

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

VOLUME III

APPENDICES L - Q



A unit of American Electric Power

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APPENDIX L



NON-RESIDENTIAL NEW CONSTRUCTION PROGRAM

2016 Evaluation Report

Prepared for:

AEP OHIO



A unit of American Electric Power

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Submitted by:

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

312.583.5700
navigant.com



Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

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

Contact:

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

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

Prepared by:

Danielle Vitoff, Managing Consultant
303.728.2460
danielle.vitoff@navigant.com

Neil Curtis, Managing Consultant
802.526.5119
neil.curtis@navigant.com

Michael Soda, Senior Consultant
303.728.2486
michael.soda@navigant.com

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EXECUTIVE SUMMARY

AEP Ohio's Non-Residential New Construction (NRNC) Program supports customers building a new facility or undertaking a major renovation in incorporating higher levels of energy efficiency in their building design. The program is divided into three participation paths: 1) Prescriptive, 2) Custom, and 3) Whole Building,¹ which are intended to meet the needs of buildings of varying size and complexity. The Prescriptive and Custom paths in the NRNC Program are similar to AEP Ohio's Prescriptive and Custom Programs, with the exception that lighting energy savings are calculated based on Lighting Power Density (LPD) calculations relative to LPD allowances in the Ohio Energy Code. The Whole Building path is a comprehensive approach utilizing building energy modeling simulations for customers with larger or more complex buildings that want to maximize the energy efficiency of their new building. In 2016, *My Solutions* was incorporated into the Whole Building path, specifically to provide smaller office and retail buildings (<70,000 sq.ft.) with similar comprehensive analysis and program services. The program is delivered by a pair of implementation contractors on behalf of AEP Ohio.

ES.1 Program Participation

The 2016 program year represents the sixth year of operation for the NRNC Program and the sixth year in which Navigant has evaluated its operation. In 2016, 216 projects were completed at 197 different buildings. The projects involved approximately 23 million square feet of new and renovated buildings.² In 2016, 143 unique participants³ participated in the program. In 2016, 28 participants completed multiple projects, accounting for 101 of the 216 projects completed. Overall, the number of projects and estimated floor area of the buildings participating in the program increased significantly from the prior year's program. In 2016, *ex ante* electricity savings increased by almost 20 percent compared to 2015 (Table ES-1), additionally the program saved more than four times its electric energy savings target (Table ES-2).

¹ The Whole Building approach also includes the *My Solutions* offering which offers a somewhat prescriptive approach to the Whole Building Performance path for relatively small office and retail participants.

² Floor areas were reported for 173 of the 184 unique buildings participating in the program in 2016. Navigant estimated the floor area for those with unreported square footage from the average floor area of similar buildings from the tracking database.

³ Navigant notes the tracking database contained a number of variations on some organization names. Navigant exercised judgement in identifying "unique" participants.

Table ES-1. NRNC Summary, 2015 and 2016 Program Years

	2016 Program	2015 Program
Total Incremental Participant Cost	\$14,940,573	\$8,267,040
Amount of Incentives Paid by AEP Ohio	\$3,519,527	\$2,302,725
Floor Area (reported sq.ft.)	20,007,146	10,780,453
Floor Area (total estimated sq.ft.)	23,067,462	13,165,509
<i>Ex Ante</i> Energy Savings (MWh)	42,015	35,171
<i>Ex Ante</i> Demand Savings (MW)	8.4	7.2

NOTE: Total floor area is calculated from unique buildings in each year.

Table ES-2. NRNC 2016 Program Summary

	2016 Program Goals	2016 Program, Reported
Program Budget	\$1,000,000	\$3,519,527 (incentives only)
<i>Ex Ante</i> Energy Savings (MWh)	10,000	42,015
<i>Ex Ante</i> Demand Savings (MW)	1.230	8.430

As in past years, the vast majority of the projects completed in 2016 applied under the Custom or Prescriptive path (Table ES-3). It should be noted that several Whole Building projects also utilized the Prescriptive path for some measures. The number of Whole Building projects increased by almost 30 percent compared to the prior year (28 in 2015), though the associated total *ex ante* savings decreased slightly.⁴

Table ES-3. 2016 Activity by Program Option

Option	Number of Buildings	Percent of Total Buildings	Estimated Floor Area (Sq Ft)	<i>Ex Ante</i> Savings (kWh/year)	Percent of Total Program Savings
Custom/Prescriptive	149	76%	17,515,220	30,268,437	72%
Whole Building	48	24%	5,552,242	11,746,597	28%
Total	197	100%	23,067,462	42,015,034	100%

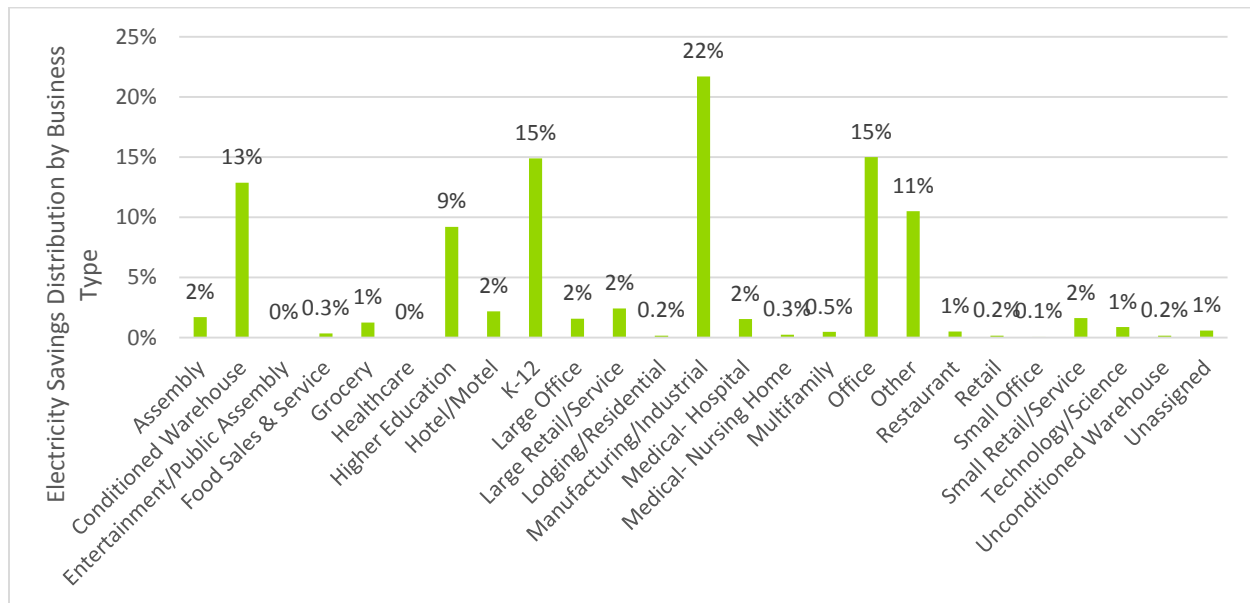
NOTE: Buildings that include Whole Building and Prescriptive/Custom projects are counted under the Whole Building category.

Figure ES-1 shows the *ex ante* energy savings by business type. In 2016, six building segments (manufacturing/ Industrial, office, K-12 schools, conditioned warehouse, higher education, and other, i.e. buildings that do not fit within the stated building segment categories) accounted for approximately 85 percent of the reported electrical energy savings. These six building segments which account for the large

⁴ The decrease in total energy savings, which is indicative of lower energy savings per Whole Building project in 2016, may be attributable to the addition of the My Solutions program, which targets smaller Whole Building projects. There were eight My Solutions projects completed during 2016.

majority of program savings, encompass 127 projects within 116 unique buildings. The balance of the program savings was distributed in small amounts, 2 percent or less, across nineteen other building segments. These nineteen building segments included 89 projects, which were generally smaller in nature, located across 81 unique buildings.

Figure ES-1. *Ex Ante* Electricity Savings by Type of Business, 2016 Program



ES.2 Data Collection Activities

As part of the impact study, the evaluation team completed an engineering review on project files accounting for 57 percent of the claimed *ex ante* energy savings. Projects accounting for fifteen percent of the *ex ante* energy savings also underwent an on-site review. Table ES-4 provides an illustration of the impact measurement and verification (M&V) sample stratification and the level of review completed by the evaluation team within each stratum.

Table ES-4. Impact Sampling Strata and Achieved Sampling

Stratum by Approach and Energy Savings	Number of Buildings	Strata weight by Energy	Number of Desk Reviews	Number of On-site Reviews ⁵
Large (>750 MWh/yr)	13	47.7%	13	3
Medium (>300 MWh/yr, <750 MWh/yr)	30	24.3%	10	2
Small (>50 MWh, < 300 MWh)	68	24.0%	7	0
Very Small (<50 MWh)	71	4.0%	3	0
Design Review (No Savings)	15	0.0%	0	0
Total	197	100%	33	5
Percent of <i>Ex Ante</i> Savings			57%	15%

ES.3 Key Impact Findings and Recommendations

As summarized in Table ES-4, the verified electricity savings significantly exceeded the 2016 targets of 10 GWh and 1.23 MW coincident demand reduction. The *ex post* energy and summer coincident demand savings are 44,151 MWh/year and 8.27 MW respectively. The realization rate for energy is 1.05, while the demand realization rate is 0.98. These results represent both increased program savings and increased realization rates compared to 2015.

Table ES-4. Impact Savings, Realization Rate and Sample Precision

Metric	2016 Program Goals* (a)	<i>Ex Ante</i> (b)	<i>Ex Post</i> (c)	Realization Rate RR = (c) / (b)	Overall Relative Precision at 90% Confidence	Percent of Goal = (c) / (a)
Annual Energy Savings (MWh)	10,000	42,015	44,151	105%	8.6%	442%
Coincident Peak Demand Reduction (MW)	1.23	8.43	8.27	98%	15.3%	672%

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

Other key impact findings and recommendations include the following selected recommendations. Additional impact recommendations are included in Section 4.1 (Key Impact Findings and Recommendations).

⁵ On-site reviews are a sub-set of desk reviews. All buildings in the sample received at least a desk review, while some received an on-site review in addition to the desk review. If a building received both an on-site and a desk review, it is counted in both the on-site and desk review totals.

- 1) Multiple mistakes were found in the *ex ante* calculations including; typos resulting in understatements of savings and mistaken ineligibility of a measure; incorrect references to the 2014 Appendix A values instead of the 2016 Appendix A; correctly assigning savings-per-hp, but calculation resulting in incorrect total savings; and savings claimed in project files differed from the tracking database.

Impact Recommendation 1: Develop a project quality control (QC) checklist identifying the most common errors (including those mentioned above) to ensure peer reviews pick up simple errors and typos in the project files.

- 2) Detailed verification of *ex ante* lighting power density (LPD) calculations reveals several errors, including inaccurate fixture counts, missing ballast specifications, omission of lighting controls in both the baseline and as-built calculations, and ignoring the longer run hours of 24/7 security lighting.

Impact Recommendation 2a: Consider training LPD specialists to thoroughly check that all LPD submittals are consistent with the lighting layout drawings, or noting where the actual building differs from the drawings. Onsite inspections should include double checking the actual building lighting equipment matches the drawings.

Impact Recommendation 2b: Include an analysis of both the baseline and as-built lighting controls. Specify which baseline code of what vintage is being followed, IECC or ASHRAE 90.1 and the year, and calculate lighting control savings from the actual building.

ES.4 Key Process Findings and Recommendations

The following process recommendations are offered to help improve program effectiveness and efficiency, and further improve the overall experience of program participants. Additional process recommendations are included in Section 4.2 (Key Process Findings and Recommendations).

- 1) There may be missed opportunities in some segments of the NRNC market that could be leveraged by the established NRNC pathways for additional participation. The program does not have data to compare program activity (completed projects) with actual, overall volume of nonresidential new construction projects in the AEP Ohio jurisdiction.

Process Recommendation 1: AEP Ohio should compare program participation results with jurisdictional construction data to assess program penetration and identify underserved market segments. Specific attention should be given to Build-to-Lease projects and properties with very small footprints to determine whether there is a reduction in program use correlated with building size.

- 2) Participant outreach activities are conducted primarily through Technical Account Managers, which by all stakeholder accounts is well received.

Process Recommendation 2: Prioritize and expand the Technical Account Manager role to provide outreach, education, manage long-term project communications, complete project applications, and maintain ongoing communication with design teams and trade ally associations.

1. INTRODUCTION AND PURPOSE OF STUDY

AEP Ohio's Non-Residential New Construction (NRNC) Program provides support for customers building a new facility or undertaking a major renovation to incorporate higher levels of energy efficiency in their building design. The program is divided into three paths which are intended to meet the needs of buildings of varying size and complexity. The three program paths include the following:

- 1) Whole Building Performance, including the My Solutions option – a comprehensive approach, which relies on building energy modeling,
- 2) Prescriptive – which is treated the same as the Prescriptive Program, except lighting is based on lighting power density.
- 3) Custom – which involves engineering calculations on a measure-by-measure basis.

The 2016 program year represents the sixth year of operation for this program. The program is delivered by two implementation contractors on behalf of AEP Ohio, CLEAResult and DNV GL. CLEAResult assumed responsibility for customer outreach and communication as well as the delivery of the Whole Building path, while DNV GL administered applications under the Custom and Prescriptive paths. The transition to this split delivery arrangement took place during the first half of 2015.

1.1 Evaluation Objectives

This report presents the findings from the impact and process evaluations of the AEP Ohio Non-Residential New Construction Program (NRNC) for 2016. The three major objectives of the evaluation were to:

- 1) Quantify energy and summer peak demand savings impacts at the meter from the program during 2016.
- 2) Determine key process-related program strengths and weaknesses and identify ways in which the program can be improved.
- 3) Determine program cost-effectiveness.

Specific process evaluation questions are summarized in Section 2.2 (Key Evaluation Questions) and Section 3.2.5 (Process Evaluation Findings).

1.2 Evaluation Methods

Program impacts for the 2016 NRNC Program were evaluated in terms of electric energy and peak demand savings. A portion of the completed project population was sampled with the intention of achieving 90 percent confidence and a +/-10 percent precision for both the program energy and demand savings.

The *ex post* energy and demand savings of the sampled projects were determined by engineering review of the project files, engineering review of the *ex ante* savings analysis, inspection of the building energy

models and/or site verification of the installed components of the energy efficiency measures designed for the subject buildings. Summer coincident peak savings are determined by engineering analysis of the savings potential during the peak period or by adjusting demand savings with a published coincidence factor for summer peak demand.

Data collection activities are summarized in Table 1-1. During the 2016 program evaluation, Navigant interviewed staff from AEP Ohio and the implementation contractors, reviewed program materials, and reviewed strategy documents to gain an understanding of program logic, expected inputs, outputs, and outcomes for the program.

