of the shop, while the existing equipment remained in place and in use. The equipment itself was not inherently energy efficient, and the method used to normalize production does not capture the energy required to produce the final products. Navigant's position is this is not an energy efficiency project, and thus should not receive credit for any energy or demand savings.
5. **Grocery 1 and Grocery 2**. These two projects represent a portion of many refrigeration projects claimed in 2016 in the large grocery store space. The projects included adding variable-speed drives to refrigeration compressors to increase part load performance. The VSD retrofits were applied to a single compressor within a compressor rack, often consisting of three to six compressors in parallel, This VSD compressor was programmed to operate all the time to manage the load, when, for example, one single speed compressor was not enough, but two single speed compressors were too much. The VSD compressor therefore operated as trim. The *ex ante* savings were calculated based on logged data pre/post retrofit during different seasons, as well as for the entire compressor bank power draw, not just the VSD compressor. It was therefore not possible to disaggregate the VSD load and generate a savings value from that

method. Instead, *ex post* savings were calculated using compressor specifications for power draw and estimated load curves for both VSD-enabled compressors and single-speed compressors. Operation was assumed to be 8760 hours per year, and demand savings were estimated from an annual average savings value.

6. **Industrial 14**. This project consisted of an air compressor system upgrade. Two single-speed compressors were replaced with a single large VSD compressor. Logging was performed both pre- and post-retrofit. The energy realization is 100 percent, while the demand savings realization rate was 276 percent. The demand savings realization rate was driven by an adjustment to the pre-retrofit load, which was an assumed average in the *ex ante* calculations. The *ex post* calculations used the AEP Ohio coincident demand interval, resulting in an increase in savings.

3.2.3 Findings from the Tracking Data Review

The Custom Program evaluation team has periodic access to extracts from AEP Ohio's tracking database to monitor program activity. The tracking data delivered for this evaluation was extracted on January 19, 2017. The sample for the impact evaluation was drawn from this extract.

The database extract spreadsheet includes a project level dataset with project total impacts, application submittal and status data, and internal approval information. Project data was linked by a unique project number to measure level records. Each project could have one or more linked measures of the same or different end-uses.

In general, the implementation contractor maintains quality and accurate data in the tracking system. Navigant did not identify any serious deficiencies, errors or patterns of missing data. The tracking system is adequate for planning all aspects of the program's evaluation, however, the evaluator did not address whether the tracking system is adequate for regulatory prudency reviews or corporate requirements.

3.2.4 Findings from the Program Documentation Review

To support the engineering review, AEP Ohio provided project documentation in electronic format for each sampled project. Documentation included materials from the applicant (invoices, measure specification sheets, vendor proposals) and implementation contractor (calculation spreadsheets and verification photos and site reports). This documentation was provided by uploading to a secure file transfer site.

Navigant also reviewed program materials developed by the implementer and AEP Ohio, including the implementer's technical reference manual documenting prescriptive savings (Appendix A of the Program Operations Manual), application forms and checklists, and program materials available from the program web site.

The evaluation found all documents required according to the project tracking milestones and incentive calculations were accurate according to the calculation rubric, and program materials were sufficient to provide detail about the program processes.

3.3 Process Evaluation Findings

3.3.1 Findings from In-depth Interviews with Program and Implementer Staff

Navigant conducted interviews with AEP Ohio's Custom Program Coordinator, Business Sector Manager, and the Operations Manager and Engineering Team Lead from DNV GL, the program implementer, as well as CLEAResult (the outreach team), between September and October of 2016. In-depth interviews with key program staff reviewed the status of recommendations from 2015 and changes made to the program in 2016.

Applications. The implementation contractor reported receiving 25 percent of all 2015 applications in the last week before the application deadline of November 13. The implementation contractor believes this is inherent to the program and will continue to happen. Navigant recommended in 2015 for the program to implement incentive mechanisms to induce Solution Providers to submit applications in a steady flow throughout the year, rather than waiting to submit at year-end. This change was not made to the program in 2016 and thus remains relevant for 2017.

Early project review. Navigant, the implementer, and AEP Ohio increased early project review and analysis to include all projects greater than 500,000 kWh of savings, down from 1,000,000 kWh projects in 2015. Approximately 18 Custom Program projects were reviewed during 2016, up from 9 in 2015. The implementation contractor is also interested in using building interval data to test the reduction in energy usage of custom projects and confirm persistence of energy savings. The implementer would like to use this methodology as part of design to review large projects. For example, on a 10 GWh project, the savings could swing by almost 50 percent and result in a lower realization rate.

Solution Providers. There is an opportunity to increase Solution Provider participation in the Custom Program by allocating projects, or only allowing a certain percentage of savings to come from a single Solution Provider. Implementing a change like this also has the opportunity to diversify customer type outside of the industrial/manufacturing sector.

Marketing. Several marketing recommendations were made in 2015, including increasing outreach and targeted marketing to other customer segments outside of industrial/manufacturing, developing case studies highlighting successful projects and opportunities, targeting multi-site customers. In addition, piloting initiatives with industry professional groups similar to the initiative with the wastewater management group, but on a larger scale. The AEP Ohio Program Coordinator expressed interest in adding other groups in 2016, but no other groups had been identified. The Program Coordinator said in 2016 AEP Ohio was doing more with its Energy Solutions newsletter by including more success stories. Also, AEP Ohio now has an Energy Efficiency Today magazine and there is interest in doing another version, as the AEP Ohio Program Coordinator believes it was well received.

Pilots. The Emotor rewind pilot was not very successful in 2016 according to the AEP Ohio Program Coordinator. Four or five motor rewind shops were certified at a cost of $10,000 each. There are opportunities to redesign the pilot to ensure more success with this technology. Additionally, as recommended in 2015, AEP Ohio should continue to explore emerging technologies as part of the Custom Program.

3.3.2 Findings from Participant Onsite Surveys

Program participant surveys contribute valuable insights to the process evaluation by providing direct insights into customer expectations, motivations and experiences. The evaluation team conducted a short survey when on-site collecting data for the impact evaluation. The survey took approximately five minutes to complete, and included questions on program awareness, customer satisfaction, program benefits, and barriers to participation. The subcontractor completed three surveys as compared to the eight surveys completed in 2015. The survey instrument is provided for reference in Appendix Section A.1.

Program satisfaction, and satisfaction with the utility, were equal to 9.2[4] on a 0 to 10 scale where 0 is extremely dissatisfied and 10 is extremely satisfied. All Custom Program participants reported the main reason they participated was the rebate. However, one participant stated, "…the contractor has done most of the work, but there is a significant expense to participate." Two of the participants found out about the program from a Solution Provider, while one participant found out about the program from an AEP Ohio account representative. When asked about other technologies they were interested in receiving rebates for, responses included DC drives and more food service equipment.

3.3.3 Findings from Program Tracking Data Review

The process team thoroughly reviewed the Custom Program tracking dataset as a key component of the process evaluation. The tracking data process review included analysis of completeness and overall quality of the tracking data and analysis of the tracking data to answer process-related research questions. Sections 3.3.3.1 through 3.3.3.4. present detailed findings from this analysis.

3.3.3.1 Tracking Data Quality and Completeness

High quality, complete data is critical to enabling successful process and impact evaluations. The process team completed a high-level review of Custom Program tracking data, and an in-depth analysis of the completeness of a sample of key variables. Process evaluation tracking data review allows us to gauge whether the Custom Program tracking is complete enough to support impact and process analyses and to identify potential areas for improvement.

The Custom Program tracking data reviewed by Navigant has already undergone review and correction by AEP Ohio, and is high quality and mostly complete. The majority of entries are entered and formatted in a uniform manner, and the dataset as a whole is well-organized. A visual investigation of the data did not reveal any entries that were clearly in error, such as text recorded in numerical fields, inconsistent spelling or naming conventions, etc.

For a sample of process-related variables, the process team analyzed data completeness. Key dates were largely complete (99% to 100% complete), though other critical information such as contractor and participant contact fields, were less complete, with some fields missing over 25 percent of entries.

[4] Not statistically significant due to low number of surveys conducted.

The ability to identify and contact, if needed, participants and contractors active in the program is essential. Compared with participant contact information, which was either 97 (email) or 100 (telephone) percent complete, contractor contact fields had significantly more missing entries. Contractor business name, contact and email were 97, 82, and 69 percent complete, respectively. As these are all fields we might reasonably expect to be complete on applications, this identifies an area for improvement in data collection for the program.

Visual inspection of the tracking data revealed the square footage variable was missing for over 25 percent of projects, which was better than 2015, when close to half of projects were missing this variable. However, it could be that square footage information is collected, but never used in analysis. This observation led to the general observation that if variables are deemed important enough to collect, then a goal should be to improve their completeness.

3.3.3.2 Participation Characteristics

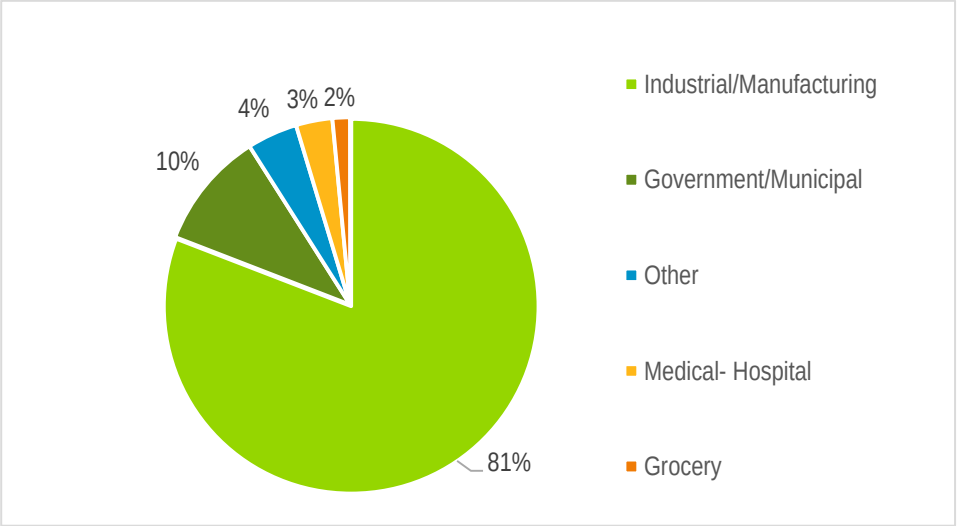
The participation graphics in this section indicate the program is well-established and built around a core of participation by industrial manufacturing customers. Program participation stayed the same between 2015 and 2016, though the number of projects per firm decreased in 2016 (58 customers completed 72 projects in 2015 versus 61 customers completing 72 projects in 2016). The largest business sector, industrial and manufacturing, contributed more projects to the program in 2016 (47 projects) than all the other business types combined (25 total). Table 3-6 illustrates that this mix of firms has not changed significantly between 2015 and 2016, though the industrial/manufacturing sector has increased slightly in prominence and government/municipal, grocery, and medical-hospital also saw growth. In terms of percent contribution to total program savings, the industrial/manufacturing sector decreased from 85 percent of *ex post* energy savings in 2015 to 81 percent in 2016, but still dwarfs the contribution of other business types (Figure 3-5). Figure 3-6 shows a more detailed breakdown of participant types and contribution to overall program savings.

Table 3-6. Project Count by Business Type

Participant	2015	2016
Industrial/Manufacturing	42	47
Government/Municipal	1	5
Large Office	3	4
Grocery	0	4
Medical- Hospital	0	3
School	4	2
College/University	2	2
Large Retail/Service	7	1
Hotel/Motel	1	1
Restaurant	1	1
Conditioned Warehouse	0	1
Unconditioned Warehouse	0	1

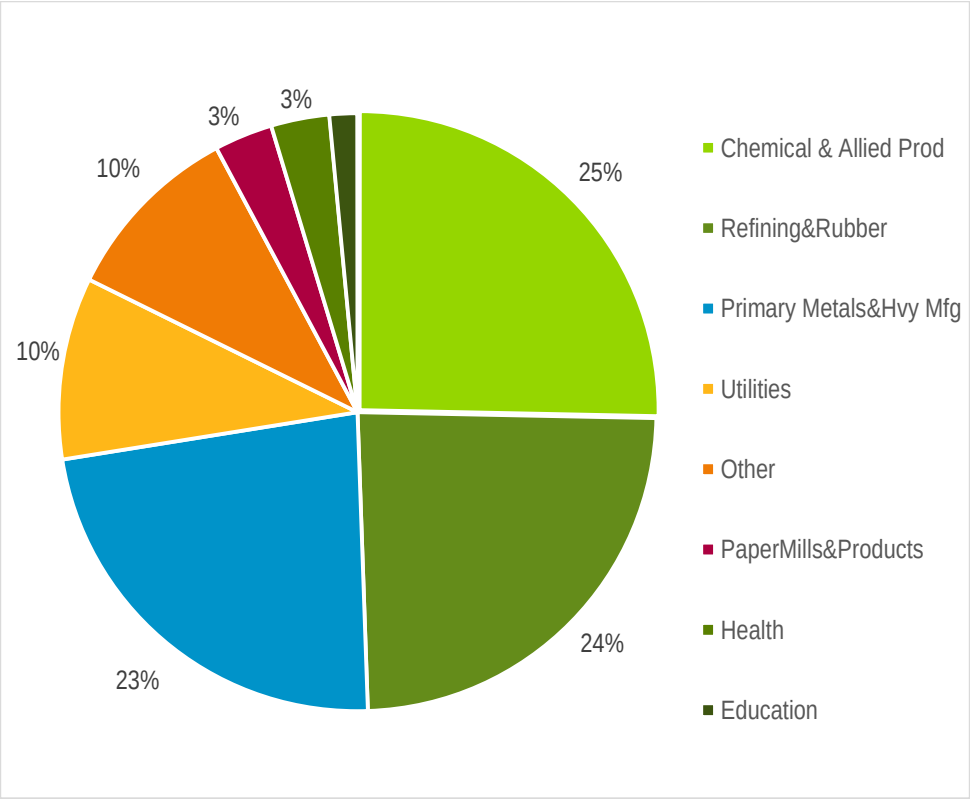
Miscellaneous	6	0
Assembly	3	0
Multifamily	1	0
Small Retail/Service	1	0

Figure 3-5. 2016 Percentage of Program Level *Ex Post* Energy Savings by Business Type



Note: Other includes College/University, Hotel/Motel, Unconditioned Warehouse, Large Office, School, Conditioned Warehouse, Restaurant, Large Retail/Service, Miscellaneous, Assembly, Multifamily, and Small Retail/Service.