Table 1-1. Summary of Data Collection Activities

Data Collection Type	Targeted Population	Supported Evaluation Activities
Review of Program Documentation	Program documentation and marketing materials for 2016 program.	Process Evaluation
Secondary Literature Review	Publicly-available evaluations of other utility non-residential new construction programs; reports of construction practices in absence of utility programs.	Impact and Process Evaluation
In-depth Telephone Interviews	AEP Ohio Program staff	Process Evaluation
	DNV GL and CLEAResult staff	Process Evaluation
Project File Review	Sample of completed projects	Impact Evaluation
Telephone Verification	Where project files were incomplete	Impact Evaluation
On-site Verification	Where uncertainties in the savings calculations existed	Impact Evaluation
Tracking Data Review	All program participants	Impact and Process Evaluation

2. METHODOLOGY

This section describes the methodology used to conduct the process and impact evaluations. A high-level overview of the steps taken to collect and analyze the data for this evaluation is described in Section 2.1. This is followed by a discussion of the research questions that guided the evaluation and the tasks completed as part of the process evaluation; including the review of tracking data, the marketing activities and participation. Finally, the methods used for primary data collection tasks and in analyzing the impact and process data are discussed.

2.1 Overview of Approach

The evaluation was driven by three overarching objectives: (1) quantify electric energy and summer coincident demand savings impacts from the 2016 program year, (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. To meet these objectives, the evaluation team undertook the following activities.

- 1) **Evaluation Questions.** Established key evaluation questions as part of developing the 2016 Evaluation Plan with AEP Ohio staff.
- 2) **Tracking Data Review.** Reviewed the program tracking data collected by the implementation contractor and provided to the evaluation team by AEP Ohio.
- 3) **Review of Marketing Activities.** Reviewed the overall marketing activities and approach as implemented by the implementation contractor.
- 4) **Review of Participation.** Reviewed program participation by building type, program path, completion date, and geographic location.
- 5) **Primary Data Collection.** Performed primary data collection, including in-depth interviews with program staff and the implementation team, a file review for a randomly-selected sample of projects, and on-site verification for a subset of the sampled projects.
- 6) **Methods Used to Analyze Impact Data.** Navigant quantified energy and coincident peak demand reduction savings by reviewing project files. File reviews included verifying engineering calculations and building model simulations. Telephone verifications were conducted if clarifications from the project files were needed to complete the analysis. Telephone verifications included clarifications of the project scope, determination of incremental cost, quantifying operation hours, requests for missing files or drawings, and any other clarification needed to accurately determine the impact of the project.

Where uncertainties still existed in the savings calculations, on-site visits were conducted. On-site visits included verification of equipment specifications and quantities, collection of energy management system data, and metering of equipment.

- 7) **Methods Used to Analyze Process Data.** Navigant assessed the effectiveness of the program processes by analyzing program documents, the results of in-depth interviews with program staff at AEP Ohio, the implementation contractors, and conducted a review of program tracking data.

2.2 Key Evaluation Questions

Navigant worked with AEP Ohio to identify a number of key evaluation questions regarding the 2016 NRNC Program. Three broad evaluation questions were addressed by the evaluation study as a whole.

- 1) What is the status of implementing recommendations / issues identified in the 2015 evaluation?
- 2) How do the findings in the 2016 evaluation compare with findings from prior year evaluations?
- 3) Have changes made to the 2016 program been effective in increasing satisfaction and/or participation?

The following key research questions were addressed through a review of program data and interviews or surveys of those involved with the program. Table 2-1 lists the research questions to be addressed in the evaluation and the information sources used to identify each question.

Table 2-1. Evaluation Questions, 2016 Evaluation

Research Objective	Information Sources	
	Database, Secondary Data Review & On-sites	Staff/ Implementation Contractors
Impact Questions		
1. Were the impacts reported by the program achieved? If not, why not?	√	-
2. What were the realization rates and what were primary factors driving the realization rates? (Defined as evaluation-verified (<i>ex post</i>) savings divided by program-reported (<i>ex ante</i>) savings.)	√	-
3. What are the values for program benefits and costs and the associated estimate for program cost effectiveness?	√	-
Process Questions		
1. What are the key motivators for and barriers to increased energy efficiency in non-residential new construction for different customer segments (i.e. build to own, build to sell/lease)?	-	√
2. What customer market segments or types of projects participate in the program?	√	√
3. How did customers and trade allies become aware of the program?	√	√

Research Objective	Information Sources	
	Database, Secondary Data Review & On-sites	Staff/ Implementation Contractors
4. How thoroughly do outreach activities cover the AEP Ohio service territory?	√	√
5. How successful has the program been in obtaining repeat participation from customers? From design teams?	√	-
6. How successful has the program been in obtaining broad participation from design teams within firms that have participated in the program?	-	√
Questions regarding program tracks-		
7. Do participants and trade allies understand the available program tracks and their differences?	-	√
8. Do program staff/Solution Providers provide advice to participants when it would be appropriate or advantageous for projects to use the whole building track? And how do the implementation contractors share project leads, especially when dealing with whole building projects?	-	√
9. How do participants determine whether to pursue the custom or prescriptive tracks versus the whole building track?	-	√
10. Do participant needs vary by sector or design method ⁶ employed?	-	√
11. How could the program encourage deeper comprehensive savings, beyond lighting power density and HVAC mechanical efficiencies, for projects participating in the Custom or Prescriptive Tracks?	-	√
12. Does the program include any opportunity for building tenants in the AEP Ohio service territory to indicate interest in energy efficiency?	-	√

⁶ For example: design-build versus design-bid-build or build-to-lease versus build-to-own.

Research Objective	Information Sources	
	Database, Secondary Data Review & On-sites	Staff/ Implementation Contractors
13. How many participants applying to the program drop out before completion of their project? Where this occurs, what causes participants to drop out of the program? Has the new design incentive had an impact on reducing the number of program dropouts?	√	√
14. Have any changes been introduced to the program since the last evaluation? If so, how, why, and what has been the impact of the change on program performance?	-	√
15. Are the program processes effective for smoothly processing applications, providing incentives to participants, and motivating design teams to participate? Review:		
a. Program tracking and data management	√	-
b. Required forms	√	-
c. Impact to timeline	√	-
d. Ease of use	√	-
e. Internal program communications	√	-
f. Program staffing	√	-
16. Does the program tracking system provide adequate information for QA/QC and program evaluation?	√	-
17. How have the verification procedures carried out by the Implementation Contractor for the program changed in the past year? Do these procedures create implementation barriers or opportunities to support the design teams?	-	√
18. Are incentives calculated accurately and according to program rules and policies?	√	-
19. Does AEP Ohio, CLEAResult and DNV-GL award customers with completed energy efficient buildings with public recognition or acknowledgment (certificate, plaque, occupant communications, etc.) to publicize their achievements in their community?	-	√
20. What types of recognition does AEP Ohio provide to design teams? How is this recognition perceived by design teams? Is it effective in encouraging participation or encouraging more efficient design?	-	√

2.3 Tracking Data Review

Program tracking data is critical for determining the impacts of the NRNC Program. A copy of the program tracking data collected by the implementation contractors was provided by AEP Ohio to the evaluation

team. The evaluation team reviewed all fields recorded on the application forms and key data fields in the database were reviewed to identify missing, incomplete, or inconsistent data. The data collected was also reviewed to identify any additional information that would be helpful in evaluating program performance. The evaluation team did not assess whether the tracking system was adequate for regulatory prudency reviews or corporate requirements.

2.4 Review of Marketing Activities

Marketing collateral, application forms and other materials available from the AEP Ohio website were reviewed by the evaluation team. Additional marketing materials were requested from AEP Ohio and the implementation contractors. Information on marketing, communications and outreach efforts was also obtained from both AEP Ohio and the implementation contractors.

2.5 Review of Participation

The evaluation team used the program tracking data to analyze program participation by a number of key factors including building type, completion date, program path (Whole Building, Prescriptive and Custom), and geographic location. The analysis focused on metrics such as number of participants and impact results. The results of this analysis are presented, in part, in the discussion of program activity in Section 3.

2.6 Interviews with Program and Implementation Contractor Staff

In-depth qualitative interviews were completed with AEP Ohio and the implementation contractor staff. The purpose of these interviews was to understand how the program worked and how it was marketed for 2016. Discussion guides were developed allowing a structured but open-ended interview and provided to AEP Ohio for review. A free-flowing discussion resulted between interviewer and respondent. Staff experienced in new building programs and program evaluations were used to perform the interviews. Interviews were conducted by telephone to provide flexibility to the respondents' schedules.

2.7 Methods Used to Analyze Impact Data

Through a review of the tracking data, the evaluation team divided the completed projects into four strata based on *ex ante* energy savings. A random sample was selected from each stratum to be reviewed by the evaluation team. Desk reviews were conducted on all sampled projects, including engineering calculations of energy savings claims and verification of baseline and as-built assumptions. Energy modeled projects were reviewed for model inputs on the baseline and as-built models. Where the project files were incomplete, telephone verifications were conducted. Telephone verification consisted of a conversation with the site representative most familiar with the project details. The site representative was asked about the project scope and missing information was requested. Additionally, if uncertainties in the savings calculation existed, a site visit was conducted. Site visits inspected equipment specifications and quantities, verified hours of operation, collected energy management system data and/or metered systems where required, and answered any outstanding questions. The results of the verification of the sampled projects were statistically applied to the entire population of projects to determine *ex post* savings.

2.7.1 Impact Sample of Project Files

The impact sample for 2016 was chosen to achieve a 90% level of confidence and +/- 10% relative precision for the engineering review. The program was evaluated at the building⁷ level and the completed projects were divided into four strata based on *ex ante* energy savings. There were some buildings where multiple projects were completed during the 2016 program year. Since these buildings underwent one efficiency effort, but were divided by milestones or components of the building, Navigant evaluated these at the building level rather than at the project level.

The evaluation team sorted the projects from largest to smallest *ex ante* kWh savings and placed them into strata, attempting to achieve a relatively even distribution of cumulative standard deviation in electric energy savings between strata and minimize overall sample size. This approach resulted in a total sample of 33 buildings to be selected for engineering review. In the end, Navigant completed desk reviews on a sample comprising 57 percent of the reported program MWh savings. Table 2-2 provides an illustration of the impact measurement and verification (M&V) sample stratification and the level of review complete by the evaluation team within each stratum. Figure 2-1 illustrates the total *ex ante* energy savings claim for the program and the proportion on which the evaluation team completed either a desk or on-site level review.

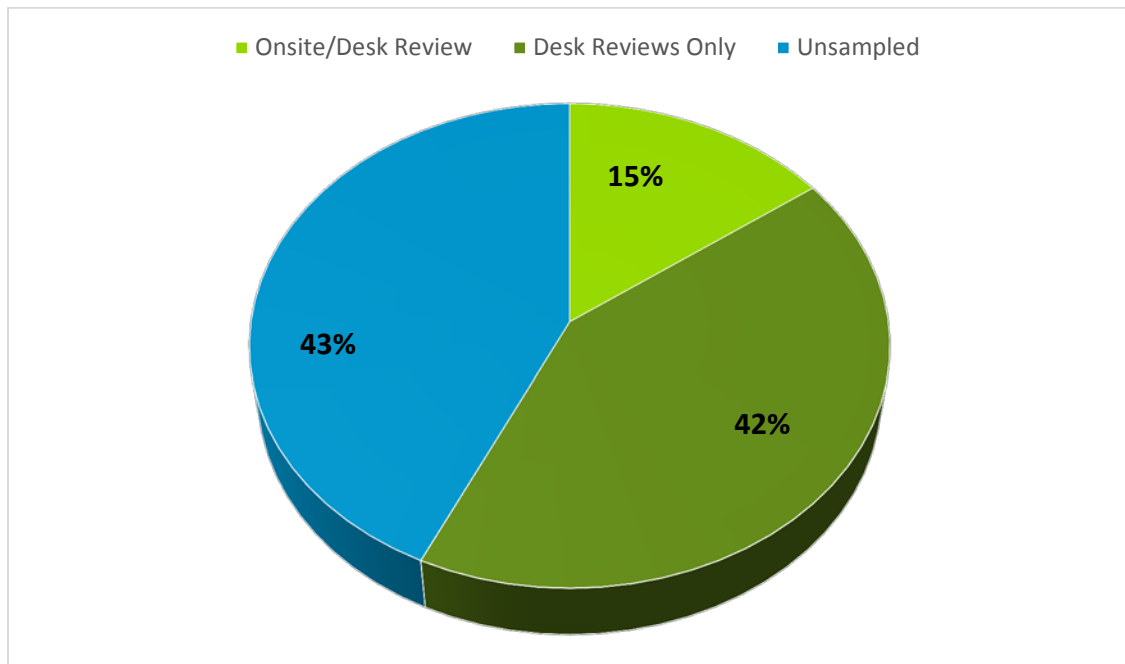
Table 2-2. Impact Sampling Strata and Achieved Sampling

Stratum by Approach and Energy Savings	Number of Buildings	Strata weight by Energy	Number of Desk Reviews	Number of On-site Reviews ⁸
Large (> 750 MWh/yr)	13	47.7%	13	3
Medium (> 300 MWh/yr, < 750 MWh/yr)	30	24.3%	10	2
Small (> 50 MWh, < 300 MWh)	68	24.0%	7	0
Very Small (< 50 MWh)	71	4.0%	3	0
Design Review (No Savings)	15	0.0%	0	0
Total	197	100%	33	5
Percent of <i>Ex Ante</i> Savings			57%	15%

⁷ In most cases, a building is the same as a premise, with a few exceptions. Exceptions include where there are premises representing a campus of buildings, or buildings with multiple premises for various wings.

⁸ On-site reviews are a sub-set of desk reviews. All buildings in the sample received at least a desk review, while some received an on-site review in addition to the desk review. If a building received both an on-site and a desk review it is counted in both the on-site and desk review totals.

Figure 2-1. Impact Sampling as a Percent of *Ex Ante* Savings



2.7.2 Ex Post Energy Savings Calculation

Energy savings calculations were conducted in accordance with the 2016 Appendix A - AEP Ohio Prescriptive Measures Protocols, the 2010 Draft Ohio Technical Reference Manuals (Draft TRM), or other published methodologies, such as regional TRM's and accepted engineering approaches, as appropriate. Building code, which is referenced as the baseline in many of these new construction projects, is defined by the State of Ohio. The default reference code for non-commercial new construction in Ohio is IECC 2009, though an option is provided to use ASHRAE 90.1-2007. The evaluation team followed this protocol and used IECC 2009 as the referenced baseline code, except for projects where ASHRAE 90.1-2007 was explicitly referenced in the implementation contractor files as the baseline code, and for whole building projects, which were evaluated in accordance to ASHRAE 90.1 – Appendix G. Lighting was analyzed via lighting power density calculations using the building area method unless the space-by-space method was specified or indicated by the project specifications. Standard approaches were taken with HVAC, shell, appliances, and other equipment. When executable building energy models were available, the models were analyzed for run hours during the actual peak period to determine coincident peak demand reduction.

2.7.3 Realization Rates Calculation Method

Realization rates for each stratum were calculated with the following equation:

$$RR = \frac{\sum_{sampled} E_{ex-post}}{\sum_{sampled} E_{ex-ante}}$$

Where:

E = the electric energy savings or peak demand reduction for each project in the stratum

Realization rates in each stratum were applied to the project population of that stratum with the following equation:

$$E_{i,ex-post} = RR_{stratum} * E_{i,ex-ante}$$

2.8 Methods Used to Analyze Process Data

The purpose of the process evaluation is to assess the effect of the program structure and program implementation on program performance and customer satisfaction. The evaluation team's process efforts help to provide insights and recommendations to support the continued success of the Non-Residential New Construction program. The process activities for 2016 were relatively limited as there were no significant program changes between the 2015 and 2016 program years.

The main activity of the 2016 process evaluation for the NRNC Program was interviews with key program and implementation contractor staff. In-depth qualitative interviews were completed with program managers and implementation contractor staff using interview guides designed to allow an open-ended discussion of key issues with respect to program operation, outreach and interactions with participants, and the challenges faced during 2016.

3. DETAILED EVALUATION FINDINGS

The following section includes evaluation findings from both the process and impact evaluation of the NRNC Program.

3.1 Program Activity

The 2016 program year represents the sixth year of operation for the NRNC Program and the sixth year in which Navigant has evaluated its operation. In 2016, 216 projects⁹ were completed across 197 unique buildings. Overall, the number of projects completed increased significantly from the previous year, with 154 projects completed in 2015. The 197 buildings where projects were completed also marked a significant increase over 2015, when projects were completed at 138 buildings.

The projects completed in 2016 involved approximately 23 million square feet (Table 3-1) of new and renovated building area.¹⁰ In 2016, 143 unique participants¹¹ participated. In 2016, 28 participants completed multiple projects, together accounting for 101 of the 216 projects completed. Overall, the number of projects and estimated floor area of the buildings participating in the program increased significantly from the prior year's program.

Total *ex ante* electricity savings reported for the program amounted to 42,015 MWh (Table 3-1), an almost 20 percent increase compared to the prior program year and an achievement of more than four times the program's electric energy savings target for 2016. The *ex ante* demand reduction totaled 8.43 MW, an approximately 15 percent increase compared to 2015. The total amount of incentives issued in 2016 is significantly greater than the amount distributed in 2015. Additionally, because of the increase in the number of buildings served through the program in 2016, each building received slightly less incentive money on average, approximately 3 percent less, as compared to the prior year.

Table 3-1. Program Ex Ante Summary, 2015 & 2016 Program Years

	2016 Program	2015 Program
Total Incremental Participant Cost	\$14,940,573	\$8,267,040
Amount of Incentives	\$3,519,527	\$2,302,725
Floor Area (reported sq.ft.)	20,007,146	10,780,453
Floor Area (total estimated sq.ft.)	23,067,462	13,165,509
<i>Ex Ante</i> Energy Savings Reported to Program (MWh)	42,015	35,171

⁹ The project count includes projects receiving early design assistance as separate from the completed whole building projects. If the early design assistance is rendered for a project in the same year it is completed, which is highly unlikely, it will be counted as two separate projects completed at the same premise.

¹⁰ Floor areas were reported for 173 of the 184 unique premises where projects were completed in 2016. Navigant estimated the floor area for the buildings with unreported square footage based on the average floor area of similar buildings using data from the tracking database.

¹¹ Navigant notes the tracking database contained a number of variations on some organization names. Navigant exercised some judgement in identifying "unique" organizations.

Ex Ante Demand Savings Reported to Program (MW)

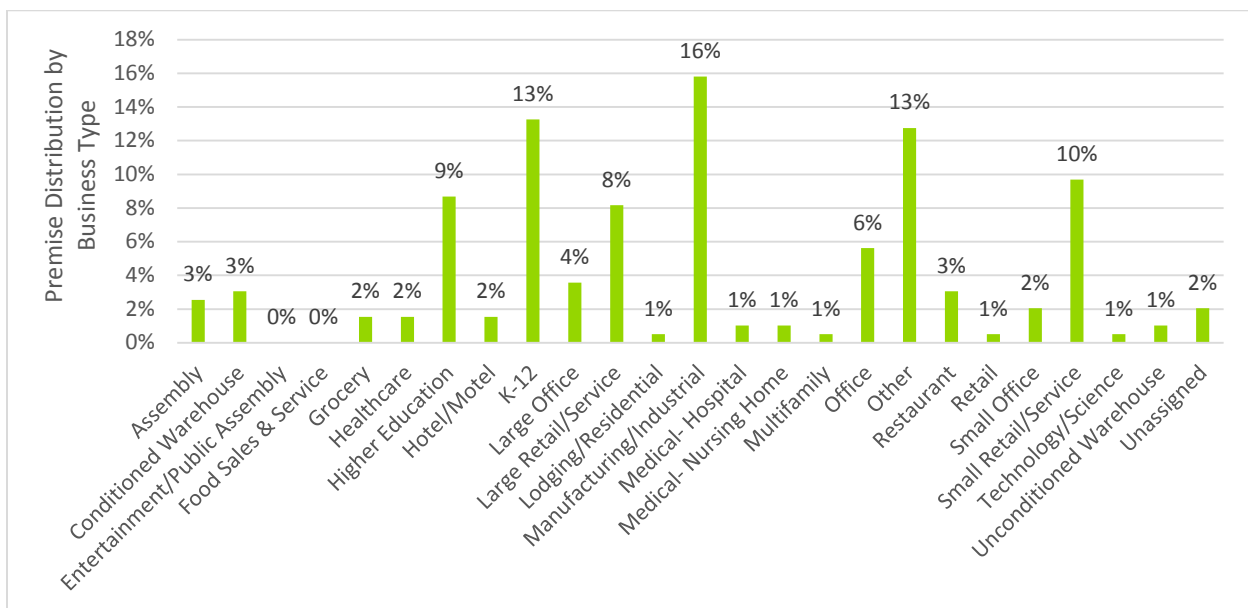
8.4

7.2

NOTE: Total floor area is calculated from unique buildings in each year.

The number of buildings participating in the 2016 program were reasonably well distributed across business types (Figure 3-1), though the associated energy savings were less evenly distributed (Figure 3-2). The manufacturing/ industrial sector accounted for 16 percent of buildings, followed by K-12 schools (13%), other (13%), and small retail/service (10%). The balance of applications came from a variety of other building segments.

Figure 3-1. Distribution of Participating Buildings by Business Type, 2016 Program



In terms of energy savings, Figure 3-2 shows the distribution of *ex ante* energy savings by business type. Six building segments (manufacturing/ Industrial, office, K-12 schools, conditioned warehouse, higher education, and other, i.e. buildings that do not fit within the stated building segment categories) accounted for approximately 85 percent of the reported electrical energy savings in 2016. The six building segments accounting for the large majority of program savings encompass 127 projects at 116 unique buildings. The balance of the program savings was distributed in small amounts, two percent or less, across nineteen other building segments. These nineteen building segments included 89 projects, which were generally smaller in nature, located across 81 unique buildings.

Figure 3-2. Energy Savings by Type of Business, 2016 Program

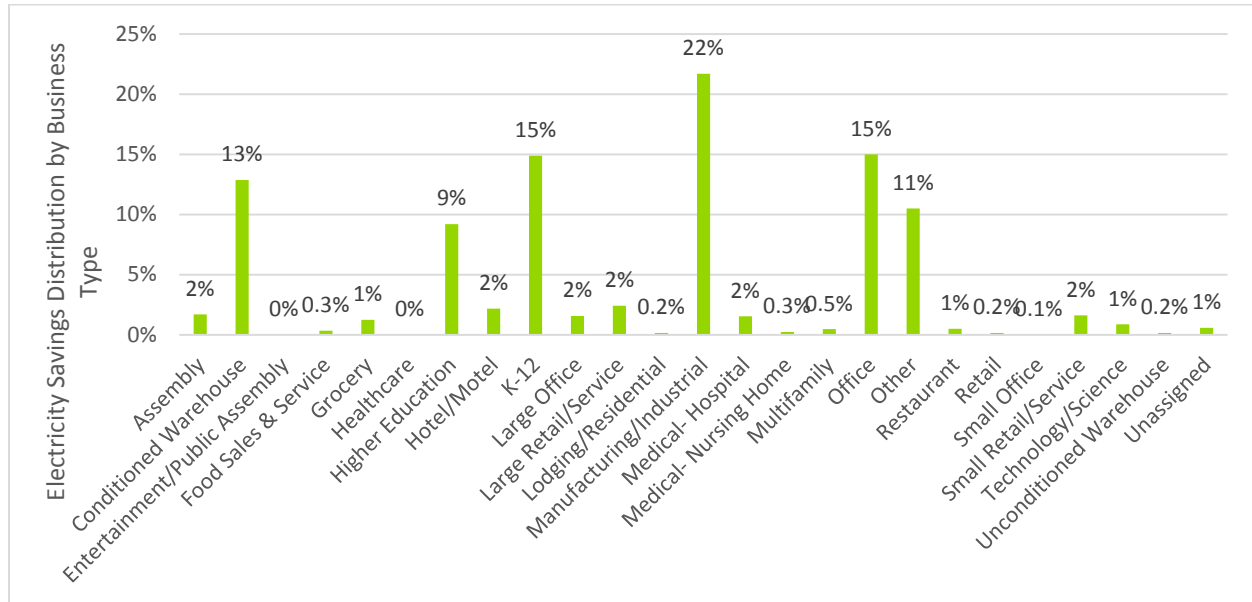


Table 3-2 shows the number of projects and unique buildings which participated in the program by business type, along with the level of savings, based on information reported in the tracking database.

Table 3-2. 2016 Program Activity by Business Type

Business Type	Number of Projects	Number of Buildings	Ex Ante Savings	
			(kWh/year)	(kW/year)
Assembly	5	5	718,956	169
Conditioned Warehouse	6	6	5,404,736	935
Entertainment / Public Assembly	1	1	-	-
Food Sales & Service	1	0	141,683	36
Grocery	3	3	523,171	49
Healthcare	3	3	-	-
Higher Education	20	17	3,868,367	852
Hotel / Motel	3	3	912,439	53
K-12	27	26	6,257,108	1,059
Large Office	8	7	659,427	211
Large Retail / Service	17	16	1,014,094	222
Lodging / Residential	1	1	71,715	19
Manufacturing / Industrial	35	31	9,112,976	1,691
Medical - Hospital	5	2	644,680	86
Medical - Nursing Home	2	2	105,256	20
Multifamily	1	1	197,546	131
Office	14	11	6,295,403	1,541
Other	25	25	4,412,345	936
Restaurant	7	6	215,369	38
Retail	1	1	65,577	15
Small Office	4	4	23,782	5
Small Retail / Service	20	19	683,845	179
Technology / Science	1	1	371,451	78
Unconditioned Warehouse	2	2	73,328	15
Unassigned	4	4	241,780	88
Total	216	197	42,015,034	8,429

NOTE: Totals may not sum due to rounding.

Savings may be zero for early design assistance projects.

Table 3-3 shows the distribution of buildings by program option. Seventy-six percent of the buildings in the 2016 program applied under the Custom/Prescriptive paths. The number of buildings applying under the Custom/Prescriptive paths increased by approximately one-third compared to the 2015 program (110 Prescriptive/Custom buildings in 2015). The number of buildings applying under the Whole Building path also increased from 2015 by over 70 percent (28 Whole Building buildings in 2015). Overall, the number of projects, estimated floor area affected by program, and *ex ante* savings claimed by the program increased significantly from 2015. With these increases, the program achieved more than four times its 2016 electric energy savings goal and six times the demand savings target.

Table 3-3. 2016 Activity by Program Path

Program Path	Number of Buildings	Percent of Total Buildings	Estimated Floor Area (Sq Ft)	Ex Ante Savings (kWh/yr)	Percent of Total Program Savings
Custom/Prescriptive	149	76%	17,515,220	30,268,437	72%
Whole Building	48	24%	5,552,242	11,746,597	28%
Total	197	100%	23,067,462	42,015,034	100%

NOTE: Buildings that include Whole Building and Prescriptive/Custom projects are counted under the Whole Building category.

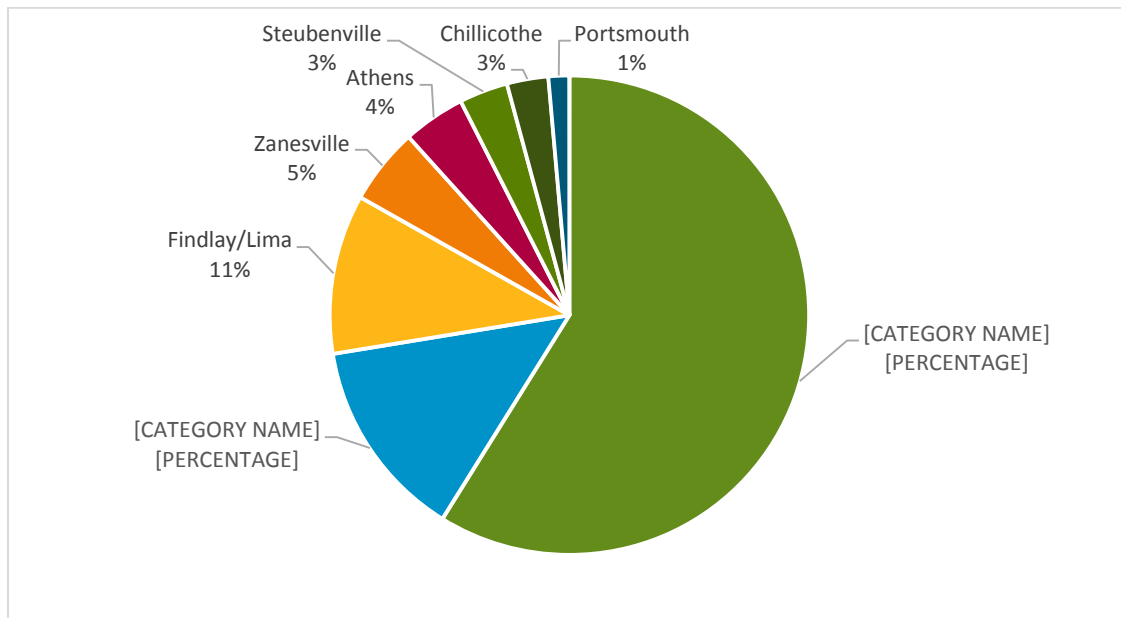
In 2016, the average building size for buildings where floor area was reported in the program tracking data was 118,414 square feet. This marks an increase in the size of buildings in the program compared to 2015, when the average reported building size was 95,402 square feet. A review of the reported building size indicated the average building size was similar under each of the program paths, with the buildings completed under the Prescriptive/Custom path being only slightly larger than those completed under the Whole Building path (Table 3-4). This marks a striking difference from the prior year, where the Whole Building projects were significantly larger than those participating in the Prescriptive/Custom path. The buildings completed under the Prescriptive/Custom path comprised a wider range of building sizes, from less than 1,000 sq.ft. to 2.3 million sq.ft., compared to the Whole Building projects, which ranged in size from 14,000 sq.ft. to 333,000 sq.ft.