Figure 3-6. 2016 Percentage of Program Level *Ex Post* Energy Savings by Sector Type



Note: Other includes Food and Kidred Products, FinIns Real Estate, Transport Mfg, Grocery Stores, Wood Products, Hotels/Motels, Electronic Mfg, Transportation, Local Govt, Fine Instrumentation, Restaurants, Light Mfg, Retail Trade, Communication Equip, Entertainment, Farm Fish Forest, Misc Services, and Museum/Zoo.

3.3.3.3 Incentives and Savings

Average program incentives account for a larger percentage of total project cost in certain measure types relative to others. For instance, the average incentive paid for HVAC measures covered 36 percent of total project cost in 2015 compared to 12 percent in 2016. For lighting projects, the typical incentive paid accounted for 14 percent of project cost in 2015, and increased to 31 percent in 2016. Overall, incentive costs in 2016 were lower than in 2015. The fluctuation in incentive payments is not surprising due to the design of the Custom Program.

3.3.3.4 Measures and Measure Types

The measure offerings in 2016 were consistent with the offerings in previous years, although the mix is different due to the variable nature of the projects entering the Custom Program. Overall, industrial process improvements dominate the Custom Program savings, with a mix of other commercial and industrial measures as detailed in Section 3.1.

3.3.4 Findings from Program Documentation Review

The evaluation team reviewed current program documentation provided by the implementation contractor. The Custom Program implementation contractor maintains a comprehensive, accessible and navigable set of program documents, the most important of which are the (1) 2016 AEP Ohio Quality Plan, formally called the Policy and Procedures Manual, and (2) the 2016 AEP Ohio Project Management Plan, formally called the Operations Manual.

The Quality Plan is most likely customer facing; however, this is not explicitly stated in the document itself. The document outlines customer eligibility, project requirements, incentive caps and limits, incentive amounts per measure, measure descriptions and base cases, and finally outlines required supporting documentation. The document provides a distinction between the Prescriptive, Self Direct, New Construction, and Custom programs. Some sections within the document provide clickable links which is a useful tool. For example, there is a link to the online application which removes barriers for the customer. Additionally, the document links to equipment specifications and program terms and conditions. For the Custom Program, this document provides guidelines for calculating and documenting energy savings, including acceptable and unacceptable calculation methodologies.

The Project Management Plan looks largely unchanged from the Operations Manual reviewed in 2015. This document looks to serve as an internal reference and compendium of guidelines and processes. The Project Management Plan is an extensive guide containing the purpose of the manual, program overview and goals, purpose of the program, eligible customers/projects/measures, incentive limits, summary of program steps, roles and responsibilities of the implementer and AEP Ohio, key positions, operations, application processing, program controls, complaint resolution, invoicing, acceptable calculation methods, specific measure guidelines, quality control process, safety requirements, and EM&V. This document is thorough and comprehensive. Review of this document assures there are processes in place to handle potential issues in an effective manner. Navigant recommends further review of how both of these documents are actually used by the implementer and AEP Ohio.

3.4 Cost Effectiveness Review

This section addresses the cost effectiveness of the 2016 Custom Program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. Table 3-7 summarizes the unique inputs used in the TRC test.[5]

Table 3-7. Inputs to Cost-Effectiveness Model for AEP Ohio Custom Program

Item	2016
Measure Life	15
Participants	72
Ex Post Annual Energy Savings (kWh)	43,002,933
Ex Post Coincident Peak Savings (kW)	3890.61
Third Party Implementation Costs	$1,474,098
Utility Administration Costs	$451,847
Utility Incentive Costs	$1,522,175
Participant Contribution to Incremental Measure Costs	$20,034,582

Based on these inputs, the TRC ratio is 1.4 and the program passes the TRC test. Table 3-8 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 3-8. Cost-Effectiveness Results for Custom Program

Test Results for Custom Program	2016 Ratios
Total Resource Cost	1.4
Participant Cost Test	1.8
Ratepayer Impact Measure	0.8
Utility Cost Test	8.9

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.

[5] A clarification on participant counts is worth noting regarding Table 3-7. For tracking purposes, AEP Ohio designates participants at the project level either as Custom Program or Prescriptive Program participants, even though a small number of participants have both custom and prescriptive measures associated with their project. The impact evaluation was conducted at the project-level, so all projects that had both custom *and* prescriptive measures were only included in the Custom Program evaluation. The cost effectiveness analysis is based on evaluation of *ex post* impacts. The data for "Participant Contribution to Incremental Measure Costs" were taken from the tracking system based on participant-supplied project costs.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Impact Evaluation Findings and Recommendations

The impact results for the 2016 Custom Program are shown in Table 4-1, which shows the *ex ante* savings claimed by the program, the evaluated savings, and the 2016 realization rates. In 2016, the program achieved 43 GWh energy savings and 3.89 MW peak demand savings. The realization rate for 2016 was 80 percent for energy and 83 percent for demand savings. Reasons for adjustments to savings estimates were varied but not systemic.

- The evaluation team interpreted the baseline differently, including technology adjustments and adjustments to the baseline period.
- Supplemental production and energy data acquired by the evaluation team modified some results.
- Differences in methodology used to calculate savings, especially for peak demand savings calculations.

Table 4-1. Program Savings and Realization Rate for 2016

	2016 Program Goals[1] (a)	*Ex Ante* Savings[2] (b)	*Ex Post* Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goals = (c) / (a)
Energy Savings (MWh)	67,456	53,482	43,003	0.80	64%
Demand Savings (MW)	8.99	4.67	3.89	0.83	43%

Sources: [1]*AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014*. [2]Evaluation analysis of AEP Ohio tracking data from January 15, 2017.

The 2016 Custom Program impact evaluation resulted in several findings and recommendations:

1. **Finding 1:** Navigant, the implementer, and AEP Ohio increased early project review and analysis to include all projects greater than 500,000 kWh of savings, down from 1,000,000 kWh projects in 2015. Approximately 18 Custom Program projects were reviewed during 2016, up from 9 in 2015.
   - **Impact Recommendation 1**: As an additional review step for large projects, use facility interval data to test the reduction in energy usage of custom projects and confirm persistence of energy savings.

3. **Finding 1:** Several large projects that relied on whole building monthly energy use and production received low realization rates due to significant month-to-month variation and seasonal effects. The pre- and post- data presented in the original application often did not represent steady state usage, and the addition of more post- data resulted in significant savings reductions. In one case, Navigant questioned whether a project should be considered an energy efficiency project.
   - **Impact Recommendation 1a:** For energy intensity projects, ensure process improvements can be quantified, make sense from an engineering perspective, and do not simply reflect production

or yield increases. Require additional pre- and post- data to ensure seasonal trends are accounted for. Consider a brief period of hourly data logging to understand detailed system performance. Use pre-retrofit production levels rather than post-production levels, where appropriate, based on counterfactual options for production increases to calculate final energy savings, and consider a dual baseline for increased production.

- **Impact Recommendation 1b:** The program should enforce its requirement to submit a pre-application prior to purchasing equipment or otherwise committing to a project, which will help ensure viable projects move forward in an orderly manner. Encourage Solution Providers to work with large customers on a proactive basis to assist in creating value for customers through energy efficiency. This action has the additional benefit of encouraging additional pre-retrofit data logging, and a better understanding of the baseline conditions.
- **Impact Recommendation 1c:** Quantify other efficiency improvements and load changes in both the pre- and post- conditions. These efforts can have significant impact on monthly energy intensities.

4. **Finding 2:** Demand savings should be characterized based on average savings during the various peak periods, including AEP Ohio peak, PJM summer peak and PJM winter peak. Errors include using maximum peak load rather than coincident peak load, and incorrect hours for the coincident peak definitions.
   - **Impact Recommendation 2a:** Ensure demand savings are recorded in the tracking data separately for AEP Ohio, PJM summer, and PJM winter. This will improve the accuracy of PJM estimates and reduce uncertainty.
   - **Impact Recommendation 2b:** For projects with hourly data, especially energy intensity improvements associated with increased production, ensure the correct coincident time period is used in the calculations.

2. **Finding 4:** Several refrigeration projects did not accurately quantify the effect of variable speed drives and did not include robust weather dependencies inherent in these systems.
   a. **Impact Recommendation 4a:** Work with trade allies to time projects so that pre- and post-metering can cover representative seasons.
   b. **Impact Recommendation 4b:** Consider moving small refrigeration VSDs to the Prescriptive Program.

4.2 Process Findings and Recommendations

The 2016 evaluation resulted in several recommendations:

2. **Finding 1:** The 2016 *ex ante* and *ex post* energy and demand savings fell short of program goals. Prior evaluations have demonstrated the year-to-year success of the program relies on a few very large projects, but more projects, even if smaller, will tend to reach more commercial and industrial participants who can benefit from the program. Correspondingly, large projects are important for program goals, but over-reliance on large projects can impede the program from broad-based participation, appeal and acceptance.
   - **Process Recommendation 1a:** Keep a steady, modest pipeline of very large projects to support the program and ensure close tracking to program savings goals. Enhance outreach to enroll

more diverse projects and participants that can deliver more projects of all sizes. Encourage Solution Providers to submit applications in a steady flow throughout the year. This might include additional outreach during the first quarter.

3. **Finding 2:** Industrial and manufacturing sector projects continued to dominate the program in 2016. The AEP Ohio Program Coordinator indicated interest in expanding marketing efforts, including increasing outreach and targeted marketing to other customer segments outside of industrial and manufacturing.
   - **Process Recommendation 2a:** There is an opportunity to diversify the participating customer base by implementing Solution Provider requirements. Currently, a few Solution Providers bring in the majority of the savings and specialize in industrial/manufacturing customers. By encouraging different Solution Providers to participate and grow their businesses, either through training, additional research on barriers to entry, and creating limited-time incentives, the customer type and measure type could diversify.
   - **Process Recommendation 2b.** The program marketing team should develop case studies highlighting successful projects and opportunities, and piloting initiatives with industry professional groups similar to the initiative with the wastewater management group. AEP Ohio should publish these case studies in a new version of the Energy Efficiency Today magazine.
4. **Finding 3:** The eMotor rewind pilot was not as successful as program staff hoped.
   - **Process Recommendation 3a**: Focus Solution Providers on all of the motor retrofit options (rewind, replacement, downsizing, variable speed drives) to offer customers several choices to increase efficiency, and work with them to implement the highest efficiency, cost-effective options.
   - **Process Recommendation 3b.** Continue to research and pilot emerging technologies such as voltage optimization.

APPENDIX A. SURVEY INSTRUMENTS

A.1 Program Participant Onsite Survey Guide

Process Questions to add to Field Form:

1. How did you first hear about the AEP OH Rebate program?

2. Have you participated in the AEP OH RCx program or any other AEP OH energy efficiency programs before 2016?
    a. If yes, please circle all that apply:
        i. Prescriptive
        ii. Custom
        iii. Self Direct
        iv. Retrocommissioning
        v. Data Center
        vi. Continuous Energy Improvement
        vii. Express
        viii. Other: _____

3. What was the primary reason you participated in the AEP OH Rebate program?

4. On a scale of 0 to 10, where 0 is very dissatisfied and 10 is very satisfied, how satisfied are you with the AEP OH program?
    a. Why did you give it that rating?

5. Using the same 0 to 10 scale, how would you rate your satisfaction with AEP OH overall?
    a. Why did you give it that rating?

6. What do you see as the main benefits to participating in the AEP OH Rebate program?

7. What do you see as the drawbacks to participating in the program?

8. What do you think are reasons companies like yours may not participate in this program?

9. Do you plan to participate in the program again in the future?

10. How would you improve the AEP OH Rebate program?

11. What additional measures or types of equipment would you like to see added to the program?

Thank you for your time, if there is anything else you would like to share, please do so below.

A.2 Program Manager In-depth Interview Guide

AEP-Ohio Evaluation for the Business Custom Program
PY2016 Program Staff In-Depth Interview Guide

Name of Interviewee: Date:

Title: Company:

Contact Information:

[Note to Interviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff and implementation contractors. 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. The interviews will be audio taped and transcribed. Interviews in every case will be conducted by Navigant's process evaluation lead for the program to ensure full context and understanding for the interview, and to enable the interviewer to probe for the most meaningful questions and responses.

Roles and Protocols

1. Has your role changed over time and if so, how?

2. With respect to DNV GL, CLEAResult, AEP OHIO staff and the solution providers, do you think there have been any substantial changes in the roles and people assigned to the Custom Program in the past year compared to previous program years? If so, what were they?

3. How often do you meet with the implementation contractor and in what manner? Do you feel information between you and the implementation contractor is shared in a timely manner? If not, what can be done to improve this situation?

Program and Incentive Changes

4. What does the current mix of measures look like from your perspective (e.g. what are some of the most common Custom measures, least common, etc. and why?)

5. Do you have any suggestions for common Custom measures that should be added as Prescriptive program offerings?

6. Have you made any changes to incentive levels in 2016, and do you plan to make any in 2017?

7. Have there been any other significant changes to the program (delivery, components, etc.) in 2016, and do you have any significant changes planned for 2017? Why were/are these changes made, and how do they affect program performance?

Overall Goals and Objectives

8. Do you expect to meet the program savings goal in 2016 (for instance are the number of rebate applications on track)?

9. Of course energy savings goals are primary, but how is the Custom Program doing with respect to other goals and objectives? (Ohio jobs, outreach and participation levels, customer satisfaction, cost effectiveness, etc.)

10. Do you have any sense for if the Self Direct program is successfully channeling future participants into the Custom Program, and if so, do you have a sense of what percentage of Custom participants learned about the program through previous participation in the Self Direct Program?