Table 3-4. Building Area by Program Path, 2016 Program

Program Path	Average Building Area Reported (Sq.Ft.)
All NRNC Buildings	116,321
Whole Building Stream	106,413
Prescriptive/Custom Stream	118,414

The project tracking database reports the location of each project. The Navigant team associated each reported building location with the closest large city to understand the geographical influence of the program. Participating buildings again were concentrated in the Columbus and Canton regions (Figure 3-3). The tracking data does indicate over one-quarter of the projects completed in 2016 were completed outside of the Columbus and Canton region, and spread across 32 different rural communities, indicating a reasonable coverage of the entire AEP Ohio territory.

Figure 3-3. Participating Building Locations, 2016 Program



3.1.1 Prescriptive / Custom Program Path Activity

There were a total of 521 prescriptive/custom measures completed within the NRNC Program in 2016. The breakdown of the prescriptive/custom energy savings by measure category is shown in Table 3-5 and Figure 3-4. The prescriptive approach is considered to be mostly driven by Solution Providers and as such is an indication of the Solution Provider's activity. Compared to the previous year activities, there was a marked decrease in the percent of savings attributable to the lighting measure, 54.8 percent as compared to 73.1 percent in 2015. Comparatively, the 2016 program sees a significant increase in the savings attributable to custom measures, 21.4 percent as compared to 0.3 percent in 2015. Overall, the 2016 program experiences a more even distribution of savings across the prescriptive/custom measures than has been seen in previous years of this program.

The prescriptive/custom measure mix experienced in 2016 marks a significant swing away from a lighting savings dominated program. The Navigant team previously mentioned mature programs following best practices typically achieve 40 to 50 percent savings through non-lighting measures. Though the 2016 program numbers seem to reflect a shift in this direction, it is important to note this change is due almost single-handedly to an increase in the savings associated with a small number of custom measures.¹² If the custom measures are removed from consideration, then almost 70 percent of the prescriptive/custom energy savings are attributable to the lighting category. So, it is not as much a swing away from savings attributable to lighting, but an increase in the savings attributable to custom measures causing the Prescriptive/Custom program activity to look markedly different in 2016.

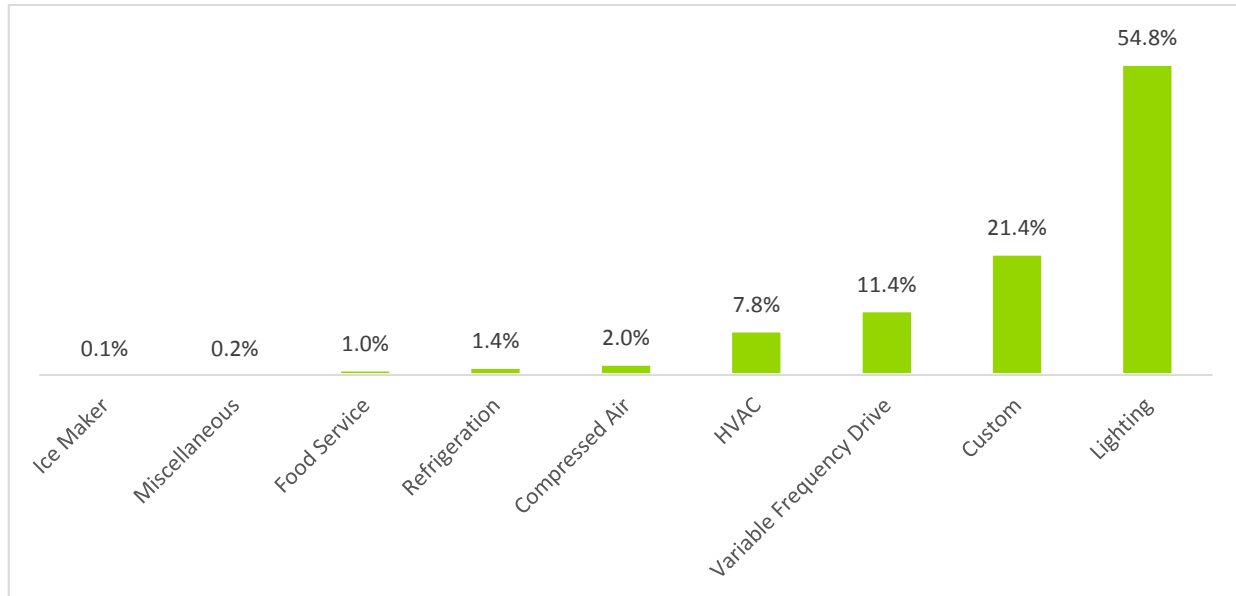
¹² The evaluation team did not review all of the project files with custom measures, but the custom files that were reviewed by the evaluation team included non-lighting, process measures.

Table 3-5. Prescriptive / Custom Measure *Ex Ante* Savings, 2016 Program

Measure Category	Measure Count	<i>Ex Ante</i> Energy Savings (kWh)	Percent of Total Savings
Compressed Air	7	602,709	2.0%
Custom	14	6,510,386	21.4%
Food Service	14	294,849	1.0%
HVAC	144	2,389,157	7.8%
Ice Maker	14	15,833	0.1%
Lighting	197	16,686,411	54.8%
Miscellaneous	6	51,878	0.2%
Refrigeration	51	439,910	1.4%
Variable Frequency Drive	74	3,474,702	11.4%
Total	521	30,465,834	100%

NOTE: Totals may not sum due to rounding.

The total *ex ante* energy savings in this table will not equal the total *ex ante* energy savings under the Prescriptive/Custom paths, as some Prescriptive/Custom measures were completed within buildings counted under the Whole Building path.

Figure 3-4. Prescriptive / Custom *Ex Ante* Energy Savings by Measure Type, 2016 Program


Lighting measures completed under the NRNC Program are divided into two broad categories, 1) Lighting Power Density (LPD) and 2) interior lighting controls, and are further subdivided within the categories, as shown in Table 3-6. The division of energy savings within the prescriptive lighting measures are very similar to the prior program year, with Lighting Power Density reductions accounting for 99 percent of the

reported lighting energy savings. Lighting controls accounted for one percent of lighting savings and six total installations within the NRNC Program during 2016.¹³

Table 3-6. Prescriptive Lighting Measures by Category, 2016 Program

Prescriptive Lighting Measures	Number of Measures	<i>Ex Ante</i>		Percent of <i>Ex Ante</i> Lighting Energy Savings
		Energy Savings (kWh)	Demand Savings (kW)	
Interior LPD	121	11,393,192	2,329	68%
Exterior LPD	65	2,751,715	-	16%
Garage LPD	5	2,390,098	273	14%
Interior Daylighting Controls	5	151,009	65	1%
Interior Timeclock Controls	1	397	-	0%
TOTAL	197	16,686,411	2,667	100%

NOTE: Totals may not sum due to rounding.

3.1.2 Whole Building Program Path Activity

There were a total of 78 whole building measures completed across 48 buildings within the 2016 NRNC Program. The whole building measures fell into three categories, standard new construction measures, design/modeling incentives, and My Solutions, as shown in Table 3-7.

Table 3-7. Whole Building Measure *Ex Ante* Savings, 2016 Program

Measure Category	Measure Count	<i>Ex Ante</i> Energy Savings (kWh)	% of Total Savings
New Construction	32	11,399,009	99%
Design/Modeling Incentive	38	-	0%
My Solutions	8	150,191	1%
Total	78	11,549,200	100%

The design and modeling incentives have no associated savings, as these measures are associated with incentives provided to the design team for early design assistance or support over the course of the building project. Some of the design and modeling incentives provided in 2016 are associated with projects completed in 2016, but because of the length of time required to complete most non-residential new construction projects, most of the design and modeling incentives are related to projects that will be completed, and contribute energy savings, in future program years.

¹³ Advanced lighting controls were included on several new construction projects in 2016. These savings were calculated and claimed under the Advanced Lighting pilot and as such were not included in the NRNC Program data.

Ninety-nine percent of the *ex ante* energy savings associated with the whole building measures are associated with the standard new construction measures. The My Solutions option, which was introduced in 2016, only accounts for one percent of the *ex ante* energy savings associated with the Whole Building measures. The eight My Solutions measures identified in Table 3-7 are associated with three separate projects, meaning the average savings for a My Solutions project is approximately 50,000 kWh, significantly less than the average savings for a standard whole building project of approximately 350,000 kWh.

3.2 Impact Evaluation Findings

This section includes a summary and discussion of the evaluation-calculated electrical energy and peak demand savings for the 2016 Non-Residential New Construction Program. Annual electricity savings were calculated using the data collected through document reviews and field visits for the sample of sites.

3.2.1 Summary of Impact Findings

The *ex post* energy and summer coincident demand annual savings for 2016 are 44,151 MWh and 8.27 MW respectively. This result is significantly larger than the historical *ex post* program savings (an increase of 37 percent for energy savings and 19 percent for coincident peak savings) and greatly exceeded the 2016 goal of 10,000 MWh savings and 1.23 MW coincident demand reduction. The realization rate for energy savings was found to be 1.05, while the demand savings realization rate was found to be 0.98. These results are shown in Table 3-8 and represent both increased program savings and increased realization rates.

Table 3-8. Impact Savings, Realization Rate and Precision of Sample

Metric	2016 Program Goals* (a)	<i>Ex Ante</i> (b)	<i>Ex Post</i> (c)	Realization Rate RR = (c) / (b)	Overall Relative Precision at 90% Confidence	Percent of Goal = (c) / (a)
Annual Energy Savings (MWh)	10,000	42,015	44,151	105%	8.6%	442%
Coincident Peak Reduction (MW)	1.23	8.43	8.27	98%	15.3%	672%

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

3.2.2 Driving Factors of Realization Rate

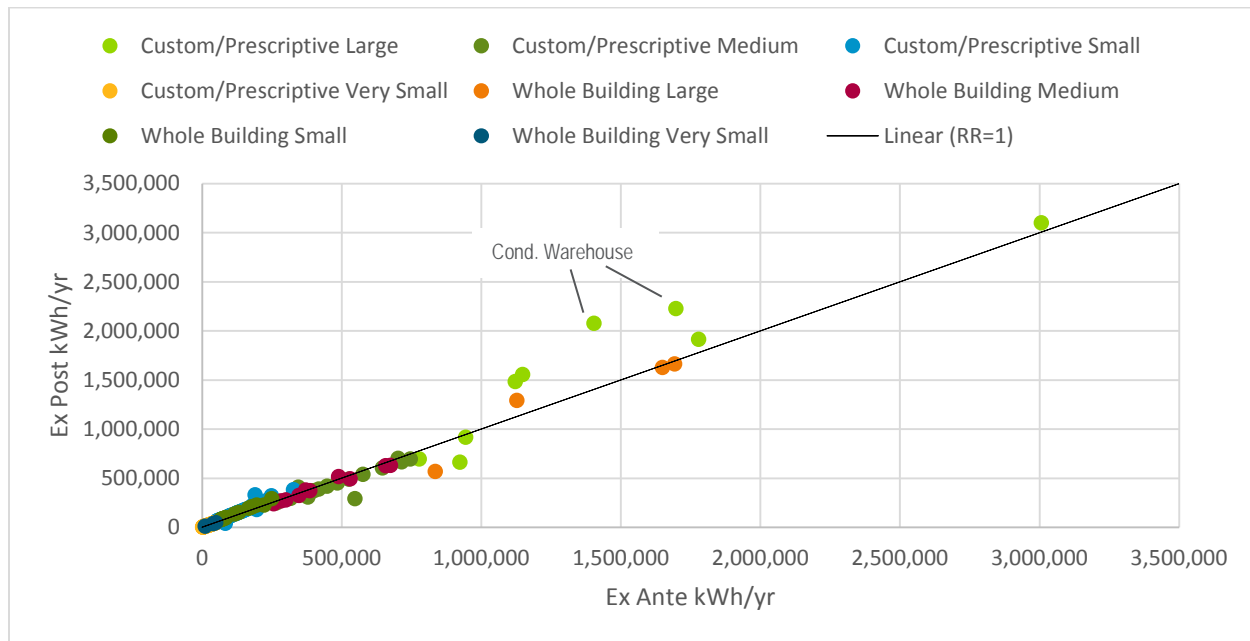
Data analysis revealed certain factors are driving the realization rate between claimed savings and verified savings. Energy savings and demand savings will be discussed individually.

3.2.2.1 Energy Considerations

Figure 3-5 is a graphical representation of the building level *ex ante* versus *ex post* energy savings grouped by sample strata and program approach. The diagonal line represents the goal of a realization

rate of one. Points above and to the left of the $RR=1$ line represent buildings with energy realization rates above one, while those points below and to the right are building with realization rates less than one. The most significant outliers, though outliers are relatively non-significant in the 2016 program analysis, are labeled with their respective building types.

Figure 3-5. *Ex Ante* vs. *Ex Post* Energy Savings



The differences in savings associated with the two conditioned warehouses, which are called out as the most significant in terms of their realization rates in Figure 3-5, were dominated by LPD measures. There is no specific trend relating to the fact these are both conditioned warehouses that leads to the high realization rates for both projects; in fact, both projects seemed to have one-off mistakes leading to the high realization rate. The evaluation team found the *ex ante* calculations differed from what was reported in the tracking database for one project. As for the other project, errors included a typo resulting in the square footage of a significant space being off by a factor of ten, and a calculation error resulting in a large overstatement of fixtures, and therefore an understatement of savings. Both projects also failed to consider occupancy controls in the *ex ante* calculations, but the difference between the *ex ante* and *ex post* savings as a result of not considering the occupancy controls was much smaller than the effect of the mistakes and typos found for these two projects.

Overall, the findings from the 2016 evaluation point to rather strong agreement between the *ex ante* and *ex post* findings. However, the evaluation team did find a larger number of simple mistakes than in previous years. These issues are identified in greater detail in Section 3.2.4, but beyond the issues previously discussed, the simple mistakes found by the evaluation team include the following.

- *Ex ante* calculations correctly assign savings per horsepower (hp), but the calculation used results in incorrect total energy savings.
- *Ex ante* calculation missed 19,000 kWh of exterior lighting savings because a mistake resulted in an incorrect determination that no savings were available.

- *Ex ante* calculations incorrectly reference values from the 2014 Appendix A, instead of the 2016 Appendix A.
- Unit power was rounded to the closest full hp in *ex ante* calculations, resulting in an overstatement of savings.
- *Ex ante* calculations used the wrong demand period for calculating coincident peak demand.

Though most of the issues identified above did not result in significant adjustments to the claimed savings through the *ex post* analysis, these do point to a need to refocus on project quality control.