Program Theory, Market Barriers and Barriers to Participation

11. In your own words, what are the market barriers addressed by the Custom Program, and how does the program overcome them? (We are looking for cause and effect relationships)

12. What do you see as the key barriers to program participation for the Custom Program, and how is the program overcoming these?

Marketing and Promotion

13. Please describe the Custom Program marketing approach in your own words. Include all relevant components, and describe how effective you think they are.

14. Is the current level of marketing sufficient and does it address all measure end-use categories equally well, or are some over or under represented?

15. How could marketing for the Custom Program be improved?

16. Do you have any planned changes for the marketing of the Custom Program in 2016?

17. Who has been most influential in getting customers to participate? Who else has been influential?

18. Did you continue marketing the Custom Program to professional groups in 2016? Do you plan to expand this effort in 2017 or just maintain it?

19. Are webinars still an important marketing tool for the program? Explain and give examples?

20. Are case studies still an important marketing tool for the program? Explain and give examples?

21. What role does the Website play in generating interest and participation by customers, and how has this changed over time? Are there improvements still needed?

Program Process Overall

22. What processes work really well in the Custom Program, and what processes need improvement? (e.g., communication, time processing applications, customer interaction, marketing, relationship between utility and implementation contractor, etc.)

23. What do you think is the biggest process area for improvement going forward? (ie—what processes could be changed that would have the biggest positive impact on program functioning and performance?)

24. How active are account managers in the program? Is their activity helpful and adequate? In what ways do account managers improve the customer experience? Are any improvements needed in the role account managers play?

25. Do you have a sense of how satisfied customers are with various aspects of the program (time to process incentives, application process, interaction with implementation contractor or Solution Providers, etc.)?

26. Do the customers mostly complete the applications, or the Solutions Providers?

27. How is QA/QC currently handled for this program, and what improvements could/should be made?

Solution Providers

28. Is the program successful at marketing to the Solution Provider network to recruit participation by Solution Providers? Do you know how many Solution Providers were active in 2016, and is this number increasing or decreasing, and why?

29. In your opinion, what could the program do to recruit more Solution Providers?

30. In your opinion, are the Solution Providers well-spaced throughout AEP Ohio's utility territory, or are there certain areas that are under or over represented?

31. Do you have a sense of Solution Providers' overall satisfaction with their participation in the Custom Program in 2016 and with the implementation contractor? Have you noticed or heard any changes from past years?

32. Are Solution Providers and the implementation contractor meeting your expectations for the Custom Program? If not, what could be improved?

33. Did AEP Ohio offer trainings or marketing materials in 2016 to help support Solution Providers and the implementation contractor market the program?
34. In previous evaluations, Solution Providers suggested a faster pre-approval process would improve the program from their perspective. Has this been accomplished? If so, how, if not, why not?

Customer Interest, External Factors, Strengths and Weaknesses

35. Based on your experience with implementing the program and communicating with customers, how did interest in the program in 2016 compare to interest in 2015?

36. Are economic conditions affecting the program? If so, how?

37. What changes have been made in 2016 to improve participant program communication processes? What do you think still needs to be improved going forward?

38. In your opinion, what is working best in the Custom Program, and what needs the most improvement?

Wrapping Up

39. Are there any questions I didn't ask that you think I should be asking? I would love to hear any insights you have that have not come up during the course of our interview.

40. Who should we contact at the implementation contractor for interview for this program?

A.3 Implementation Contractor Interview Guide

AEP-Ohio Evaluation for Prescriptive, Custom and Self Direct Programs
2016 Implementation Contractor In-Depth Interview Guide

Name of Interviewee: Date:

Title: Company:

Contact Information:

[Note to Interviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff and implementation contractors. 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. The interviews will be audio taped and transcribed. Interviews in every case will be conducted by Navigant's process evaluation lead for the program to ensure full context and understanding for the interview, and to enable the interviewer to probe for the most meaningful questions and responses.

Roles and Protocols (Please answer with respect both to your role managing the Custom Program and the Self Direct Program)

1. [ALL] Has your role changed over time and if so, how?

2. [ALL] With respect to AEP OHIO staff and the solution providers, do you think there have been any substantial changes in the roles and people assigned to these programs in the past year compared to previous program years? If so, what were they?

3. [ALL] How often do you meet with AEP Ohio staff for each program, and in what manner? Do you feel information between DNV GL and AEP Ohio is shared in an efficient manner? If not, what can be done to improve communication?

Program Changes, New Measures, Measure Mix and Incentives

4. [P AND C] Have there been any changes to measures offered in 2016 across the three programs? Are there any planned changes on the horizon? What does the current mix of measures look like from your perspective (lighting versus HVAC versus VSDs, etc.)?

5. [P AND C] Do you have any suggestions for measures that should be added?

6. [ALL] Have you made any changes to incentive levels in 2016, and do you plan to make any in 2017?

7. [ALL] Have there been any other significant changes to the programs (delivery, components, etc.) in 2016, and do you have any significant changes planned for 2017? Why were/are these changes made and how do they affect program performance?

Overall Goals and Objectives

8. [ALL] Do you expect to meet the program savings goal in 2016 (for instance are the number of rebate applications on track)?

9. [CUSTOM] The end of the year can be crunch time as customers rush to get applications in. The Custom program manager mentioned that you'd brought extra engineers on board to handle the volume. Are you on track to get all these end-of-year applications processed? What about projects in final review? The program manager also mentioned a large cue of projects in final review. Do you expect to have these finalized before the end of the year? Is there anything you feel DNV GL could do in future years to ease the number of projects still waiting in final review at the year's end?

Program Theory, Market Barriers and Barriers to Participation

10. [ALL] In your own words, what are the market barriers (ie. things preventing people from taking the same actions without the program) addressed by these programs—in other words, why is there a need for the program—and how does the program overcome these barriers? (We are looking for cause and effect relationships)

11. [ALL] What do you see as the key barriers to program participation for the Custom program, and how is the program overcoming these?

12. [ALL] What is the status of an online application system for these programs?

Marketing and Promotion

13. [ALL] Please describe the marketing approach to each of these programs in your own words. Include all relevant components, and describe how effective you think they are.

14. [ALL] How could marketing for these programs be improved?

Program Process Overall

15. [ALL] What processes work really well in each program, and what processes need improvement? (e.g., communication, time processing applications, customer interaction, marketing, relationship between utility and IC, etc.)

16. [ALL] What do you think is the biggest process area for improvement going forward? (i.e., what processes could be changed that would have the biggest positive impact on program functioning and performance?)

17. [ALL] How is QA/QC currently handled for this program, and what improvements could/should be made?

18. [ALL] We like to review program materials the implementation contractor has in place as part of our overall review. Would you be able to share with us a copy of the Operations Manual, QA/QC guidelines, process flow diagrams or other documents that help guide program implementation?

Solution Providers

19. [ALL] Do you have a sense of Solution Providers' overall satisfaction with their participation in these programs in 2016? Have you noticed or heard any changes from past years?

20. [ALL] Are Solution Providers meeting your expectations for the Custom Program? If not, what could be improved. Are SP's spread across the territory well, or are some areas less well represented?

21. [ALL] Did AEP Ohio offer trainings or marketing materials in 2016 to help support Solution Providers marketing the program? Was there an SP bonus in 2016? How does the bonus affect program participation?

Customer Interest, External Factors, Strengths and Weaknesses

22. [ALL] Based on your experience with implementing the program and communicating with customers, how did interest in these programs in 2016 compare to interest in 2015?
23. [ALL] Are economic conditions affecting these programs? If so, how?

Wrapping Up

24. [ALL] Are there any questions I didn't ask that you think I should be asking? I would love to hear any insights you have that have not come up during the course of our interview.

25. [ALL] I have heard, talking to several people, about examples recently of SPs taking so long to submit paperwork for the Prescriptive or Custom programs that projects ultimately get submitted and claimed under Self Direct instead. Do you have a sense of how common this is, if at all?

Thank you very much for talking with me today. If additional questions arise, would it be alright to contact you by email?

APPENDIX K

Self Direct Program

2016 Evaluation Report

Prepared for:

AEP Ohio

A unit of American Electric Power

May 12, 2017

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EXECUTIVE SUMMARY

This report presents the results of the evaluation of the 2016 AEP Ohio Self Direct Program. The Executive Summary provides a high-level description of the program, key impact evaluation findings, 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 goal of the Self Direct Program is to educate AEP Ohio Mercantile customers on all of AEP Ohio's energy efficiency and peak demand reduction (EE/PDR) business sector programs and allow qualifying business customers to commit their already completed energy efficiency and summer peak demand reduction resources to AEP Ohio. The Self Direct Program incentives are intended to 'prime the market' for more energy efficiency projects by providing participants start-up funds to re-invest for their next project that qualifies for AEP Ohio's Custom or Prescriptive Programs for businesses. The Self Direct Program is marketed, administered, and delivered by an implementation contractor in coordination with AEP Ohio.

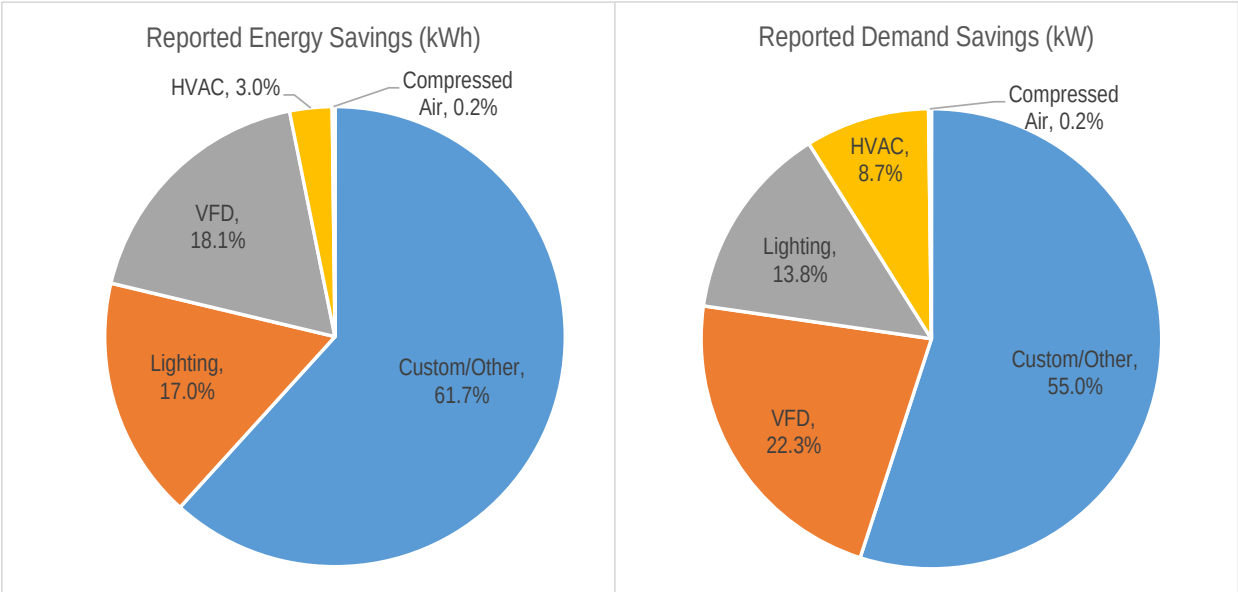
As shown in Table ES-1, the 2016 Self Direct Program paid incentives on 73 projects constituting 22,472 MWh of *ex ante* reported annual energy savings and 3.04 MW of peak demand savings. The majority of installed savings were from custom measures; percentages associated with other, specific measures are shown in Figure ES-1.

Table ES-1. 2016 Self Direct Program Projects and *Ex Ante* Savings

Metric	*Ex Ante* Value
Number of Projects	73
Annual Energy Savings (MWh)	22,472
Electric Peak Demand Savings (MW)	3.04

Source: Evaluation Analysis of 2016 AEP Ohio Tracking Data

Figure ES-1. Percentage of Measures Installed by Measure Category



Source: Evaluation Analysis of 2016 AEP Ohio Tracking Data

ES.2 Key Impact Evaluation Findings

Table ES-2 shows the *ex ante* savings claimed by the program, the verified savings, and the 2016 realization rates. The realization rate for 2016 was 0.86 for energy and 0.84 for demand.

Table ES-2. Program Savings and Realization Rate for 2016

Metric	2016 Program Goals[1] (a)	*Ex Ante* (b)	*Ex Post* (c)	Realization Rate RR = (c)/(b)	Percent of Goal = (c) / (a)
Annual Energy Savings (MWh)	20,000	22,472	19,223	0.86	96%
Peak Demand Savings (MW)	2.46	3.04	2.55	0.84	104%

Source: [1] AEP Ohio VOLUME 1: 2012 TO 2014 Energy efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011 data for 2014; Evaluation Data Collection and Analysis as described in Appendix A.

ES.3 Conclusions from 2016, Findings and Recommendations

The following list provides a summary of the key findings and recommendations from the evaluation of the 2016 Self Direct Program.

1. **Finding 1:** Both the magnitude of the Coefficient of Variations (CVs), as well as the trend of increasing CVs from 2014 to 2015, and again from 2015 to 2016 (shown in Table 3 2) suggest there are pervasive errors in the *ex ante* analysis, which are having increasingly larger impacts on the sample design and ultimate precision of this evaluation.
    - **Recommendation 1:** The implementation contractor should review internal QA/QC policies and the execution of those practices. This is a key internal step for all projects, regardless of size.

2. **Finding 2:** One of the Self Direct projects sampled had a combination of new (eligible) measures, as well as some measures previously incentivized through another program. Double-dipping is an extremely rare occurrence, and appears to have occurred because of change in staff at the affected site.
    - **Recommendation 2a:** Consider adding a penalty in the terms and conditions should a participant or trade ally be found to have violated the spirit of the program through intentional or repeated errors of this nature.
    - **Recommendation 2b:** Require the implementation contractor's database to have the ability to search each participating company, site address, and primary contact to retrieve project and measure participation history for each view. This information would only be viewed by AEP Ohio and the implementation contractor. Further, require the implementation contractor to check every application for past redundancy, both within the Self Direct Program and within all programs implemented by the contractor. Require at least a five-year rolling repository of incented projects and measures.
    - **Recommendation 2c:** Consider updating AEP Ohio's portfolio level tracking database to allow program administrators to crosscheck across all programs for redundancy of previously incented measures.