Figure 3-6. *Ex Ante* vs. *Ex Post* by Stratum and Application Type

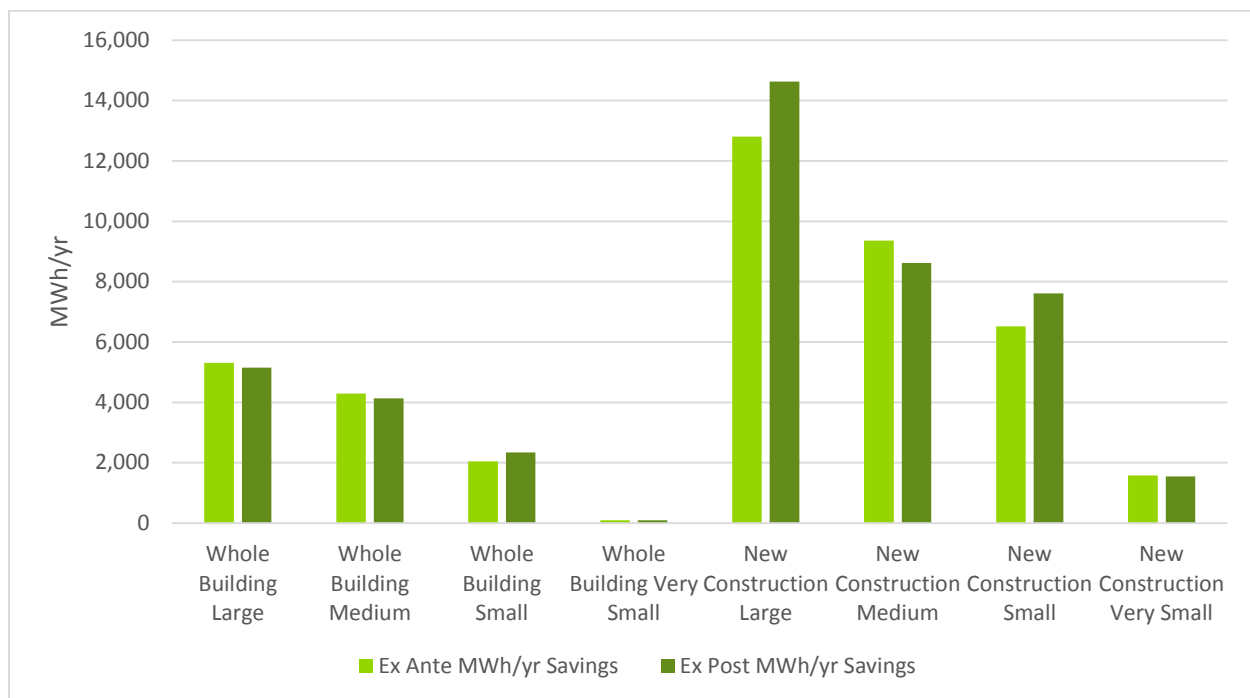
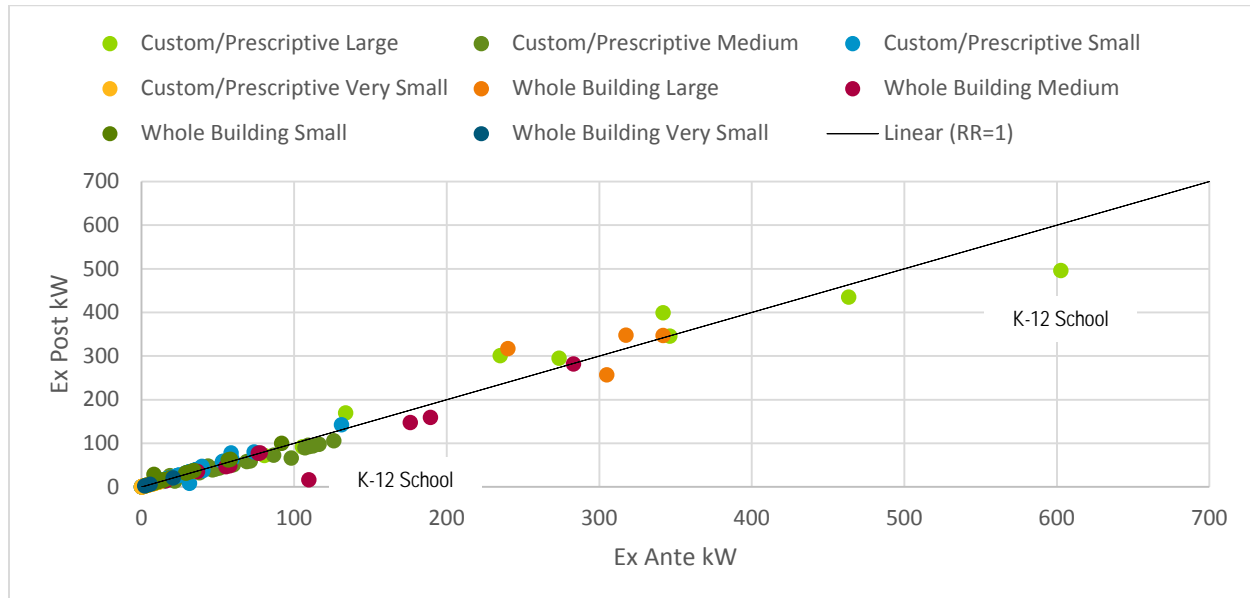


Figure 3-6 illustrates the difference in *ex ante* and *ex post* energy savings by both verification sampling stratum and application type. The differences between the *ex ante* and *ex post* savings were very small for the Whole Building projects; the realization rate adjustments are mostly attributable to Prescriptive and Custom projects.

3.2.2.2 Demand Considerations

Similar to the energy savings analysis, the discussion of coincident demand reduction is begun by analyzing Figure 3-7, which is a graphical representation of the building level *ex ante* versus *ex post* coincident demand findings. The diagonal line represents the goal of a realization rate of one. Points above and to the left of the RR=1 line represent buildings with demand realization rates above one, while those points below and to the right are buildings with realization rates less than one. The most significant outliers, though outliers are relatively non-significant in the 2016 program analysis, are labeled with their respective building types.

Figure 3-7. *Ex Ante* vs. *Ex Post* Coincident Demand Reduction



There is little that can be called out as significant in the comparison of the *ex ante* and *ex post* values for coincident demand reduction, especially considering the overall resulting realization rate is 0.98. There are two projects that stand out slightly from this analysis, both of which are K-12 school projects.

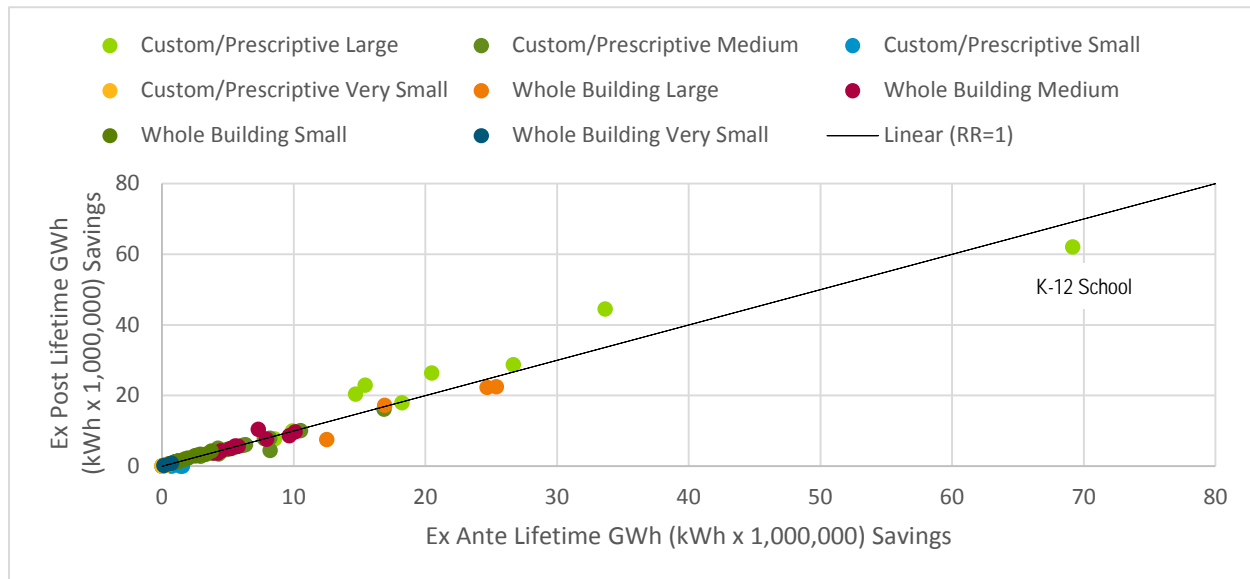
The largest project from a coincident demand reduction standpoint is a school project with multiple buildings. This project was verified onsite by the evaluation team. The differences between the *ex ante* and *ex post* coincident demand savings result in differences found between what was identified onsite and the claims in the model. More specifically, the onsite identified differences with the building model in terms of boiler efficiency, maximum air supply temperature, thermostat throttling range, chilled water temperature, hot water supply temperature, economizer cutoff, and the installation of additional economizers. The resulting realization rate for this project was 0.82, which is not overly significant, but it does pull down the realization rate for the entire program because it was the largest project in terms of coincident demand.

The second project that stands out, is relatively small in terms of overall impact, but did see the lowest realization rate for kW demand, 0.145. During the desk review, the evaluation team determined the *ex ante* coincident demand savings for this project were calculated by determining the difference between the maximum demand during the peak period. To calculate the *ex post* coincident demand, the evaluation team used the prescribed methodology for determining coincident demand for whole building projects by instead calculating the difference in the average demands during the peak period.

3.2.3 Lifetime Energy Considerations

Figure 3-8 is a scatter plot of the *ex ante* and *ex post* lifetime energy savings by building. Compared to previous year evaluations, there is relatively little variance off the RR=1 line for the Lifetime Energy Savings, indicating project lifetimes were generally in agreement between *ex ante* and *ex post*.

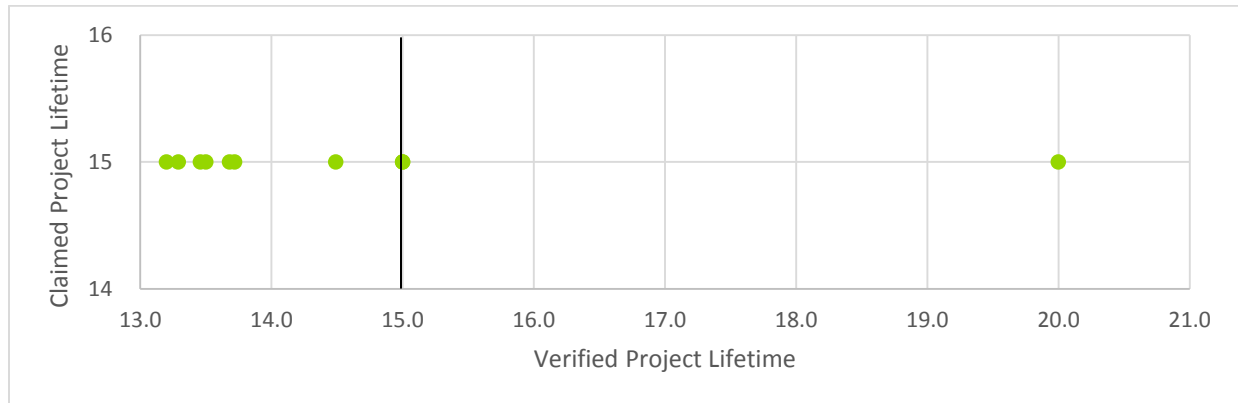
Figure 3-8. *Ex Ante* vs. *Ex Post* Lifetime Energy Savings



The only consistent issue the evaluation team found with the assignment of project lifetimes is for Whole Building projects. *Ex ante* lifetimes are uniformly assigned at 15 years for Whole Building projects. Often, there is a note left in the project files indicating that ideally this number would be based on estimates of total savings by different measures and 15 years is simply a rough, conservative guess at typical life for Whole Building projects. Whole Building lifetimes are not provided in the implementer's Appendix A. *Ex post* calculations separate energy savings given by the building models into lighting LPD savings and various HVAC measures, apply specific lifetimes for each savings category, and calculate a weighted average lifetime for the entire Whole Building project, in alignment with the procedure described by the note in the *ex ante* project files.

The note in the *ex ante* project files indicates 15 years is a conservative guess at a typical life for Whole Building projects. However, the *ex ante* results indicate this value may not be all that conservative. Figure 3-9 illustrates for seven of the ten Whole Building buildings reviewed by the project team, the *ex post* lifetime was calculated to be less than 15 years, and one building was found to have a lifetime more than 15 years.

Figure 3-9. *Ex Ante* vs. *Ex Post* Lifetime for Whole Building Projects



Additional findings from the impact analysis, including details of less significant issues identified through the impact analysis are included in APPENDIX A Other Issues Found During the Impact Analysis.

3.3 Process Evaluation Findings

The NRNC Program underwent a significant administration change in 2015. Under a new contractual relationship, program implementation was partially transferred from DNV GL to CLEAResult. DNV GL continued in its role as the implementation contractor for the Prescriptive and Custom paths of the program, while CLEAResult assumed overall responsibility for achieving program results, customer outreach and communication, and the implementation of the Whole Building path, including the new My Solutions path.

In 2015, issues related to putting the new contractual, communications and data exchange processes in place delayed some aspects of the program, and delayed the issuance of incentive payments for some participants. Navigant conducted an in-depth process evaluation of the 2015 program (including customer surveys and solution provider interviews) to determine whether these types of issues had created any problems for program participants. Feedback from implementation contractor staff and solution providers through the 2015 evaluation indicated that apart from the noted time delays, the transition issues seemed to have had a limited impact on customer experience.

The 2016 process evaluation was more limited in nature, focusing on program coordination strategies between the implementation contractors and the extent to which early program participation is being encouraged among NRNC customers.

Key findings from the 2016 process evaluation include the following.

- 1) There are structural contract challenges with respect to span of control and data transparency for both implementation contractors, which results in program management inefficiencies. Navigant understands the NRNC implementation contract structure is expected to change again in 2017, which will presumably resolve these issues.
 - a. DNV GL does not have visibility into a pipeline of anticipated Prescriptive and Custom projects for processing. This is an acute challenge as the DNV GL contract with AEP

Ohio is managed based on project turn-around time. It is not possible for DNV GL to prepare adequate staffing and manage spikes in project production (such as end of year) without visibility into anticipated projects.