3. **Finding 3:** Participant interviews and tracking data analysis suggest there is room for improvement in the role the Self Direct Program plays as a feeder for the Prescriptive and Custom Programs**.** The 2015 evaluation revealed Solution Providers are using the Self Direct Program as an enticement for firms to participate in other programs. However, participant interviews indicated more firms saw the Self Direct funds more as an added benefit rather than a key influence on participation in other programs. This previous finding continues to apply in 2016. Additionally, some participants are applying to the Self Direct Program in multiple years.
    - **Recommendation 3a:** The Self Direct Program delivery team should work to increase the role of the program as a feeder for the Prescriptive and Custom Programs.
    - **Recommendation 3b:** AEP Ohio staff report program participation is tabulated on a regular basis at the utility level. These cross-participation details should be shared with the Program Coordinator annually to make the best use of this information, to proactively reach out to firms that have participated in Self Direct projects recently, but have not gone on to participate in other business sector programs.

1. INTRODUCTION

This section provides a description of the AEP Ohio Self Direct Program, as well as a brief discussion of the underlying program theory and logic. Other topics covered in this introduction are the objective of this evaluation and the savings terminology used in this report.

1.1 Program Description

The Self Direct Program allows qualifying business customers to commit their already completed energy efficiency and peak demand reduction resources to AEP Ohio. AEP Ohio accepts projects on a case-by-case basis, and each must be approved by the Public Utility Commission of Ohio through a special arrangement. Eligibility is for business customers that qualify as mercantile by meeting one of two criteria:

- The customer has energy consumption greater than 700,000 kWh per year from AEP Ohio, or
- The customer is part of a national account involving multiple facilities in one or more states.

Submitted projects must have an installation date within three years of the date of acceptance into the program. Each project is required to produce verifiable and persistent energy savings and/or peak demand reduction for at least five years from the date of installation. Projects are also required to have a payback period between one and seven years without the incentive applied, and pass cost-effectiveness tests determined by AEP Ohio.

The goal of the Self Direct Program is to educate qualifying business customers on all of AEP Ohio's business sector programs. Self-Direct incentives are designed as a way to 'prime the market' for more energy efficiency projects by providing participants start-up funds to re-invest in future projects qualifying for AEP Ohio's Custom or Prescriptive Programs.

The Self Direct, Custom and Prescriptive programs are marketed, administered, and delivered as a single program by AEP Ohio in order to streamline the administration of these programs. The program is managed by an implementation contractor in coordination with AEP Ohio.

1.1.1 2016 Program Changes

The core program processes and basic program theory of the 2016 program did not change from 2015. However, in 2015 there were several changes related to program implementation and marketing for all programs. Most notably, the marketing function was transferred to a single vendor that manages a coordinated outreach effort for all business sector programs.

1.2 Evaluation Objectives

This report presents the findings from the evaluation of the AEP Ohio Self Direct Program for 2016. The objectives of the evaluation were to: (1) quantify energy and peak demand savings impacts in 2016 for these products, (2) evaluate program functioning from a process standpoint, and (3) provide impact and process recommendations to improve the program. The evaluation sought to answer the following research questions.

1.2.1 Impact Questions

1. Did AEP Ohio appropriately calculate the annual energy (kWh) and demand (kW) impacts?
2. What were the energy and demand realization rates?
3. What is the cost effectiveness of this program?

1.2.2 Process Questions

Marketing and Participation

1. Is the outreach provided by Solution Providers effective for this program?
2. Are program managers satisfied with the performance of, and communication from, Solution Providers?
3. Are Solution Providers knowledgeable about all of AEP Ohio's business programs? Are they participating in other AEP Ohio business programs?

Program Characteristics and Barriers

1. How effective has the program been at channeling customers to future participation in the Prescriptive and Custom programs?
2. How many customers have participated in the Self Direct Program multiple times instead of transitioning to the other business programs?
3. How do program managers evaluate Solution Provider's satisfaction with the program, and how satisfied are Solution Providers with their participation experience?

Administration and Delivery

1. How can AEP Ohio better communicate to Self Direct Program participants and Solution Providers the benefits of participating in other programs that offer higher incentives?
2. What changes should be implemented to make the program more effective?
3. What changes should be implemented to make the program more efficient?
4. What are the verification procedures for the program? Have they been implemented in a manner consistent with the program design?

1.3 Savings Terminology

This section defines the terminology used to describe the savings values at each stage of the evaluation.

- *Ex ante* savings – Savings reported by AEP Ohio
- *Ex post* savings – final verified savings taking into account findings from all steps, including the technical review of project files and site visits for a sample of projects
- Realization rates – evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings

2. METHODOLOGY

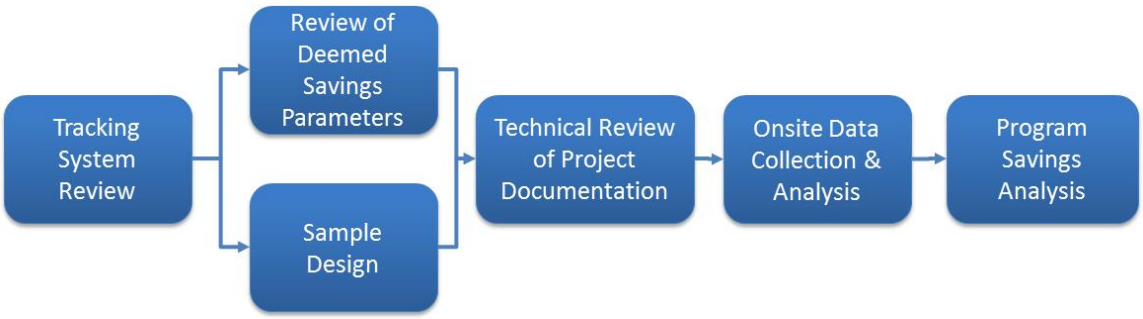
This section describes the methodology used to conduct the evaluation. Table 2-1 summarizes the various activities undertaken.

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	Process and Impact Evaluation
Technical Review of Project Documentation	Sampled projects	Impact Evaluation
On-Site Data Collection and Analysis	Sampled projects	Impact Evaluation
Program Documentation Review	Project Management Plan, Quality Plan, and other program documents	Process Evaluation
Program Participant Interviews	Program participants	Process Evaluation
In-depth Interviews and Follow-up Questions	Program staff and implementer	Process Evaluation

Figure 2-1 illustrates the impact evaluation task flow.

Figure 2-1. Impact Evaluation Task Flow



2.1 Tracking Data Review

In the first step of the impact evaluation, Navigant reviewed the data tracking system provided by AEP Ohio. This review was conducted for evaluation purposes only, not for regulatory prudency reviews or corporate requirements. The evaluation team identified key tracking fields, including project number, participant name and contact information, project status, building type, measure type, and savings. Next, the team summarized the tracking system data to identify the sectors and measures contributing the majority of savings.

2.2 Impact Evaluation Sample Design

The evaluation team pulled a statistically relevant, random sample of projects from the project database to verify savings through a technical review of project documentation (described in Section 2.3), on-site data collection, and analysis (described in Section 2.4). This sample design used stratified ratio estimation to reduce the number of sample points required to meet the precision targets, thus providing accurate results at reduced overall cost.

The sample frame for the 2016 evaluation included only those projects reported as paid during Program Year 2016.[1] The sample sizes within each stratum were calculated to provide 10 percent relative precision at the two-tailed 90 percent confidence interval (90/10)[2] for Self Direct Program annual energy (kWh) and peak demand (kW) savings. Table 2-2 shows the strata definitions, the number of projects within each stratum, and the calculated sample sizes.

Table 2-2. Strata Definitions and Sample Sizes

Stratum Number	Stratum Name	Lower kWh Threshold	Lower kW Threshold	Sample Frame Projects	Sample Size
1	Large	1,000,000	200	7	5
2	Medium	100,000	25	18	9
3	Small	None	None	48	7
Total				**73**	**21**

The savings summaries from the tracking system revealed that (based on individual project savings) the top 75 percent of projects accounted for approximately 99.7 percent of the program's energy savings. This is visually represented in Figure 2-2. The team subsequently set a threshold of 10,000 kWh per project as a division point within the Small stratum. If a project did not meet this criterion, it was removed from the sample frame. These projects remain in the program population for the roll-up of results and otherwise receive the same treatment as other Small projects. However, this stratum level division is a key step to increase the sampling efficiency, since the cost of evaluating these very small savings projects exceeds the value of the information gleaned.

[1] This pool of participants includes many who started participation in prior years, but did not complete all participation requirements and receive the incentive payment until 2016. The date the project was filed with the PUCO was used to determine inclusion in 2016.
[2] Sample design is based on previously achieved Coefficient of Variation (CV). However, the final, achieved level of precision cannot be determined until after the project analysis is complete.

Figure 2-2. Cumulative Program Savings vs Project Size

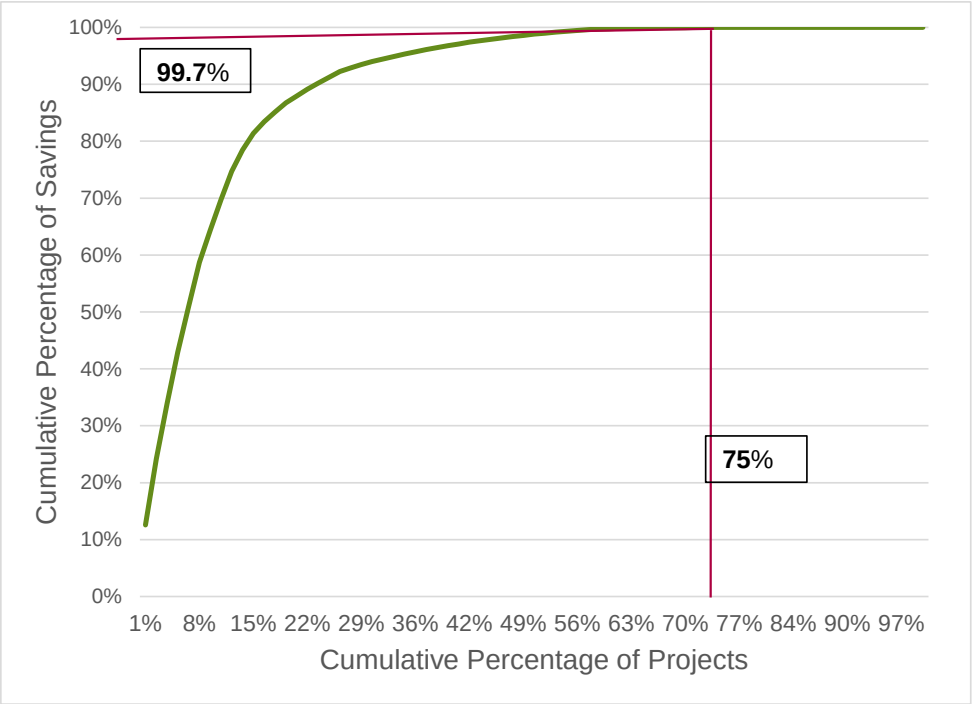


Table 2-3 shows the reported savings associated with the sampled projects as a percentage of the sample frame (2016 program population).

Table 2-3. Savings by Strata

Stratum Name	MWh Savings			kW Savings		
	Sample Frame (SF)	Sample	% of SF	Sample Frame (SF)	Sample	% of SF
Large	14,716	11,208	76%	1,934	1,315	68%
Medium	6,340	3,648	58%	911	510	56%
Small	1,416	187	13%	195	23	12%
Total or Weighted Average	**22,472**	**15,044**	**67%**	**3,040**	**1,848**	**61%**

Source: 2016 AEP Ohio Tracking Data and Navigant Sample Design.
Note: Totals may not sum due to rounding.

2.3 Technical Review of Project Documentation

Navigant requested project-specific documentation for each of the 21 sampled projects from the implementation contractor and conducted a detailed technical review of each. The assessment included a

review of the tracking databases, customer applications, supporting analysis files, invoices, and equipment specifications.

These supporting documents were subjected to an engineering desk review that assessed or completeness, accuracy of calculations, reasonableness of the analytical approach, and any data entry errors in data entry to the database.

As part of this initial desk review, the engineering team creates a site-specific field form that is then used during the on-site data collection. This field form identifies any specific data collection needs for an independent verification of project level savings.

2.4 On-Site Data Collection and Analysis

Navigant conducted either telephone based participant interview or direct, on-site data collection for 18 projects selected from the technical review sample. Three sites did not receive deeper custom review because of the short turnaround time available between the tail end of the eligible submittal window and the conclusion of this study. Also, a small fraction of the projects is sufficiently simple and well documented, such that an on-site review is not necessary. An in-depth telephone interview is a more time and cost effective way to confirm the necessary details for independent analysis. Navigant representatives conducted on-site visits for all remaining, willing participants.

A project-specific measurement and verification (M&V) plan was developed for each sampled project. These plans detailed the reported measures and operating characteristics, as well as the data collection plan for the project. The M&V plans all followed a common template, but the data collection tasks within each were custom-designed to target any key uncertainties in the reported savings analysis. The default on-site M&V tasks included:

1. Visual verification of measure installation and operation
2. Verification of reported measure quantities
3. Verification of measure nameplate data, including manufacturer and model number, capacity (watts, Btu/h, tons, etc.), and efficiency
4. Verification of measure operating characteristics, including the schedule of operation, annual operating hours, and loading
5. Verification of the appropriate baseline technology

If the incentivized equipment is attached to an energy management system (EMS), and trend data is available, then spot measurements were taken to confirm calibration of the data collected by the EMS; then the trend data were leveraged in the analysis process. If EMS data were not available for motor or HVAC equipment, the evaluation team deployed temporary data loggers to verify energy use for end-uses with intermittent, irregular, or otherwise variable use profiles.

For lighting end uses, fixture counts and wattage were visually confirmed. After which, temporary, state-based data loggers were deployed to confirm hours of use and peak demand coincidence factors. Relevant data collected in the field was summarized and converted into algorithm inputs.

2.5 Program Savings Analysis

In the final step of the impact evaluation, Navigant combined the outputs from all previous steps to determine program-level verified energy and demand savings. The evaluation team calculated the ratios between the project-specific verified savings for the sampled projects to the savings reported in the program database. Project level results were there rolled into strata level realization rates.

The sample results for each stratum were then extrapolated to the population of program participants for that stratum. The extrapolation procedure followed the structure specified by the sample design, and used stratified ratio estimation to determine program-level verified (i.e., realized) savings. Finally, the program-level realized savings were compared to the *ex ante* program savings to determine the Self Direct Program realization rate.

2.6 Process Evaluation

The purpose of the process evaluation is to assess how program structure and implementation affect performance and other key metrics such as customer satisfaction. The evaluation team's process efforts provide insights and recommendations to support the continued success of the Self Direct Program and enable continuous program improvement.

There are several key components to the process evaluation:

- Conducting Program Manager and Implementation contractor interviews
- Conducting focused program participant interviews
- Reviewing tracking data for completeness and quality, and for insights into key performance indicators
- Reviewing program documentation for completeness and to assess whether program protocols are handled in a manner consistent with program documentation

All process activities are designed and carried out with process recommendations from the previous year's evaluation report and process questions from the current year's evaluation plan in mind. The process evaluation team's primary goal is to develop a set of relevant findings informing actionable recommendations to help maintain effective processes already in place and develop new and improved processes to enhance program effectiveness and efficiency moving forward.

2.6.1 Program and Implementer Staff In-depth Interviews

In-depth interviews were conducted with the AEP Ohio Self Direct Program Coordinator and Business Programs Manager, and with the Operations Manager and Engineering Team Lead from implementation contractor, DNV GL. Interviews were designed to provide insights into program function, identify program strengths and areas for improvement, document changes to the program in 2016 and the effects of these changes, and identify how, and to what extent, process recommendations from the 2015 evaluation report have been addressed during 2016. These interviews were conducted between September and October, 2016, by the program process evaluation lead, and were recorded and transcribed verbatim for reference. The interview guides used for these interviews are included in the Appendices. Section 3.3.1 provides detailed findings from program staff and implementer in-depth interviews.

2.6.2 Program Participant Interviews

While conducting onsite impact verifications, an in-person process interview was administered. The survey was short in length, aiming to collect information from the participant regarding participation in other AEP Ohio EE/PDR programs either in the past, concurrently with the Self Direct program, or in the future and overall satisfaction with the Self Direct program and the utility. Eight interviews were conducted, an increase from the six telephone interviews conducted in 2015. The survey guide used for these interviews is included in the Appendices.

2.6.3 Tracking Data Review

While tracking data is essential to impact evaluation, it can also contribute important insights to the process evaluation. For instance, the evaluation team might need to analyze a particular variable in the tracking data and find that entries for that field are mostly missing or incomplete. This would lead to a recommendation to improve data entry and recording as a process improvement for the program.

The process evaluation team completed a thorough review of the tracking data and system with process-related questions in mind. The findings and results of this analysis are presented in Section 3.3.3.

2.6.4 Program Documentation Review

Program documents play an essential role in ensuring all parties involved in implementing a program have adequate resources to understand intended program design and protocols. Even if a program is well designed and has adequate documentation, how the program is administered in reality may not conform to how program administration is intended. For this reason, program documentation is also essential for comparing against current practice to ensure program procedures and protocols are adhered to, and that the program is implemented in accordance with its design.

As a critical part of its evaluation activities, the process evaluation team acquired all relevant and available documentation for the Self Direct program from AEP Ohio and the implementation contractor, and reviewed this material both to see that the documents were up to date and sufficient, and to compare against observed current practice in the program. Findings and results of the program documentation analysis are provided in Section 3.3.4.

3. DETAILED EVALUATION FINDINGS

This section presents the detailed findings from the 2016 Self Direct Program evaluation related to (1) program activity, (2) verified impact findings, and (3) cost effectiveness review.

3.1 Program Activity

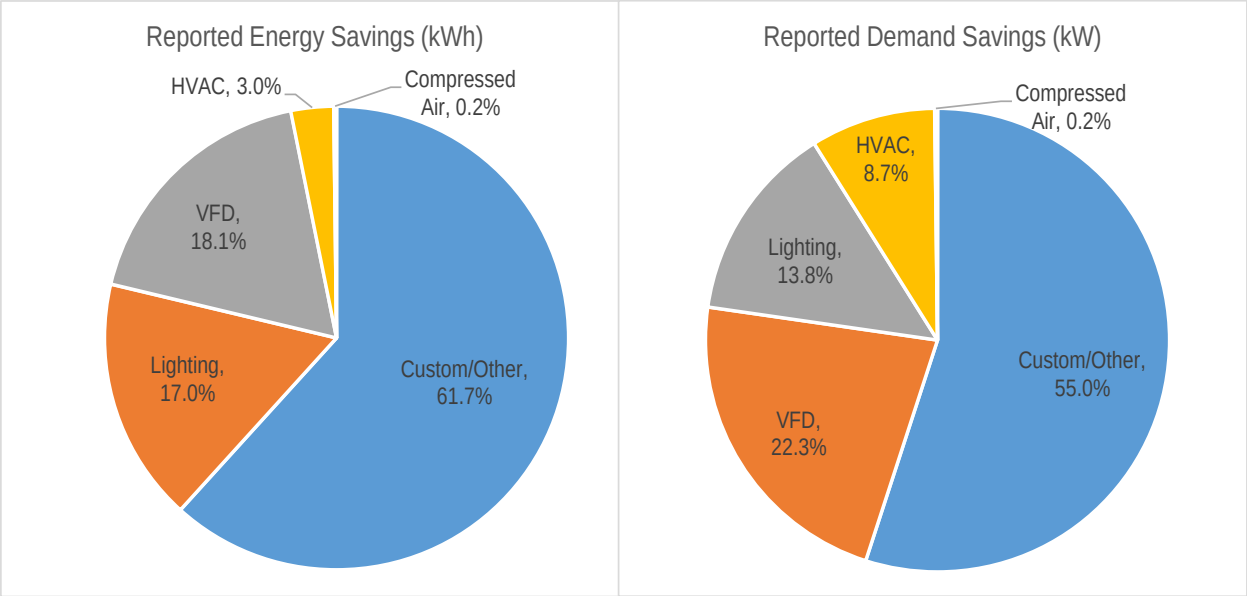
The evaluation team analyzed data extracted from AEP Ohio's tracking system on March 3, 2017; this delay past the end of the calendar year is a reflection of the reporting window available to Self Direct projects. As shown in Table 3-1, the 2016 Self Direct Program paid incentives on 73 projects constituting 22,472 MWh of *ex ante* reported annual energy savings and 3.04 MW of *ex ante* demand savings. The majority of installed measures were custom measures, as shown in Figure 3-1.

Table 3-1. 2016 Self Direct Program Projects and *Ex Ante* Savings

Metric	*Ex Ante* Value[1]
Number of Projects	73
Annual Energy Savings (MWh)	22,472
Electric Peak Demand Savings (MW)	3.04

Source: Evaluation Analysis of 2016 AEP Ohio Tracking Data

Figure 3-1. Percentage of Measures Installed by Measure Category



Source: Evaluation Analysis of 2016 AEP Ohio Tracking Data

Further review of the Self Direct Program tracking data yielded insights into key characteristics of program participants, and ways in which these have changed relative to past years. The number of projects and participants approximately doubled from 2015 to 2016. Some of the increase is due to late submissions in 2015 which were processed in 2016. Business types participating in the program in 2016 are more diverse than in 2015. In 2015, 94 percent of program level savings were claimed by the Industrial/Manufacturing sector. In 2016, this sector was 65 percent of program level savings, followed by Government/Municipal at 12 percent (Figure 3-2).

Segments with the greatest numbers of projects look very different than in 2015. In 2016, Primary Metals and Heavy Manufacturing made up nearly half of participating business segments, followed by utilities, health, and wholesale trade – non-durable at five percent each (Figure 3-3).

Figure 3-2. Percentage of Program Level Savings by Business Type

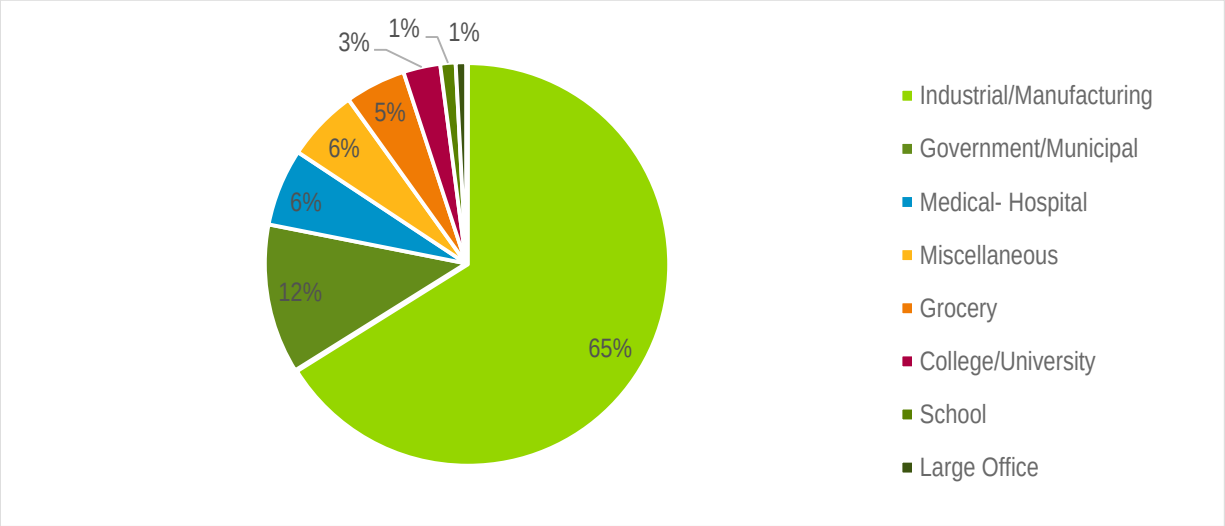
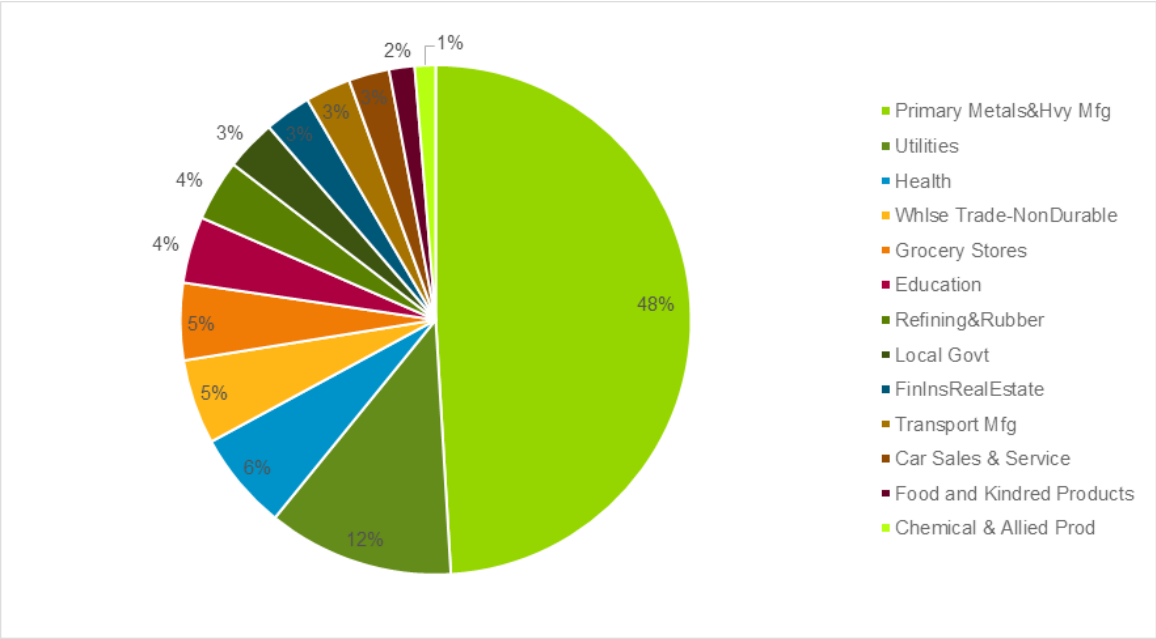


Figure 3-3. Percentage of Program Level Savings by Business Segment



3.2 Impact Evaluation Findings

This section provides a detailed description of impact findings for the 2016 Self Direct Program.