- b. CLEAResult does not have visibility into DNV GL's reported project savings. This is an acute challenge as the CLEAResult contract with AEP Ohio is based on achieving a specific savings goal for the overall program. It is not possible for CLEAResult to accurately manage savings production without real time access to up-to-date reported program savings.
- 2) Build-to-Lease type projects are not prioritized or served through a NRNC Program path.
 - a. AEP Ohio does not have a customer outreach or project support mechanism dedicated to managing Build-to-Lease type projects. Stakeholders observed developers of these project types typically are not anxious to exceed code, and pushing potential participants to exceed code is more likely in a building they will own than one they will lease.
 - b. When asked about this market sector, each stakeholder indicated it was a significant challenge. None of the stakeholders could articulate how the program currently outreaches to or manages Build-to-Lease projects to overcome the unique barriers to program participation for these projects.
- 3) There may be missed opportunities in some segments of the NRNC market that could be leveraged by the established program pathways to increase participation. The program does not collect data to compare program completed projects with actual non-residential new construction activity within the AEP Ohio jurisdiction.
 - a. Stakeholders indicated small businesses or plaza-type construction with leased space may be under represented in the program portfolio. However, stakeholders do not have data on completed projects within the jurisdiction to compare to AEP Ohio NRNC completed projects. This feedback is in alignment with Finding 2, above.
 - b. The new My Solutions path is focused on buildings less than 70,000 square feet, but it is not clear to stakeholders what the lower bounds are for this path. If buildings are too small, owners may not feel the potential incentives are commensurate with the effort required to engage the program.
- 4) The program is implementing strategies resulting in early involvement in the project design and development phase. Earlier engagement typically leads to increased savings and a clear connection between program promoted activity and project savings.
 - a. CLEAResult has prioritized early stakeholder engagement through the requirement of pre-enrollment for the Whole Building path. Staff report anecdotally they have transitioned some customers who did not pre-enroll in the Whole Building path to the Prescriptive path, because they could not demonstrate the comprehensive Whole Building path resulted in project savings.
 - b. The Whole Building path provides stakeholder incentives to participate in a pre-design meeting. All key players attend – architect, engineer, customer, commissioning agent, etc. CLEAResult staff facilitate a discussion to determine the customers' energy goals for the project, identify key project strategies for the design team's consideration, and describe the incentives available to support efficient measures.

- c. While there is a cost associated with these early meetings (in terms of both the incentive and implementation contractor staff resources), because saving opportunities are identified earlier, this effort is expected to result in additional savings at lower cost per project. Design teams and trade allies have become accustomed to the program expectations.
 - d. Design teams that historically have not prioritized energy modeling now are integrating it into their services. Implementation contractor staff report some engineering firms have added an employee to develop energy models, primarily to take advantage of the incentives and technical assistance available from the Whole Building path.
 - e. Pre-enrollment allows the implementation contractors to align each customer's project with the proper path earlier in the process, providing early and clear direction for design teams and customers with respect to project goals, minimum requirements, and expected incentives.
- 5) Program staff are aligning program services with customer needs through adjustments to the Whole Building path and the creation of the My Solutions path.
 - a. The Whole Building path modelling process has been adjusted to be consistent with LEED requirements. Stakeholders report a strategy of positioning the paths' services to provide a check on the LEED submitted model. This change receives positive feedback from some customers, as they are getting compensated by the customer for the LEED modeling which complies with the NRNC modeling requirements.
 - b. In 2016, CLEAResult launched the My Solutions path for smaller office and retail facilities (less than 70,000 sq.ft.). The path is currently available to customers, but has not yet generated measurable enrolled projects. For My Solutions projects, CLEAResult staff will develop project modeling and energy savings estimates at no charge to projects, and customers receive the incentive and savings. The intent of this path is to identify and encourage deeper energy savings with increased accuracy for smaller projects that would have otherwise participated in the Prescriptive path.
- 6) Initial communication challenges identified in 2015 between implementation contractors have improved. Program stakeholders note several key communication tactics as supporting improved internal and external communications and program management.
 - a. Strategy meetings between implementation contractors and AEP Ohio program management staff for any project with greater than 1/2 GWh savings (reduced from 1 GWh in 2015).
 - b. Direct outreach occurs bi-weekly between the implementation contractors and a high performing trade ally to review and manage their specific pipeline of projects.
 - c. Bi-weekly meetings between program staff and the evaluation team to proactively discuss and review project analysis and baselines for large, unusual or otherwise complicated projects.
 - d. CLEAResult manages all customer communication. For Prescriptive and Custom path projects, CLEAResult collects project data from customers and submits to DNV GL for project processing. Any follow-up communications or questions from DNV GL are delivered through the initial customer Technical Account Manager (CLEAResult staff) contact to provide customer consistency.

- e. Consistent procedures have been out in place for communicating and recording project details, processing invoices and incentive checks.
- 7) Program staff indicate project transfer between paths has been smooth.
 - a. All stakeholders agreed path transfers happen, and that these were handled expeditiously and without issues. Ultimately, AEP Ohio is responsible for which program path is most appropriate; AEP Ohio indicates that, “the answer is typically so obvious as to not require a decision from AEP Ohio.”
 - b. Due to the structure of implementation contractor goals, the contractors are not penalized for project transfers.
 - c. Implementation contractors observe customers typically provide sufficient data on the application form to inform a transfer, and can complete the project without burdening the customer for additional information.
 - d. DNV GL observes 99 percent of projects come in to the correct program path. Those that don't are identified by DNV GL staff and processed directly according to the most appropriate path. The new construction teams of both DNV GL and CLEAResult meet monthly to review active projects, the reservation list, and ensure projects are moving forward.
- 8) Participant outreach activities are conducted primarily through Technical Account Managers (TAMs), which by all stakeholder accounts is well received.
 - a. The TAM team are responsible for design team outreach, project initiation, arranging pre project design team meetings, etc. Design team outreach includes lunch and learn presentations at architecture and engineering firms and memberships in AIA, USGBC, and associated organizations. TAM's receive the Dodge weekly report with new construction pipeline projects that are used to prioritize and guide outreach activities.
 - b. TAMs complete an estimated 25 percent of Prescriptive path customer applications.
- 9) Environmental certificates were awarded to architectural firms in 2016, acknowledging project impact in a non-energy fashion, such as carbon reduction, number of cars removed from the road, trees planted, homes off the grid, etc. Program stakeholders have insights on how to further improve and leverage the certificates to recognize successful market actors and generate additional savings, including:
 - a. Expand environmental awards to include engineering firm participants.
 - b. Create an annual competition from environmental certificate results. Provide public recognition and awards at trade ally meetings with architects and engineers.

3.3.1 Marketing Efforts and Program Awareness

AEP Ohio and the implementation contractors continued to be proactive in identifying and reaching out to key market segments and market actors to build awareness of the NRNC Program and to recruit projects.

- As in past years, the implementation contractor and AEP Ohio staff held meetings with solution providers and attended trade shows and other events attended by members of the design community.

- Several improvements were made by the previous implementation contractor to strengthen communications with both applicants and solution providers and to reinforce the value of the program. For example, improvements were made to the check conveyance process to specifically identify that the monies being provided are a result of participation in the NRNC Program. In addition, a new step added in 2015 asked participants if they are involved in any other new construction or major renovation projects which might be eligible for the program.
- Starting in 2014, efforts were made to offer client recognition, such as the provision of certificates and big check presentations. Navigant understands big check presentations and recognition of solution providers continued throughout 2016. Navigant recommends expanded recognition for participants be considered to increase program awareness and reinforce participant behavior. Case studies (such as those used in the Data Center program), could be used to document and recognize the success of program participants while providing a vehicle for promoting the benefits of the program.

3.3.2 Program Requirements

Program requirements have not changed significantly since the prior program year. While the requirement for pre-enrollment in the Whole Building solution is not new for 2016, CLEAResult reports strengthening its enforcement of this provision in 2016. Navigant recommends continuing to provide outreach and messaging to architecture and engineering design firms to raise awareness of and support early project applications.

The historical perception of many customers who were also participating in the LEED process was they had to complete their LEED application before submitting their NRNC Program application. In past years, program staff has worked to overcome this perception and encourage customers to enroll their Whole Building projects earlier in the process. The implementation contractor indicated these efforts have led to more opportunities for projects to enroll while still at the design stage, allowing the program to have greater influence on project design.

While there is currently no firm evidence of this influence, program staff indicated they believe their earlier involvement has resulted in additional actions by some participants. Early involvement in the design process has the potential to increase the impact of the program, as participants can choose alternative paths to attaining certification under the LEED program. As a result, inclusion of additional energy efficiency measures could help reduce customer costs, increase program results, and also contribute to the customer's ability to attain LEED certification.

3.3.3 Barriers to Participation

No significant barriers to participation were identified in reviewing the 2016 NRNC Program. Comments from program staff and solution providers indicated they have not had any feedback from customers expressing concerns over program requirements, and very few customers drop out of the program once they have applied. Previous feedback from Solution Providers indicated it is very rare for a client not to participate in the program if eligible, and when this occurs it is generally because the level of incentives for a particular project are quite small.

With this context, the 2016 evaluation did not research non-residential new construction market segments which may be underserved by the program. Build-to-Lease projects are the clear example, but also projects with very small footprints should be researched to determine if the program is designed to overcome the unique obstacles to participating in the AEP Ohio program.

3.3.4 Customer Enrollment Process

Navigant reviewed the customer enrollment process, including the application forms; processes followed by the implementation contractor in reviewing and approving applications; the time required for review and approval of applications; and the approval review processes. The evaluation team found no significant issues with respect to the enrollment and approval process.

Navigant believes recent changes made to the application process, including simplification; adding a requirements checklist and the provision of an Energy Analysis Report template; have helped improve the process for participants and made the review process clearer. Additionally, support from the Technical Account Managers to facilitate enrolling projects and completing applications is a benefit to customers and the program as a whole.

Past feedback from solution providers and participants indicated there were no significant barriers to program participation once a decision had been taken to achieve higher efficiency in a project. Solution providers and the implementation contractor often provide significant support to applicants in completing the application process, often helping to complete the application form and supporting the collection of required documentation.

3.3.5 Incentive Payment Process

Funds for each program year are reserved on a project-by-project basis as applications are received. Applications are then monitored as these proceed through the application steps to verify these are progressing as expected. If projects are delayed, particularly between program years, monies reserved for a particular project may be freed up. In 2015, Solution Providers mentioned they have regular meetings with program staff to discuss the progress of projects enrolled in the program.

The evaluation team attempted to review the timeline associated with the incentive payment process, as in past years. However, the program tracking excerpt provided to the evaluation team only included one set of dates, the incentive payment date. With only one date, the evaluation team was unable to determine the length of time between receiving a completed application and sending an incentive check or the time between an application receiving final approval and sending an incentive check. What can be noted is the data was fully complete for the date field Navigant did receive (field = *Incentive Paid Date*).

3.3.6 Program Tracking Data Review

The program tracking database is used to record all information from program applications and to track the progress of applications through the process. While the evaluation team notes some fields were not fully populated for all applications, our overall assessment is the tracking database is reasonable and accurately reflects the status of program applications. However, the evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

As in past years, Navigant provides suggestions for improving the usability of the tracking database and making the data clearer for those reviewing the data.

- 1) Several acronyms and abbreviations are used in the tracking database that may be unclear to someone unfamiliar with the system or new staff assigned to work on the tracking data by the program administrator. Navigant recommends adding documentation of the database, with an explanation of column headers describing the information included in each column, spelling out acronyms used as field values, and any protocols with respect to how the data is reported.
- 2) Some fields in the tracking database were not completed for all applicants. Some of the missing information is vital, for example incentive paid is critical for determining cost effectiveness, while other information, such as building floor area, is useful in evaluating the program. In the 2016 tracking database, the Estimated Sq.Ft. field was not reported for 57 of the projects (7 non-whole building and 50 whole buildings), though it could be determined for 32 of the whole building projects from other fields. Additionally, incentives were not reported for seven of the projects. Navigant recommends a check be added as part of the administrative review of applications to ensure complete information on the project has been received and entered into the database.
- 3) The 2016 program year tracking data for the NRNC Program is a combination of the tracking data from the two implementation contractors. As such, some of the fields are not reported consistently. Specifically, the business type classifications did not match for all instances. For example, the evaluation team determined projects referred to as *College/Univ* and *Higher Education* were referring to the same type of projects, and *Schools* and *K-12* were indicative of the same types of projects. The change in implementation contractor structure proposed for 2017 likely will resolve these issues.

3.3.7 Verification and Due Diligence

There are two levels of due diligence carried out as part of the program. The first level is the administrative element, ensuring information submitted to the program is processed accurately and recorded in the project tracking database as previously discussed. The second process is the engineering review of applications to ensure savings for a project are calculated correctly and result in the appropriate level of incentive for the customer, and verification inspections carried out by the implementation contractor to confirm measures have been implemented.

Under the new implementation arrangements, CLEAResult reviews applications for prescriptive or custom projects for completeness before conveying the application to DNV GL for processing. Where information is found to be incomplete, CLEAResult works with the applicant to obtain any required information. In terms of information tracking, all projects are subject to an administrative review after the application has been received and entered into the program tracking database. This administrative review is then confirmed through a management review before information is provided to AEP Ohio. AEP Ohio then reviews all program application data provided by the implementation contractor and approves program incentives.

The engineering review process differs depending on the type of project (Prescriptive, Custom or Whole Building) and the level of verification carried out differs depending on the type and size of the project. All projects are reviewed by a technical reviewer and most projects also go through a peer review process. Projects may also be subject to a site visit for verification. The proportion of projects subject to a site visit

is based on the level of incentive payment, with a higher sampling rate applied to projects with a higher level of incentive. All Whole Building projects are subject to a site inspection.

Reviews for the Prescriptive Approach program are relatively simple. Staff review the application and supporting documentation to determine compliance with program rules and determines the level of incentives. For the Custom Approach, engineering calculations are also reviewed and metering may be installed or other approaches taken to establish customized savings.

Building energy simulation modeling is required for all projects participating in the Whole Building option, but may also be used for some other projects. Comments from solutions providers through previous evaluations indicate that modeling can be very beneficial in demonstrating the value of including energy efficiency investments in their projects.

Starting in 2013, all applicants to the Whole Building stream were required to provide executable versions of their models. This allows program staff to review the model, project documentation and drawings to determine whether the energy simulation model properly represents the building design. The implementation contractor reviewers work with the modelers representing the applicant to ensure the model accurately reflects expected energy use, which is then used to determine the level of incentives available under the program. Given modeling results can be subject to assumptions made in the modeling process and even to the version of model used, these executable files are important parts of the review process.

The change to obtain an executable version of the model is important and has resulted in several changes in the review process. In past evaluations, both program staff and design team members commented that the ability to execute the model has made for a more focused and robust review. In most cases where some modification to the model is required, changes are made by the applicant's design team; however, modifications are occasionally done by the implementation contractor review team for convenience. Where such changes are made, these are clearly identified and the design team is advised of the change.

No significant disputes were reported to have occurred during 2016. While the evaluation may determine a level of savings that differs from the applicant's initial estimate, these differences have generally represented differences in engineering judgement and have been resolved without issue. In most instances, program staff and solution providers indicated differences arose from legitimate differences in engineering opinion on how to estimate savings or represent an efficiency change in the building energy model. While such disputes have not been significant to-date, Navigant continues to recommend consideration be given to developing a formal process to provide a framework in case such disputes arise in future.

Navigant has met regularly with the implementation contractor to discuss issues relating to how projects will be evaluated in terms of their energy and demand savings. Feedback from the implementation contractor has indicated this communication has been helpful in avoiding misunderstandings related to the approach used in the impact evaluation, particularly with respect to more complex or unusual projects under the custom stream.