The results of the impact evaluation are presented in the following parts:

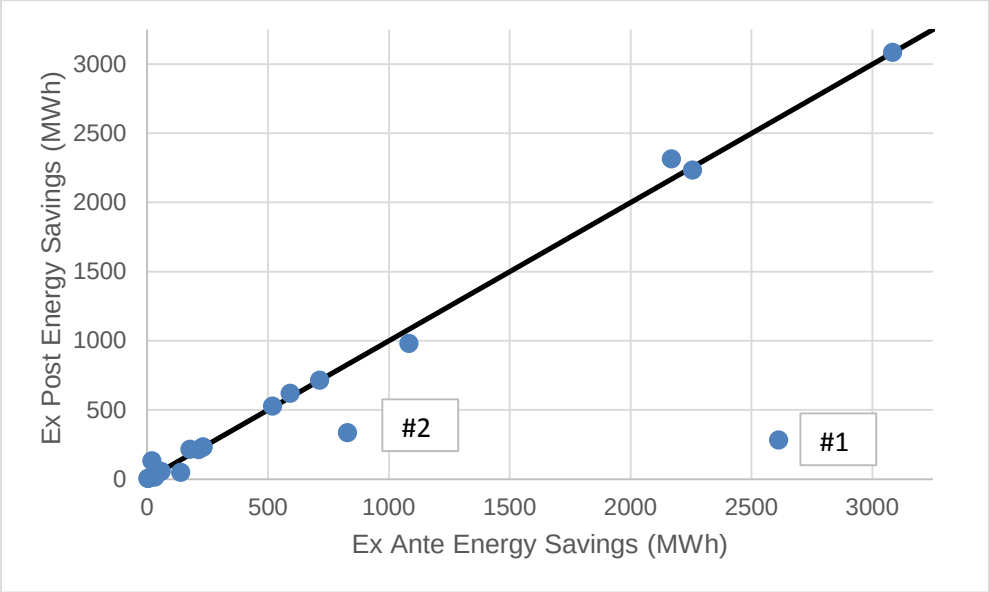
1. Findings from the Deemed Savings Review
2. Results from Onsite Data Collection
3. Program Savings Analysis

3.2.1 Evaluation Sample-Level Impact Results

Figure 3-4 through Figure 3-7 show the *ex ante* and *ex post* savings of each sampled project for energy and demand savings, respectively. The data points above the diagonal line represent projects with realization rates greater than one, while data points below the line represent those with realization rates less than one.

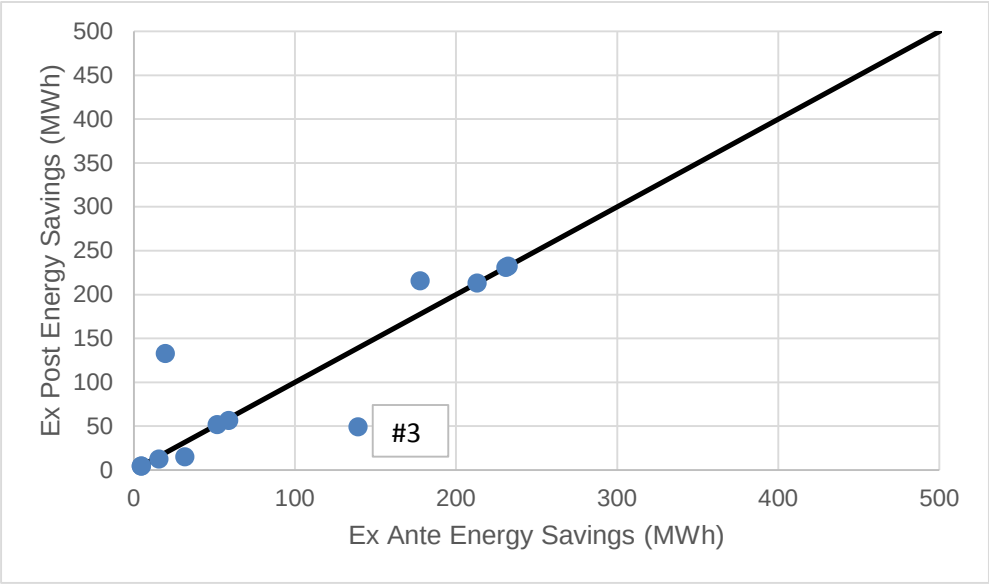
As shown in Figure 3-4 through Figure 3-7, the majority of projects had realization rates close to one. Note, due to the wide range of savings found in the sampled projects, there are two figures that show the full sample energy and demand realization rates, as well as two additional figures that zoom in on the lower end of the scale in order to provide more clarity on results within projects at the smaller end of the range. Specific comments related to the outlying projects are provided after the following series of figures.

Figure 3-4. Comparison of *Ex Ante* and *Ex Post* Energy Savings, Full Sample



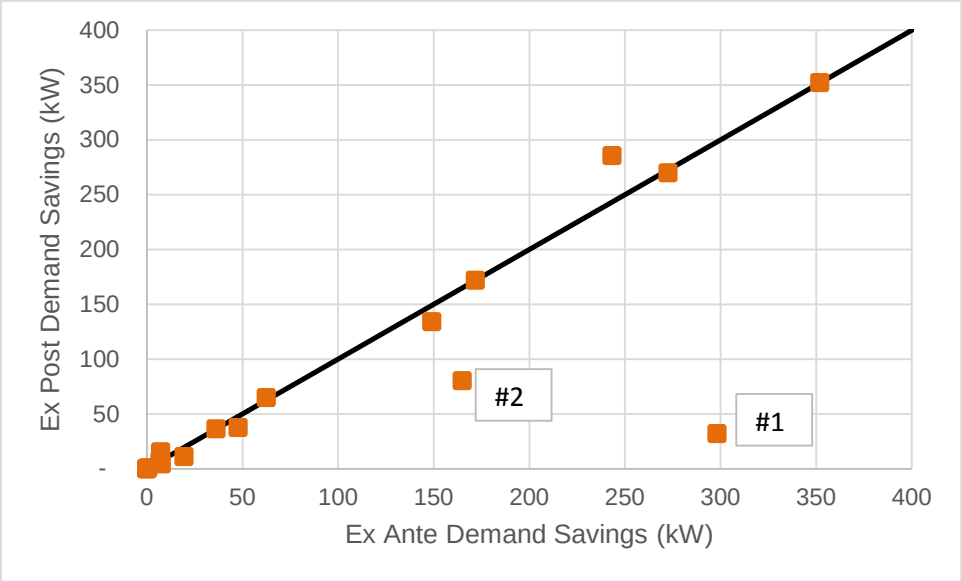
Source: Navigant Analysis, 2016

Figure 3-5. Comparison of *Ex Ante* and *Ex Post* Energy Savings, Small Projects



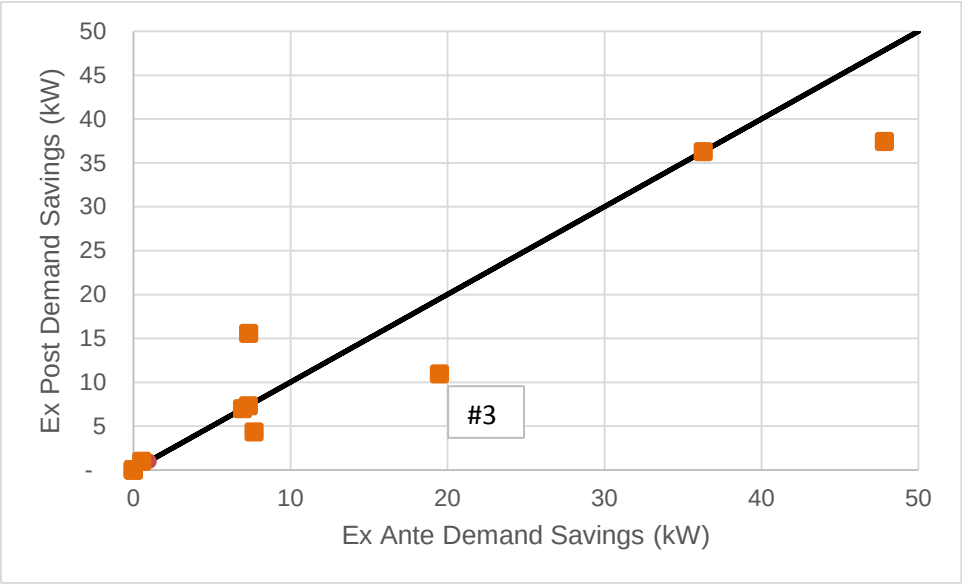
Source: Navigant Analysis, 2016

Figure 3-6. Comparison of *Ex Ante* and *Ex Post* Demand Savings, Full Sample



Source: Navigant Analysis, 2016

Figure 3-7. Comparison of *Ex Ante* and *Ex Post* Demand Savings, Small Projects



Source: Navigant Analysis, 2016

The following are a few brief comments about the primary outliers from the sample:

- The project noted as point #1 in Figure 3-4 involved three large VFDs used for a water filtration system. The 11 percent energy realization rate for this project is primarily due to a combination of the following factors.
    - The baseline for this project assumed that all three pumps were originally running at full capacity year round. In practice, the pumps were found to be in a lead-lag arrangement where one pump typically handles the full load, with a second only coming on intermittently. The third pump is for redundancy; so, one of the three is always off.
    - The original analysis also averaged pump flows, including types the pumps were off, and then used this average value to determine load and efficiency from the pump curves. The pump horsepower load should have been determined from the average flow only when the pump was running. This would have provided a more accurate horsepower load. This error ends up being somewhat minor because these pumps have high static head. (see next bullet)
    - An additional key driver of the low energy realization rate for this project is the pumps are operating as part of a filtration system where the load is based on static head induced by the filter medium. The high static head results in a small variation in horsepower load relative to the pump flow; therefore, loads that are static head dominant are inherently poor use of variable speed drives.
    - Ex Post results for this project are based on updated EMS data provided by the site contact in conjunction with 2016 flow data. The system flow in 2016 is greater than the annual flow for 2015; however, this is due to the warmer climate and is considered to be a reasonable reflection of average annual flows for the next several year.

- The project noted as point #2 in Figure 3-4 is a site that previously participated in another program. The facility management has since undergone turnover and the new staff sought to participate for a new chiller project; at the same time, they also attempted to report additional, recent ECMs, unaware some of the measures reported were incentivized previously.
    - The 41 percent energy realization rate for this project is better than initially anticipated as the largest single measure in the application (a 500-ton chiller) was new and eligible.
    - Savings from two additional, smaller chillers were zeroed out as these were previously reported though another program.
    - Savings from the lighting measures were previously incentivized, however the building type applied originally was incorrect and only supported a ~1.0 Watts per square foot baseline lighting power density (LPD). The new application correctly identified the building type and revised the baseline LPD up to ~1.2 Watts per square foot. The verified savings acknowledge the incremental savings provided by the baseline adjustment, but not the remainder of the previously reported savings.
- The project noted as point #3 in Figure 3-5 is a medium-sized lighting project. The primary driver of the extreme correction to savings is due to adjustments to both the baseline and current operating hours of use.
    - The customer self-reported hours of use for these fixtures is generally 30 to 50 percent of the default values found in the implementer's Appendix A (depending on specific zones within the space).
    - Verified hours of use are determined using temporary data loggers installed for two weeks. These logged hours of use support the self-reported hours of use, with only marginal opportunity for additional savings in areas that also received occupancy sensor based controls as part of this project.
    - Realization rates for this project are 35 percent for energy and 56 percent for demand.
    - Demand reduction is limited by verified Coincidence Factors (CF) derived from the primary data collection via temporary data logging.

3.2.2 Program Savings Analysis

In the final step of the impact evaluation, Navigant combined the outputs from all previous steps to determine program-level verified energy and demand savings. The evaluation team calculated the ratios between the project-specific verified savings for the sampled projects to the savings reported in the program database. Project level results were there rolled into strata level realization rates.

The sample results for each stratum were extrapolated to the population of program participants for that stratum. The extrapolation procedure followed the structure specified by the sample design, and used stratified ratio estimation to determine program-level verified (i.e., realized) savings. Finally, the program-level realized savings were compared to the *ex ante* program savings to determine the Self Direct Program realization rate.

Table 3-3 shows the ratio estimators and relative precision at the two-tailed 90 percent confidence interval for energy and demand savings. Overall, the relative precision on the sample results was ± 17.9 percent for energy and ± 18.6 percent for demand.

These precision bounds are a reflection of larger than anticipated adjustments to projects in all three strata. In particular, the small strata has a kWh coefficient of variation (CV) of 1.1 and a kW CV of 1.0; both are nearly 50 percent higher than the CV applied during the sample design phase. The CV for the Large stratum is also higher than expected, but this is mitigated somewhat by the sample having captured five of the seven large projects, a near census.

This year-over-year increase in CVs is concerning as the 2016 sample design is based on an average CV from the previous four years of evaluation (see Table 3-2). The CV of 1.17 for demand savings in 2015 was considered an extreme outlier; and all of the other values were rounded up slightly as a safety margin. However, in 2016 we see similar levels of scatter in both the demand and energy use savings for the Small stratum.

Table 3-2. Energy and Demand Coefficient of Variation, Historic and Current

Savings Metric	Stratum	2012 Achieved	2013 Achieved	2014 Achieved	2015 Achieved	Four Year Average	2016 Sample Design	2016 Achieved
kWh CV	Large	0.57	0.11	0.25	0.02	0.24	0.20	0.61
	Medium	n/a	n/a	n/a	0.64	0.64	0.75	0.50
	Small	0.68	0.39	0.15	0.63	0.46	0.60	1.09
kW CF	Large	0.09	0.15	0.30	0.06	0.15	0.20	0.54
	Medium	n/a	n/a	n/a	0.73	0.73	0.75	0.65
	Small	0.89	0.72	0.20	1.17	0.75	0.60	0.98

The CVs show in Table 3-2 have two implications of particular interest:

- Foremost, this indicates there are pervasive errors in the *ex ante* analysis and that these errors are showing up more and more in the evaluation. This implies that the implementation contractor should review internal QA/QC policies and the execution of those practices.
- This trend is also concerning as future evaluations will require significantly larger sample sizes in order to achieve the 90/10 confidence and precision targets.

Table 3-3. Energy and Demand Ratio Estimators and Relative Precision

Stratum Name	Energy Savings Statistics		Demand Savings Statistics	
	Energy Realization Rate	Relative Precision @ 90% Conf. Int.	Demand Realization Rate	Relative Precision @ 90% Conf. Int.
Large	0.79	31%	0.82	27%
Medium	0.86	22%	0.80	37%
Small	1.48	74%	1.23	111%
Overall	**0.86**	**18%**	**0.84**	**19%**

Source: Evaluation analysis of tracking data and sample results

AEP Ohio achieved 96 percent and 104 percent of the 2016 program goals for energy savings and demand reduction, respectively, as shown in Table 3-4.

Table 3-4. 2016 Program Goals, *Ex Post* Savings and Realization Rates

Metric	2016 Program Goals[1] (a)	*Ex Ante* (b)	*Ex Post* (c)	Realization Rate RR = (c)/(b)	Percent of Goal = (c) / (a)
Annual Energy Savings (MWh)	20,000	22,472	19,223	0.86	96%
Peak Demand Savings (MW)	2.46	3.04	2.55	0.84	104%

Source: [1] AEP Ohio VOLUME 1: 2012 TO 2014 Energy efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011; Evaluation Data Collection and Analysis as described in Appendix A.

3.3 Process Evaluation Findings

This section provides a detailed description of process findings for the 2016 Self Direct Program. The evaluation team completed the following process activities:

- Conducted Program Manager and Implementation contractor interviews
- Conducted in-person program participant interviews
- Reviewed tracking data for completeness and quality, and for insights into key performance indicators
- Reviewed program documentation for completeness and to assess whether program protocols are handled in a manner consistent with program documentation

A detailed explanation of each of these process activities is provided in Section 2. Sections 3.3.1 through 3.3.4 provide detailed process findings resulting from each activity.

3.3.1 Findings from In-depth Interviews with Program and Implementer Staff

Navigant conducted interviews with AEP Ohio's Self Direct Program Coordinator, Business Sector Manager, and the Operations Manager and Engineering Team Lead from the program implementer, between September and October of 2016.

The program staff and implementer interviews described the Self Direct program as a mature program that contributes modest savings, but plays an important role within AEP Ohio's suite of business programs. A key objective of the program is to encourage current and future participation by business customers in AEP Ohio's Prescriptive and Custom Business Programs, both by offering rebates which can be invested in new energy efficiency projects, and by educating customers about the other business programs through which their current and planned energy efficiency improvements qualify for incentives.

Feeding Other Programs. Overall, participation in the program has trended downward over time. The Program Coordinator points out this decline was predicted, as the program was designed to "naturally

phase itself out over time." Contrary to expectations, the Self Direct Program experienced a surge in participation during 2015, prompting speculation by the Program Coordinator as to what caused the increase. The Program Coordinator cited new, more effective outreach by the unified Outreach team as a likely cause of the uptick, stating "we're way over where we expected to be with goals this year, mostly because of the new outreach uncovering a lot of projects." The Program Coordinator said that while the outreach teams are in the field identifying potential new Custom and Prescriptive projects, they often uncover retrospective Self Direct projects in the process. The Program Coordinator described the Self Direct Program as "a good tool to increase awareness and participation by customers that have never participated in programs before." The program continued this upward trend in 2016 and nearly doubled participation and savings from 2015.

According to the implementation contractor, "the vast majority of Self Direct projects are coming from a few Solution Providers at facilities that have done a ton of stuff. Generally speaking, there are not many participants who only participate in the Self Direct Program, and many of those that do participate in Self Direct put in several projects." The Program Coordinator echoed the observation that there is a single Solution Provider in the field addressing industrial customers and uncovering many Self Direct projects. However, he thinks by its nature, the Self Direct Program will phase out over time as customers become more aware of the AEP Ohio EE/PDR programs. The Program Coordinator indicates the program does not actively track Self Direct participants to see if they have gone on to participate in other business programs; thus, however, he believes this might be a good process improvement. AEP Ohio as a whole, however, does track this information, and as a result, an easy process improvement would be to increase coordination so the Program Coordinator receives this information and can make use of it on an annual basis.

3.3.2 Findings from Onsite Interviews with Program Participants

While conducting onsite impact verifications, an in-person process interview was administered. The survey was short in length, aiming to collect information from the participant regarding participation in other AEP Ohio EE/PDR programs either in the past, concurrently with the Self Direct Program, or in the future, and overall satisfaction with the Self Direct Program and AEP Ohio. Eight interviews were conducted, an increase from the six telephone interviews conducted in 2015.

Overall, customers are highly satisfied with the program (9.4 on a 0 to 10 scale) and only somewhat less satisfied with the utility (8.9 on a 0 to 10 scale). Reasons for a lower utility rating include power reliability issues causing equipment to shut down and the ability to schedule service with the call center.

Half of respondents reported participating in another AEP Ohio EE/PDR program prior to participating in the Self Direct Program in 2016. The biggest driver for participation was the rebate the customer received (60%) followed by saving energy (40%). Drawbacks reported included not having a dedicated person to fill out the rebate application, and the time commitment to participating in the program. Similarly, participants reported these as possible barriers to participation. However, the majority of respondents (80%) would participate in the program again in the future. Recommendations to improve program effectiveness included increasing program awareness, and providing one point of contact / AEP Ohio time, and expertise to assist with participation.

3.3.3 Findings from Program Tracking Data Review

As part of our process evaluation, the process team thoroughly reviewed Self Direct Program tracking data. Our process review of the data consisted of analyzing the completeness and overall quality of the tracking data, and analyzing the tracking data to answer process-related research questions. The following sections present findings from the tracking data analysis.

Data Completeness and Quality

The evaluation team completed a high-level review of Self Direct tracking data, and an in-depth analysis of the completeness of a sample of key variables. The purpose of this review is to gauge whether the Self Direct Program tracking data is sufficiently complete to support rigorous internal quality control, accurate impact estimates, and to identify potential areas for improvement.

Overall, the tracking data appears to be high quality. It should be noted that the data Navigant reviews has already been improved by AEP Ohio prior to our review. Most entries are entered and formatted uniformly, and the tracking data is well organized. A high-level scan did not reveal any entries that were obviously in error, such as text recorded in numerical fields.

The evaluation team analyzed data completeness for a sample of process-related variables. Key dates and essential contact information fields were fairly complete. Some dates, such as the project completion date and final application date were 100 percent complete. Completeness of participant contact information improved from last year with 100 percent complete participant email address and phone number. The business type was missing for approximately 5 percent of participants.

Contractor information is also a key process component, completeness improved from last year but there were still a number of incomplete contractor-related fields. Contractor business name, contractor contact and contractor email are all fields we might reasonably expect to be nearly complete. Being able to identify the contractor for a given project is critical. If, for instance, AEP Ohio needs to analyze differences in some aspect of project performance between contractors, fifteen percent of contractor contact information was missing and over twenty percent of contractor email information was missing.

3.3.4 Findings from Program Documentation Review

The evaluation team reviewed current program documentation provided by the implementation contractor. The Self Direct Program implementation contractor maintains a comprehensive, accessible and navigable set of program documents, the most important of which are the 2016 AEP Ohio Quality Plan, formally called the Policy and Procedures Manual and the 2016 AEP Ohio Project Management Plan, formally called the Operations Manual.

The Quality Plan is most likely customer facing; however, this is not explicitly stated in the document itself. The document outlines customer eligibility, project requirements, incentive caps and limits, incentive amounts per measure, measure descriptions and base cases, and finally outlines required supporting documentation. The document provides a distinction between the four programs covered (Prescriptive, Custom, New Construction and Self Direct). Some sections within the document provide clickable links which is a useful tool. For example, there is a link to the online application, which facilitates customer access to information. Additionally, the document links to equipment specifications and program terms and conditions.

The Project Management Plan looks largely unchanged from the Operations Manual reviewed in 2015. This document serves as an internal reference and compendium of guidelines and processes. The Project Management Plan is an extensive guide containing the purpose of the manual, program overview and goals, purpose of the program, eligible customers/projects/measures, incentive limits, summary of program steps, roles and responsibilities of the implementer and AEP Ohio, key positions, operations, application processing, program controls, complain resolution, invoicing, acceptable calculation methods, specific measure guidelines, quality control process, safety requirements, and EM&V. This document is thorough and comprehensive. Review of this document assures there are processes in place to handle potential issues in an effective manner. Navigant recommends further review of how both of these documents are actually used by the implementer and AEP Ohio.

3.4 Cost Effectiveness Review

This section addresses the cost effectiveness of the Self Direct Program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. Table 3-5 summarizes the unique inputs used in the TRC test.

Table 3-5. Inputs to Cost-Effectiveness Model for Self Direct Program

Item	2016
Measure Life	14
Participants	73
Ex Post Annual Energy Savings (kWh)	19,223,071
Ex Post Coincident Peak Savings (kW)	2,548
Third Party Implementation Costs	$366,085
Utility Administration Costs	$173,694
Utility Incentive Costs	$959,857
Participant Contribution to Incremental Measure Costs	$6,874,975

Based on these inputs, the TRC ratio is 1.9. Therefore, the program passes the TRC test. Table 3-6 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 3-6. Cost Effectiveness Results for the Self Direct Program

Test Results for Self Direct Program	2016 Ratios
Total Resource Cost	1.9
Participant Cost Test	2.5
Ratepayer Impact Measure	0.8
Utility Cost Test	9.2

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

The following section provides a list summarizing the key findings and recommendations from the evaluation of the PY2016 Self Direct program. This section is divided in to two sub-groups, findings from the impact portion of the evaluation, and findings from the process portion of the evaluation.

4.1 Key Impact Evaluation Findings and Recommendations

1. **Impact Finding 1:** Both the magnitude of the Coefficient of Variations (CVs), as well as the trend of increasing CVs from 2014 to 2015, and again from 2015 to 2016 (shown in Table 3 2) suggest there are pervasive errors in the *ex ante* analysis, which are having increasingly larger impacts on the sample design and ultimate precision of this evaluation.
    - **Recommendation 1:** The implementation contractor should review internal quality assurance/quality control (QA/QC) policies and the execution of those practices. This is a key internal step for all projects, regardless of size.

2. **Impact Finding 2:** One of the Self Direct projects sampled had a combination of new (eligible) measures, as well as some measures that were previously incentivized through another program. Double-dipping is an extremely rare occurrence, and appears to have occurred because of change in staff at the affected site.
    - **Impact Recommendation 2a:** Consider adding a penalty in the terms and conditions should a participant or trade ally be found to have violated the spirit of the program through intentional or repeated errors of this nature.
    - **Impact Recommendation 2b:** Require the implementation contractor's database to have the ability to search each participating company, site address, and primary contact to retrieve project and measure participation history for each view. This information would only be viewed by AEP Ohio and the implementation contractor. Further, require the implementation contractor check every application for past redundancy both within the Self Direct Program and within all programs implemented by the contractor. Require at least a five-year rolling repository of incented projects and measures.
    - **Impact Recommendation 2c:** Consider updating AEP Ohio's portfolio level tracking database to allow program administrators to crosscheck across all programs for redundancy of previously incented measures.

3. **Impact Finding 3:** The Self Direct project AEP-16-17424 appears to have an unrealistic Effective Useful Life (EUL). The reported Effective Useful Life for this measure is 30 years. However, the majority of the savings is from a VFD which has an EUL of 15 years.
    - **Impact Recommendation 3a:** Request further documentation from the implementer to support the custom effective useful life of 30 years, and correct the measure life found in the program data base to reflect the overall EUL.
    - **Impact Recommendation 3b:** Have the implementation contractor institute a quality assurance check for excessive reported lifetimes.

4.2 Key Process Evaluation Findings and Recommendations

1. **Process Finding 1:** Participant interviews and tracking data analysis suggests there is room for improvement in the role the Self Direct Program plays as a feeder for the Prescriptive and Custom Programs**.** The 2015 evaluation has established that Solution Providers are using the Self Direct Program as an enticement for firms to participate in other programs. However, participant interviews indicated more firms saw the Self Direct funds more as an added benefit rather than a key influence on participation in other programs. This previous finding continues to apply in 2016. Additionally, some participants are applying to the Self Direct Program in multiple years.
    - **Process Recommendation 1a:** The Self Direct Program delivery team should work to increase the role of the Self Direct Program as a feeder for the Prescriptive and Custom Programs.
    - **Process Recommendation 1c:** AEP Ohio staff report that program participation is tabulated on a regular basis at the utility level. These cross-participation details should be shared with the Program Coordinator's annually. Program Coordinators would be enabled to proactively reach out to firms that have participated in Self Direct projects recently, but have not gone on to participate in other business programs.
2. **Process Finding 2:** The majority of program savings come from the industrial/manufacturing market.
    - **Process Recommendation 2:** Use this program in overlooked market segments to bring in new participants by increasing outreach to other segments.
3. **Process Finding 3:** The implementation contractor hosts bi-weekly calls and provides daily reporting to one high performing Solution Provider.
    - **Process Recommendation 3:** Navigant recommends the implementation contractor expand these offerings to other high performing Solution Providers. The implementation contractor should also pursue opportunities to provide all participating Solution Providers with feedback on their performance.
4. **Process Finding 4:** A large number of projects were submitted at year end, resulting in a crunch for the utility, implementer, and evaluator.

- **Process Recommendation 4a:** Institute a contractor rating and performance feedback system that would influence the timeliness of project completion and deter project submission at the last minute.
- **Process Recommendation 4b:** Provide an incentive bonus during certain times of the year that typically have lower application volumes.

5. **Process Finding 5:** The program implementer does not actively track Self Direct participants to see if they have gone on to participate in other business programs.
    - **Process Recommendation 5:** Although the Program Coordinator is not actively tracking this information, AEP Ohio is tracking this information. Navigant recommends coordination between AEP Ohio and the Program Coordinator.
6. **Process Finding 6:** Even though AEP Ohio customers have Customer Services Account Managers and a Customer Services Engineers, participant interviews still indicated one point of contact at AEP Ohio would greatly assist in program participation.

- **Process Recommendation 6a:** Review training given to Customer Services regarding the portfolio of EE/PDR program offerings. Ensure Customer Services can speak fluently regarding program opportunities, how to correctly apply, and key program contact people.
- **Process Recommendation 6b:** Encourage Customer Services to speak frequently with their customers regarding the EE/PDR programs and Customer Services ability to guide them through the process. Consider adding EE/PDR program activities to Customer Services' performance review activities.

7. **Process Finding 7:** Contractor contact information was missing from the tracking data.
    - **Process Recommendation 7:** Set a performance indicator for the implementer to populate this information in the tracking data for all projects.