3.4 Cost Effectiveness Review

This section addresses the cost effectiveness of the NRNC Program. Cost effectiveness 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 3-9. Inputs to Cost-Effectiveness Model for the AEP Ohio NRNC Program

Item	Input
Measure Life	14
Projects	216
<i>Ex Post</i> Annual Energy Savings (kWh)	44,151,419
<i>Ex Post</i> Coincident Peak Savings (kW)	8,266
Third Party Implementation Costs	\$1,415,725
Utility Administration Costs	\$615,563
Utility Incentive Costs	\$3,519,527
Incremental Participant Cost	\$14,940,571

Based on these inputs, the TRC ratio is 2.0 and passes the TRC test. Table 3-16 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 Non-Residential New Construction Program

Test Results for NRNC	Benefit/Cost Ratio
Total Resource Cost	2.0
Participant Cost Test	2.9
Ratepayer Impact Measure	0.8
Utility Cost Test	6.2

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. KEY FINDINGS AND RECOMMENDATIONS

This section presents the key findings and recommendations from the 2016 Non-Residential New Construction program impact and process evaluations.

4.1 Key Impact Findings and Recommendations

These recommendations from the evaluation team are specific to decreasing variability between the *ex ante* and *ex post* calculations and streamlining the impact verification.

- 1) Multiple mistakes were found in the *ex ante* calculations including; typos resulting in understatements of savings and mistaken ineligibility of a measure; incorrect references to the implementer's 2014 Appendix A values instead of the implementer's 2016 Appendix A; correctly assigning savings-per-hp, but calculation resulting in incorrect total savings; and savings claimed in project files differed from the tracking database.

Impact Recommendation 1: Develop a project quality control (QC) checklist identifying the most common errors (including those mentioned above) to ensure peer reviews pick up simple errors and typos in the project files.

- 2) Detailed verification of *ex ante* lighting power density (LPD) calculations reveals several errors, including inaccurate fixture counts, missing ballast specifications, omission of lighting controls in both the baseline and as-built calculations, and ignoring the longer run hours of 24/7 security lighting.

Impact Recommendation 2a: Consider training LPD specialists to thoroughly check all LPD submittals are consistent with the lighting layout drawings, or noting where the actual building differs from the drawings. Onsite inspections should include double checking the actual building matches the drawings.

Impact Recommendation 2b: Include an analysis of both the baseline and as-built lighting controls. Specify which baseline code and of what vintage is being followed, IECC or ASHRAE 90.1 and the year, and calculate lighting control savings from the actual building.

- 3) Whole Building projects are universally assigned a fifteen-year lifetime as a conservative estimate, though the evaluation team found that for seven of the ten Whole Building buildings reviewed, the *ex post* lifetime was calculated at less than 15 years. The *ex post* lifetime, which is calculated as a weighted average (by *ex post* energy savings) of each document end use, is pulled down by the 11-year lifetime assumption for lighting.

Impact Recommendation 3: Reconsider the use of a fifteen-year lifetime on Whole Building projects. Suggest breaking up savings by end use and having a designated lifetime for each end use documented.

- 4) Three separate Whole Building projects had project files where the *ex ante* modeled results did not match provided *ex ante* summary results

Impact Recommendation 4a: Check project files to insure the latest savings analysis is included and that results are consistent on all submitted documents.

Impact Recommendation 4b: On Whole Building projects, run energy models to ensure outputs are consistent with summary results.

- 5) Three separate projects claimed savings for Split/RTU systems ineligible for program savings because the IEER value does not meet program minimum. In some cases, the units qualified by the EER value, but the implementer's 2016 Appendix A states IEER must be used for qualification, if available. These units would have been eligible under the program requirements stated in the DNV GL 2014 Appendix A.

Impact Recommendation 5: Either reconsider the requirements for Split/RTU systems in the implementer's Appendix A or enforce the 2016 Appendix A statement, "If the efficiency rating of the unit is IEER standard and available in the specification, the rating, IEER will be the qualifying efficiency rating (see table 46 for details). If only EER is available as the efficiency rating, EER will be the qualifying efficiency rating."

- 6) *Ex ante* calculations at a retail grocery store used average values for refrigeration measures instead of calculating saving for refrigerators and freezers separately.

Impact Recommendation 6: Count the number of refrigerators and number of freezers separately and apply space specific savings values.

- 7) One project included savings from a combination oven whose efficiency exceed the ENERGY STAR minimum, however the oven was not certified as ENERGY STAR, so the implementer's Appendix A indicates these savings should not be claimed. In this case, potential program savings were not calculated.

Impact Recommendation 7: Consider allowing savings to be claimed from appliances whose efficiencies exceed ENERGY STAR standards.

- 8) For chiller savings, the implementer's 2016 Appendix A indicates savings should be calculated as, "savings/ton + savings/ton per unit efficiency over minimum." For kWh savings, this is identified as "savings per unit efficiency over minimum," but for kW savings and incremental cost it's identified as "savings per 0.01 unit efficiency over minimum," which seems to be an oversight on the kWh savings calculation.

Impact Recommendation 8: Change the text in implementer's Appendix A to indicate the kWh savings for chillers should be, "savings per 0.01 unit efficiency over minimum" to match the kW and incremental cost calculations.

- 9) One Whole Building project used the wrong demand period for calculating coincident demand and another Whole Building project used the reduction between the maximum of the baseline and efficient, rather than a reduction in the average during peak periods.

Impact Recommendation 9: Add a QC check to ensure coincident peak demand is calculated correctly, according to the implementer's Appendix A, which states (1) the coincident peak demand period is summer weekdays from 3pm to 6pm, June 1 through August 31, and (2) demand savings are presented as an average of coincident peak demand during these periods.

- 10) The impact analysis reveals most lighting measures do not include the most cost-effective efficient technology. Many projects include standard T8 lighting when HPT8 systems could be employed for a 10 percent reduction in lighting power. Further, few projects include manual light reduction controls. The inclusion of light reduction controls as specified in IECC would result in a 10 percent reduction in lighting power.

Impact Recommendation 10a: Consider requiring all general illumination fluorescent light fixtures be HPT8 lamp and HPT8 ballast systems. Advise participating lighting designers that use of HPT8 systems allows these to use less fixtures, or replace normal BF with low BF for increased savings and incentives.

Impact Recommendation 10b: Strongly encourage the inclusion of manual light reduction controls where appropriate in the building design. Advise participating lighting designers that the inclusion of light reduction controls increases savings and incentives.

- 11) Determining the baseline building code used for each project, as new construction projects in Ohio have the choice to use either IECC 2009 or ASHRAE 90.1, has often been a challenge for the evaluation team and has been a recommendation in past evaluations. The project documentation this year did a significantly better job than past years in identifying baseline code. Looking forward, given the Ohio code change effective January 1, 2017¹⁴ it is expected that determining baseline code for each project will become both more challenge and more critical.

Impact Recommendation 11: Include a field in the tracking data identifying the correct baseline code for each project. This will encourage an additional check by the implementation contractor and provide more transparency to the evaluation team, specifically as the program works through the challenges of an Ohio building code change.

4.2 Key Process Findings and Recommendations

The following process recommendations are offered to help improve program effectiveness and efficiency and further improve participant's experience of the program.

- 1) There are structural contract challenges with respect to span of control and data transparency for both implementation contractors which results in program management inefficiencies. Navigant understands the NRNC implementation contract structure is expected to change again in 2017, which will presumably resolve these issues:

Process Recommendation 1: Align implementation contractor performance metrics with management span-of-control responsibilities; contractors should have access to actionable data that supports changing program implementation tactics as needed.

- 2) Build-to-Lease type projects are not prioritized or served through a NRNC Program path.

Process Recommendation 2: Develop a program path to address the needs of the Build-to-Lease market. Research and clearly identify market actors and barriers to program participation. Develop project management and financing solutions to address participation barriers; connecting future occupant and ratepayer needs with developers' building design decisions.

- 3) There may be missed opportunities in some segments of the NRNC market that could be leveraged by the established NRNC pathways for additional participation. The program does not have data to compare program activity (completed projects) with actual nonresidential new construction projects in the AEP Ohio jurisdiction.

¹⁴ The newly adopted, current Ohio building code is based on 2012 IECC and ASHRAE 90.1-2010 with amendments.

Process Recommendation 3: AEP Ohio should compare program participation results with jurisdictional construction data to assess program penetration and identify underserved market segments. Specific attention should be given to Build-to-Lease projects and properties with very small footprints to determine whether there is a reduction in program use correlated with building size.

- 4) The program is implementing strategies resulting in early involvement in the project design and development phase. Earlier engagement typically leads to increased savings and a clear connection between program promoted activity and project savings.

Process Recommendation 4: Continue to encourage participants to apply early, and require pre-application with the Whole Building and My Solutions paths. Continue to facilitate pre-design meetings to increase per project savings and clearly correlate project results to program activity.

- 5) Program staff are aligning program services with customer needs through adjustments to the Whole Building path and creation of the My Solutions path.

Process Recommendation 5: Continue to identify opportunities that reduce customer participation barriers, including (a) supporting LEED applicants through integrating NRNC Program modelling activities into the LEED modeling requirements and (b) streamlining smaller project participation through paths such as My Solutions that reduce burden of customer participation.

- 6) Initial communication challenges identified in 2015 between implementation contractors has improved. Program stakeholders note several key communication tactics as supporting improved internal and external communications and program management.

Process Recommendation 6: Continue to prioritize clear and frequent communication across stakeholders including implementation contractors, program staff, evaluators, design teams and customers.

- 7) Participant outreach activities are conducted primarily through Technical Account Managers, which by all stakeholder accounts is well received.

Process Recommendation 7: Prioritize and expand the Technical Account Manager role to provide outreach, education, manage long term project communications, complete project applications, and maintain ongoing communication with design teams and trade ally associations.

- 8) Environmental certificates were awarded to architectural firms in 2017, acknowledging project impact in a non-energy fashion, such as carbon reduction, number of cars removed from the road, trees planted, homes off the grid, etc. Program stakeholders have insights on how to further improve and leverage the certificates to recognize successful market actors and generate additional savings.

Process Recommendation 8: Continue to utilize design team reward mechanisms including environmental certificates and big check presentations. Consider expanding based on stakeholder insights to include engineering firms and annual competitions.

4.3 Key Tracking System and Project File Findings and Recommendations

With respect to the Project Tracking Database and Project Files, Navigant offers the following observations and recommendations for improved clarity and tracking.

- 1) As in past years, Navigant notes several acronyms and abbreviations used in the tracking database are open to interpretation. This aspect could create issues for someone unfamiliar with the system including new staff assigned to work on the tracking data by the program administrator and the potential for misinterpretation by the evaluation team.

Tracking System Recommendation 1: Add documentation of the database, with an explanation of column headers describing the information included in each column, spelling out acronyms used as field values, and any protocols with respect to how the data is reported. If different spreadsheets are used for different program approaches, explanations of how these spreadsheets differ and where to locate other tracking data should be included.

- 2) In reviewing the tracking database, Navigant found some fields were not completed for all applicants. Most critically the incentive payment amount and square footage was missing for a small portion of the projects.

Tracking System Recommendation 2: As part of the administrative review of applications, add a check to ensure information for fields, such as incentive payment amount and floor area, are complete and are entered into the database.

- 3) Navigant attempted to review the incentive payment process, using methodology used in past years. The program tracking data provided to the evaluation team included the incentive payment date, but did not include dates for receiving the completed application and receiving final approval on the application materials.

Tracking System Recommendation 3: Ensure the tracking data does include all applicable dates, including dates for receiving the completed application and receiving final approval on the application materials, in order to track program activity for each participant.

APPENDIX A. OTHER ISSUES FOUND DURING THE IMPACT ANALYSIS

The three tables in this section, Table 4-1, Table 4-2, and Table 4-3, identify the impact issues corrected in the *ex post* analysis, and the number of buildings where the particular issue is noted. The impact issues identified during the *ex post* analysis have been broken into three separate categories. Table 4-1 identifies issues related to lighting power density calculations, Table 4-2 identifies issues related to prescriptive measures, and Table 4-3 includes the remainder of issues found by the evaluation team during the *ex post* analysis.

Table 4-1. Lighting Power Density (LPD) Impact Issues Found in *Ex Post* Analysis

Number of Buildings with Impact Issue	Impact Issue Description
16	LPD inputs did not correctly account for baseline or installed lighting controls.
15	<i>Ex ante</i> LPD calculations included different numbers of fixtures (including in some cases double counting and/or omitting areas) and wattages than what could be verified.
7	LPD calculation did not account for security lighting with HOU of 8,760.
2	<i>Ex ante</i> LPD calculations used whole building approach, though the space-by-space approach was more appropriate.
1	A typo in the <i>ex ante</i> calculations results in a large overstatement of the number of fixtures and a corresponding understatement of savings.
1	<i>Ex ante</i> calculation missed 19,000 kWh of exterior lighting savings because a mistake resulted in an incorrect determination that no savings were available.

As Table 4-1 indicates, sixteen buildings in the impact sample had occupancy sensors or spaces where the baseline code required lighting controls, yet the *ex ante* analysis did not consider these lighting controls. Where installed occupancy sensors are ignored, savings are underestimated and the participant does not receive the full incentive that it should. If IECC 2009 is used, most baseline spaces are required to have light reduction controls as indicated in IECC Section 505.2.2.1 Light Reduction Controls. However, most *ex ante* LPD calculations used ASHRAE 90.1-2007, which does not require light reduction controls, but does require occupancy sensors in classrooms, conference and meeting rooms, and employee lunch and break rooms. ASHRAE 90.1 occupancy sensor requirements are detailed in ASHRAE 90.1-2007 Section 9.4.1.2 Space Control.

More careful *ex ante* analysis would eliminate some of the LPD issues noted. Installed fixture counts and fixture wattage should be double checked with the drawings and field verified for major projects. Detailed analysis of the lighting layout drawings would indicate if any fixtures are running 8,760 hours per year, in these cases, Navigant recommends using 8,760 hours of use (HOU).

Table 4-2. Prescriptive Measure Impact Issues Found in *Ex Post* Analysis

Number of Buildings with Impact Issue	Impact Issue Description
3	<i>Ex ante</i> calculations include savings for Split/RTU systems ineligible for program savings because IEER does not meet program minimum requirements. In some cases, the units qualified by their EER value, but the implementer's 2016 Appendix A states IEER must be used for qualification, if available.
2	<i>Ex ante</i> calculations correctly assign savings-per-hp, but the calculation used results in incorrect total energy savings.
2	<i>Ex ante</i> calculations incorrectly reference values from the implementer's 2014 Appendix A, instead of the implementer's 2016 Appendix A.
1	<i>Ex ante</i> calculations included incremental savings for variable refrigerant flow (VRFs) not valid for savings through the program, based on the requirements in the implementer's 2016 Appendix A.
1	Units claiming anti-sweat heater (ASH) controls were found to not have ASH or ASH systems with constant-on operation.
1	Unit power was rounded to closes full hp in <i>ex ante</i> calculations, resulting in an overstatement of savings.
1	<i>Ex ante</i> savings averaged the implementer's Appendix A deemed value for ENERGY STAR freezers and refrigerators and applied across all units. <i>Ex post</i> analysis applied the correct deemed value to each unit.
1	<i>Ex ante</i> savings claim savings for an ENERGY STAR solid freezer door, which was determined to not be ENERGY STAR certified and thus not eligible for savings.