APPENDIX A. INTERVIEW GUIDES

Business Programs Manager Interview Guide

AEP-Ohio Business Programs Evaluation
PY2016 Business Manager In-Depth Interview Guide

Name of Interviewee: Date:

Title: Business Manager Company:

Contact Information:

[Note to Interviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff and implementation contractors. 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. The interviews will be audio taped and transcribed. Interviews in every case will be conducted by Navigant's process evaluation lead for the program to ensure full context and understanding for the interview, and to enable the interviewer to probe for the most meaningful questions and responses.

Roles and Protocols

1. Has your role changed as the Business Program's Manager?

2. With respect to both AEP Ohio staff and implementation contractors, have there been any major personnel or contractor changes in 2016? Why, and how have these changes impacted overall program performance?

3. How often do you meet with AEP Ohio's Business Program Managers, and in what manner? Do you feel information between you and the Program Managers is shared in a timely manner? If not, are there any changes that could be made to improve communication within AEP Ohio's Business Program Sector?

Program and Incentive Changes

4. What does the current mix of Programs look like from your perspective (e.g. Which are the biggest generators of savings, which have the most participation, which are growing or shrinking the most, etc. and why?)

5. Can you identify any trends in the marketplace, codes and standards, the economy, etc. which are impacting business programs? If so, which programs and how?

6. Have incentive levels stayed constant across most Business programs in 2016, or have there been significant changes to the incentives for some programs?

7. I know due to the legislative situation, there have not been many significant changes to the Business programs in 2016 but what can you share as far as 2017 goes? Why were/are these changes made, and how do they affect program performance?

8. Do you envision adding any additional programs in the near future, or can you think of any Business programs AEP Ohio does not currently offer but might be beneficial to its customers?

Overall Goals and Objectives

9. Overall, do you expect the portfolio of Business programs to meet AEP Ohio's savings targets for 2016? Why or why not?

10. Of course energy savings goals are primary, but how is the portfolio of Business programs doing with respect to other goals and objectives? (Ohio jobs, outreach and participation levels, customer satisfaction, cost effectiveness, etc.)

Marketing and Promotion

11. Overall, do you think marketing for the portfolio of business programs is sufficient and effective? Are there areas or programs where you see room for improvements in marketing?

12. Are you aware of any major changes in marketing of Business programs during 2016, and are there any major changes planned for the upcoming year?

13. From your perspective, does the AEP Ohio website play an important role in marketing Business programs? If so, how? And has this changed over the years?

Program Process Overall

14. Do you have a sense of how satisfied business customers are with various aspects of AEP Ohio's Business programs overall (time to process incentives, application process, interaction with AEP Ohio staff, ICs or other solution providers, etc.)?

15. How satisfied are you with the level of QA/QC across the business programs in general? Are there areas you see for improvement either by AEP Ohio or by implementation contractors?

16. From your perspective, what programs or aspects of AEP Ohio's Business programs are working really well, and what programs or areas need improvement?

Solution Providers and Implementation Contractors

17. Overall do you feel that Business programs have adequate networks of Solutions Providers, or are there some Programs, end uses, or geographic areas that are not well covered?

18. In your opinion, what could AEP Ohio's Business programs do to recruit more Solution Providers?

19. Overall, are Solution Providers and the Implementation Contractors meeting your expectations for the Business programs? Are you aware of any areas for improvement, or any relationships that work particularly well?

Customer Experience

20. From your perspective, how satisfied are Business customers with the programs offered by AEP Ohio? What are some common complaints you hear, and what are some common positive comments you hear from customers?

Wrapping Up

21. Are there any areas that you would particularly like to see us delve into deeper in the process evaluation this year or questions you really want answered?

22. Are there any questions I didn't ask that you think I should be asking? I would love to hear any insights you have that have not come up during the course of our interview.

Program Manager Interview Guide

AEP-Ohio Evaluation for Business Prescriptive and Self Direct Programs

2016 Program Staff In-Depth Interview Guide

Name of Interviewee: Date:

Title: Company: AEP Ohio

Contact Information:

[Note to Interviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff and implementation contractors. 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. The interviews will be audio taped and transcribed. Interviews in every case will be conducted by Navigant's process evaluation lead for the program to ensure full context and understanding for the interview, and to enable the interviewer to probe for the most meaningful questions and responses.

Roles and Protocols (Please answer with respect both to your role managing the Prescriptive Program and the Self Direct Program)

1. Has your role changed over time and if so, how?

2. With respect to DNV GL, AEP OHIO staff and the solution providers, do you think there have been any substantial changes in the roles and people assigned to these programs in the past year compared to previous program years? If so, what were they?

3. How often do you meet with the ICs of each program, and in what manner? Do you feel information between you and the IC is shared in a timely manner? If not, what can be done to improve this situation? Last year you responded that more face to face meetings might help for the Prescriptive program. Has anything changed on this front?

Program Changes, New Measures, Measure Mix and Incentives

4. [PRESCRIPTIVE] Have there been any changes to measures offered in 2016? Are there any planned changes on the horizon? What does the current mix of measures look like from your perspective (lighting versus HVAC versus VSDs, etc.)?

5. [PRESCRIPTIVE] Do you have any suggestions for measures that should be added?

6. Have you made any changes to incentive levels in 2016, and do you plan to make any in 2017?

7. Have there been any other significant changes to the program (delivery, components, etc.) in 2016, and do you have any significant changes planned for 2017? Why were/are these changes made, and how do they affect program performance?

8. [SELF DIRECT] Have you seen any changes to the mix of measures being claimed through the Self Direct program in 2016 relative to previous years?

Overall Goals and Objectives

9. Do you expect to meet the program savings goals in 2016 (for instance are the number of rebate applications on track)?

10. Of course energy savings goals are primary, but how are the Prescriptive program and Self Direct program doing with respect to other goals and objectives? (Ohio jobs, outreach and participation levels, customer satisfaction, cost effectiveness, etc.)

Program Theory, Market Barriers and Barriers to Participation

11. In your own words, what are the market barriers addressed by the Prescriptive and Self Direct programs, and how do these programs overcome them? (We are looking for cause and effect relationships)

12. What do you see as the key barriers to program participation for the Prescriptive and Self Direct programs, and how is the program overcoming these? Have Solution Providers and AEP Account Executives been successful at removing these barriers to participation? If so, how, if not, why?

Marketing and Promotion

13. [BOTH] Please describe the Prescriptive program and Self Direct program marketing approaches in your own words. Include all relevant components, and describe how effective you think they are.

14. [BOTH] Is the current level of marketing sufficient and does it address all measure end-use categories equally well, or are some over or under represented? (E.g. lighting, HVAC, refrigeration, motors, etc.)

15. [BOTH] How could marketing for the Prescriptive program and Self Direct program be improved?

Program Process Overall

16. What processes work really well in the Prescriptive program and Self Direct program, and what processes need improvement? (e.g., communication, time processing applications, customer interaction, marketing, relationship between utility and IC, etc.)

17. What do you think is the biggest process area for improvement going forward? (i.e.—what processes could be changed that would have the biggest positive impact on program functioning and performance?)

18. How is QA/QC currently handled for this program, and what improvements could/should be made?

Solution Providers

19. Do you have a sense of Solution Providers' overall satisfaction with their participation in the Prescriptive program and Self Direct program in 2016 and in working with the IC? Have you noticed or heard any changes from past years?

20. Are Solution Providers and the IC meeting your expectations for the Prescriptive Program and Self Direct program? If not, what could be improved?

21. Did AEP Ohio offer trainings or marketing materials in 2016 to help support Solution Providers market the programs? Was there an SP bonus in 2016?

Customer Interest, External Factors, Strengths and Weaknesses

22. Based on your experience with implementing the program and communicating with customers, how did interest in the programs in 2016 compare to interest in 2015?
23. Are economic conditions affecting the program? If so, how?
24. In your opinion, what is working best in the Prescriptive Program and Self Direct Program, and what needs the most improvement?

Wrapping Up

25. Are there any questions I didn't ask that you think I should be asking? I would love to hear any insights you have that have not come up during the course of our interview.

Thank you very much for talking with me today. If additional questions arise, would it be alright to contact you by email?

Implementation Contractor Interview Guide

AEP-Ohio Evaluation for Prescriptive, Custom and Self Direct Programs
2016 Implementation Contractor In-Depth Interview Guide

Name of Interviewee: Date:

Title: Company:

Contact Information:

[Note to Interviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff and implementation contractors. 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. The interviews will be audio taped and transcribed. Interviews in every case will be conducted by Navigant's process evaluation lead for the program to ensure full context and understanding for the interview, and to enable the interviewer to probe for the most meaningful questions and responses.

Roles and Protocols (Please answer with respect both to your role managing the Prescriptive Program and the Self Direct Program)

1. [ALL] Has your role changed over time and if so, how?

2. [ALL] With respect to AEP OHIO staff and the solution providers, do you think there have been any substantial changes in the roles and people assigned to these programs in the past year compared to previous program years? If so, what were they?

3. [ALL] How often do you meet with AEP Ohio staff for each program, and in what manner? Do you feel information between DNV GL and AEP Ohio is shared in an efficient manner? If not, what can be done to improve communication?

Program Changes, New Measures, Measure Mix and Incentives

4. [P AND C] Have there been any changes to measures offered in 2016 across the three programs? Are there any planned changes on the horizon? What does the current mix of measures look like from your perspective (lighting versus HVAC versus VSDs, etc.)?

5. [P AND C] Do you have any suggestions for measures that should be added?

6. [ALL] Have you made any changes to incentive levels in 2016, and do you plan to make any in 2017?

7. [ALL] Have there been any other significant changes to the programs (delivery, components, etc.) in 2016, and do you have any significant changes planned for 2017? Why were/are these changes made, and how do they affect program performance?

Overall Goals and Objectives

8. [ALL] Do you expect to meet the program savings goal in 2016 (for instance are the number of rebate applications on track)?

9. [CUSTOM] The end of the year can be crunch time as customers rush to get applications in. The Custom program manager mentioned that you'd brought extra engineers on board to handle the volume. Are you on track to get all these end-of-year applications processed? What about projects in final review? The program manager also mentioned a large cue of projects in final review. Do you expect to have these finalized before the end of the year? Is there anything you feel DNV GL could do in future years to ease the number of projects still waiting in final review at the year's end?

Program Theory, Market Barriers and Barriers to Participation

10. [ALL] In your own words, what are the market barriers (i.e. things preventing people from taking the same actions without the program) addressed by these programs—in other words, why is there a need for the program—and how does the program overcome these barriers? (We are looking for cause and effect relationships)

11. [ALL] What do you see as the key barriers to program participation for the Prescriptive program, and how is the program overcoming these?

12. [ALL] What is the status of an online application system for these programs?

Marketing and Promotion

13. [ALL] Please describe the marketing approach to each of these programs in your own words. Include all relevant components, and describe how effective you think they are.

14. [ALL] How could marketing for these programs be improved?

Program Process Overall

15. [ALL] What processes work really well in each program, and what processes need improvement? (e.g., communication, time processing applications, customer interaction, marketing, relationship between utility and IC, etc.)

16. [ALL] What do you think is the biggest process area for improvement going forward? (i.e.—what processes could be changed that would have the biggest positive impact on program functioning and performance?)

17. [ALL] How is QA/QC currently handled for this program, and what improvements could/should be made?

18. [ALL] We like to review program materials the implementation contractor has in place as part of our overall review. Would you be able to share with us a copy of the Operations Manual, QA/QC guidelines, process flow diagrams or other documents that help guide program implementation?

Solution Providers

19. [ALL] Do you have a sense of Solution Providers' overall satisfaction with their participation in these programs in 2016? Have you noticed or heard any changes from past years?

20. [ALL] Are Solution Providers meeting your expectations for the Prescriptive Program? If not, what could be improved? Are SP's spread across the territory well, or are some areas less well represented?

21. [ALL] Did AEP Ohio offer trainings or marketing materials in 2016 to help support Solution Providers market the program? Was there an SP bonus in 2016? How does the bonus affect program participation?

Customer Interest, External Factors, Strengths and Weaknesses

22. [ALL] Based on your experience with implementing the program and communicating with customers, how did interest in these programs in 2016 compare to interest in 2015?
23. [ALL] Are economic conditions are affecting these programs? If so, how?

Wrapping Up

24. [ALL] Are there any questions I didn't ask that you think I should be asking? I would love to hear any insights you have that have not come up during the course of our interview.

25. [ALL] I have heard, talking to several people about examples recently of SPs taking so long to submit paperwork for the Prescriptive or Custom programs that projects ultimately get submitted and claimed under Self Direct instead. Do you have a sense of how common this is, if at all?

Thank you very much for talking with me today. If additional questions arise, would it be alright to contact you by email?

Participant Interview Guide

AEP Ohio Evaluation for the Self-Direct Program

2016 Participant In-Depth Interview Guide

Name:	Date:
Title:	Company:
Contact Info:	Project Number:
Interviewer:	

Participation and Other Programs

P1. How did you first hear about the AEP Ohio Self Direct Program?

P2. Have you participated in the AEP Ohio Prescriptive Program or any other AEP Ohio Energy Efficiency programs before 2016?

P3. What was the primary reason you participated in the AEP Ohio Self Direct Program?

Program Improvements

PI1. On a scale of 1 to 10, where 0 is very dissatisfied and 10 is very satisfied, how would you rate your satisfaction with the AEP Ohio Self Direct Program?

PI2. And using the same scale, how would you rate your satisfaction with AEP Ohio overall?

PI3. What do you see as the main benefit(s) to participating in the AEP Ohio Self Direct Program?

PI4. What do you see as the drawbacks to participating in the program?

PI5. What do you think are reasons companies like yours may not participate in the program?

PI6. Do you plan to participate in the program again in the future? (If no, why not?)

PI7. How would you improve the AEP Ohio Self Direct Program?

PI8. What additional measures or types of equipment would you like to see added to the program?

Thank you for your time, if there is anything else you would like to share, let me know.

Summary: Report - 2016 Portfolio Status Report of the Energy Efficiency and Peak Demand Response (Volume 2 of 3) electronically filed by Mr. Steven T Nourse on behalf of Ohio Power Company