As indicated in Table 4-2, the evaluation team identified a couple of instances where the methodology outlined in the implementer's 2016 Appendix A was not applied correctly. Three buildings were found to have savings claimed from HVAC systems which were in fact ineligible for program savings because these did not meet the minimum requirement based on their IEER value. In most cases, these units qualified for the program based on their EER rating, but the implementer's Appendix A states "If the efficiency rating of the unit has been tested per IEER standard and available in the specification, the rating, IEER will be the qualifying efficiency rating (see table 46 for details). If only EER is available as the efficiency rating, EER will be the qualifying efficiency rating." It is important the NRNC Program applies the same methodology for claiming savings from prescriptive measures as other AEP Ohio programs, and to consistently apply the methodology outlined in the implementer's 2016 Appendix A.

Table 4-3. Various Impact Issues Found in *Ex Post* Analysis

Number of Buildings with Impact Issue	Impact Issue Description
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Number of Buildings with Impact Issue	Impact Issue Description
3	Provided model yielded different results than the claimed <i>ex ante</i> model.
3	Onsite verification revealed discrepancies between model inputs and installed equipment, including overall efficiency, max supply air temperature, thermostat throttling range, chilled water temps, hot water temps, economizer cut off, and additional economizers on primary AHUs.
2	Savings claimed in provided project files differed from tracking database.
2	The <i>ex ante</i> building model incorrectly assigned HVAC system efficiencies.
1	Building area differed between <i>ex ante</i> LPD and the building model.
1	<i>Ex ante</i> calculations used the wrong demand period for calculating coincident peak demand.
1	<i>Ex ante</i> peak demand calculations used reduction between maximum of baseline and efficient rather than a reduction in average during peak periods.
1	<i>Ex ante</i> calculations conservatively estimated peak demand savings as difference between baseline and efficient interior lighting, as the model was unable to be run.
1	CUSTOM: <i>Ex ante</i> calculations assumed the same energy use as similar processes, <i>ex post</i> interpolated logged data to provide a better estimate.
1	CUSTOM: <i>Ex ante</i> calculations were based off of one of the two valid logging datasets, <i>ex post</i> calculations used both.
1	MISSING FILES: Detailed <i>ex ante</i> calculations were not provided.

In the case of Whole Building projects, care should be taken to make sure the submitted models are run and agree with the *ex ante* summary results. The evaluation team found three building models where the results from the provided model were different from the results used in the *ex ante* model, though the differences were relatively small. Care should be taken to verify all model inputs, including through onsite visits for larger projects. Additionally, the model should be used in all cases to determine the coincident peak savings by producing hourly outputs and calculating savings during the peak hours.

APPENDIX B. PROGRAM MANAGER INTERVIEW GUIDE

September 15, 2016

AEP Ohio

Process Evaluation of 2015 Non-Residential New Construction Programs

Interview Guide: AEP Ohio Staff Program Manager

(Responsible for the overall program, marketing, and Whole Building / modeling analysis)

Interview Date: TBD

Time/Duration: Estimate 1.5 hours

Interviewer(s):

Interviewee:

INTRODUCTION

1. Describe your personal role in the program in the past year?
2. I understand that last year program implantation shifted to two implementation contractors. Can we start with a brief overview of how this structure is working for AEP and your customers?
3. Please describe key changes to the program since last year?
 - a. Can you describe the impact these changes have had on program performance?
4. How many people (in terms of FTE's) in your organization are working on the NRNC Program?

PROGRAM PROCESS

5. Can you describe for me the **key steps or processes** for the programs?
 - a. Prescriptive /Custom path?
 - b. Whole Building path (*If not brought up in the response, probe for details on 'My Solutions' and the 'Early Design' review.*)
6. Please describe the roles and responsibilities for the **key players** involved in the process? (I.e. CLEAResult, DNV GL and AEP Ohio - who does what?).
 - a. Have these roles changed over the last year?
7. Can you confirm the 2016 program targets? (For both the Whole Building and Prescriptive / Custom paths)?
 - a. Do you expect them to be met?

8. Do you have an estimate of program savings in pipeline for next year?
9. What other key performance indicators do you use to measure the performance of the program?
10. Have there been any changes to how participant savings estimates are verified? (Have these changes created barriers or opportunities to support design teams?)
 - a. Prescriptive / Custom path?
 - b. For the Whole Building path?
11. For participants participating in the LEED process, how have the changes implemented last year affected participation and project performance?
12. What proportion of LEED projects changed their design to increase energy efficiency relative to their original design as a result of participating in the AEP Ohio program?
13. Have any projects which applied under the prescriptive/custom path transferred to the whole-building path? How was this transfer handled?

OUTREACH AND MARKETING

14. Have you seen any changes in the key motivations and perceived barriers for program participants? Is there any difference between 'Build to Own' and 'Build to Sell / Lease'?
15. Please describe how the customer recruitment/marketing strategy has changed in the past year. (How do customers and trade allies become aware of the program? What steps are being taken to include more participants?)
 - a. What data sources are used to identify projects occurring in the AEP Ohio territory?
 - b. How are efforts carried out consistently across the AEP Ohio service territory?
 - c. Are efforts targeted to specific market segments ('Build to Own' and 'Build to Sell / Lease')?
16. Please describe the outreach and marketing activities conducted in this past year?
 - a. How was this coordinated between CLEAResult and DNV GL?
 - b. Are there outreach nuances to particular market segments? Both customer markets and trade allies (contractors, architects, engineers)?

17. Describe any recognition provided for participating buildings or design teams? (i.e. certificate or plaque)

INTERACTION WITH MARKET DESIGN TEAMS

18. Have you seen any changes in the roles of key decision-makers/influencers in the process – specifically with respect to energy efficiency decisions? (I.e. owner/developer, architect, engineers?) from past years?
19. Are any market segments under represented (or not represented) through the program? Are there any concerns about underrepresented markets?
20. What proportion of projects proceed with essentially the level of energy efficiency initially proposed on the program application?
21. How often do you meet with the design teams either in person or by web meeting, to review project designs?
22. How do participant needs vary by sector or design method? (Design-build, design-bid-build, build to lease, build to own).
23. Can you explain the review process used to suggest efficiency measures the design team was not considering? How is this received by design teams? Customers?
 - a. (How could the program achieve deeper comprehensive savings, beyond lighting power density and HVAC mechanical efficiencies?
24. Have customers indicated they have any issues with program requirements or documentation?
25. How is the AEP Ohio recognition received by design teams? How does it encourage participation or more efficient design?

•

APPLICATION, INTAKE, PROCESSING, AND INCENTIVE PAYMENT

26. Can you explain the application intake procedures, and any changes that have been made over the last year? (I.e. *new on-line application form*). How have these been accepted by participants?
27. Do participants and trade allies understand the available program paths and their differences?

- a. How do participants determine whether to pursue whole building vs prescriptive paths? (Do program staff or trade allies provide guidance? How do they share project leads?)
28. For customers applying for incentives under multiple program pathways (i.e. whole building and prescriptive) how is the application process coordinated between CLEAResult and DNV GL?
29. At what points do you communicate with the customer? (I.e. re status of application). In what form does communication take place? How is this coordinated between CLEAResult and DNV GL if the customer is applying to multiple program pathways?
30. How many participants drop out of the program before project completion? Why? What impact has the design incentive had on drop-outs?
31. Can you describe the quality control procedures in place to ensure complete information is obtained, and accurate information is entered into the database?
32. Site inspections and verifications.

	Whole Building	Prescriptive / Custom
Frequency?		
At what milestones?		
How are sites selected?		
Who conducts SV's		
How are results documents?		
Who resolves disparities?		

33. In the interactions with energy modeling consultants - what's working well? Where do you see opportunities for improvement?

PROGRAM DATABASE

34. Have there been any changes to the structure of the program database or how it is maintained?
 - a. How is consistent data quality assured with two separate implementation contractors contributing to the data base?

PROGRAM PARTICIPATION

35. What have been the key challenges in implementing the program in the past year?

36. What steps have you taken to overcome these challenges?
37. What additional steps or activities do you feel could be taken to improve the program and boost program participation and why/how do you think this would increase activity?
- a. *Follow up if not addressed in response:* Has AEP given further consideration to incorporating commissioning or post occupancy follow up to the program?
38. Is there an opportunity for a future tenant in a new construction design project to provide input into the energy efficiency measures being considered?

PROGRAM REQUIREMENTS

39. Have you seen any increase in the use of “Integrated Design” as part of the Whole Building Design projects? How successful do you think this approach has been in improving building energy efficiency? Are these program aspects being tracked?

CLOSING

40. Is there anything else you think we should know?

If we have any additional questions is it best to follow up with you by phone or by e-mail?

Thank you very much for your time in assisting us with this evaluation. Your contribution is a very important part of the process.

APPENDIX C. IMPLEMENTATION CONTRACTOR INTERVIEW GUIDE

October 13, 2016

AEP Ohio

Process Evaluation of 2015 Non-Residential New Construction Programs

Interview Guide: Implementation Contractor

Interview Date: TBD

Time/Duration: Estimate 1.5 hours

Interviewer(s):

Interviewee:

INTRODUCTION

41. Describe your personal role in the program in the past year?
42. Please describe key changes to the program since last year?
 - a. Can you describe the impact these changes have had on program performance?
43. How many people (in terms of FTE's) in your organization are working on the NRNC Program?

PROGRAM PROCESS

44. Can you describe for me the **key steps or processes** for the non-residential New Construction program (including the Whole Building path and CLEAResult's responsibilities for prescriptive program intake)?
45. Please describe the roles and responsibilities for the **key players** involved in the process? (I.e. CLEAResult, DNV GL and AEP Ohio - who does what?).
 - a. How have these roles changed over the last year?
46. What are the 2016 program targets? (For both the Whole Building and Prescriptive paths)?
 - a. Do you expect them to be met?
47. What other key performance indicators do you use to measure the performance of the program?
48. Have there been any changes to how participant savings estimates are verified for the Whole Building path? (Have these changes created barriers or opportunities to support design teams?)
49. For participants participating in the LEED process, how have the changes implemented last year affected participation and project performance?

50. What proportion of LEED projects changed their design to increase energy efficiency relative to their original design as a result of participating in the AEP Ohio program?
51. Have any projects which applied under the prescriptive path transferred to the whole-building path? How was this transfer handled?

OUTREACH AND MARKETING

52. Have you seen any changes in the key motivations and perceived barriers for program participants? Is there any difference between 'Build to Own' and 'Build to Sell / Lease'?
 - a. Please describe your customer recruitment/marketing strategy. How has it changed in the past year? (How do customers and trade allies become aware of the program? What steps are being taken to include more participants?)
 - d. What data sources are used to identify projects occurring in the AEP Ohio territory?
 - e. How are efforts carried out consistently across the AEP Ohio service territory?
 - f. Are efforts targeted to specific market segments ('Build to Own' and 'Build to Sell / Lease')?
 - g. Have case studies been developed? Which markets are represented?
53. Please describe the outreach and marketing activities conducted in this past year?
 - a. How was this coordinated between CLEAResult and DNV GL?
 - b. Are there outreach nuances to particular market segments? Both customer markets and trade allies (contractors, architects, engineers)?
54. Describe any recognition provided for participating buildings or design teams? (i.e. certificate or plaque)

INTERACTION WITH MARKET DESIGN TEAMS

55. Have you seen any changes in the roles of key decision-makers/influencers in the process – specifically with respect to energy efficiency decisions? (i.e. owner/developer, architect, engineers?) from past years?
56. Are any market segments under represented (or not represented) through the program? Are there any concerns about underrepresented markets?

57. What proportion of projects proceed with essentially the level of energy efficiency initially proposed on the program application?
58. How often do you meet with the design teams either in person or by web meeting, to review project designs?
59. How do participant needs vary by sector or design method? (Design-build, design-bid-build, build to lease, build to own).
60. Can you explain the review process used to suggest efficiency measures the design team was not considering? How is this received by design teams? Customers?
 - a. (How could the program achieve deeper comprehensive savings, beyond lighting power density and HVAC mechanical efficiencies?
61. Have customers indicated they have any issues with program requirements or documentation?
62. How is the recognition provided by AEP Ohio received by design teams? How does it encourage participation or more efficient design?

APPLICATION, INTAKE, PROCESSING, AND INCENTIVE PAYMENT

63. Can you explain the application intake procedures, and any changes that have been made over the last year? (*ie. new on-line application form*). How have these been accepted by participants?
64. Do participants and trade allies understand the available program paths and their differences?
 - a. How do participants determine whether to pursue whole building vs prescriptive paths? (Do program staff or trade allies provide guidance? How do they share project leads?)
65. For customers applying for incentives under multiple program pathways (i.e. whole building and prescriptive) how is the application process coordinated between CLEAResult and DNV GL?
66. At what points do you communicate with the customer? (i.e. re status of application). In what form does communication take place? How is this coordinated between CLEAResult and DNV GL if the customer is applying to multiple program pathways?
67. How many participants drop out of the program before project completion? Why? What impact has the design incentive had on drop-outs?
68. Can you describe the quality control procedures in place to ensure complete information is obtained, and accurate information is entered into the database?

69. Site inspections and verifications

	Whole Building	Prescriptive / Custom
Frequency?		
At what milestones?		
How are sites selected?		
Who conducts SV's		
How are results documents?		
Who resolves disparities?		

70. In the interactions with energy modeling consultants - what's working well? Where do you see opportunities for improvement?

- a. Follow up: Are you seeing any changes with the modeled projects that are being submitted to the program? (i.e. More likely to use one software over another, new modeling software, are energy modelers' more likely to be on the team, are energy models more likely to be done by mechanical firm).

PROGRAM DATABASE

71. Can you describe your responsibility for the Tracking system database?

- a. How do you ensure data quality?
- b. How is data quality managed consistently with DNV GL?

PROGRAM PARTICIPATION

72. What have been the key challenges in implementing the program in the past year?

73. What steps have you taken to overcome these challenges?

74. What additional steps or activities do you feel could be taken to improve the program boost program participation and why/how do you think this would increase activity?

- a. Follow up: How has 'My Solutions' affected participation?

75. Is there an opportunity for a future tenant in a new construction design project to provide input into the energy efficiency measures being considered?

PROGRAM REQUIREMENTS

76. Have you seen any increase in the use of “Integrated Design” as part of the Whole Building Design projects? How successful do you think this approach has been in improving building energy efficiency? Are these program aspects being tracked?

CLOSING

77. Is there anything else you think we should know?

If we have any additional questions is it best to follow up with you by phone or by e-mail?

Thank you very much for your time in assisting us with this evaluation. Your contribution is a very important part of the process.

APPENDIX M



EXPRESS PROGRAM FOR SMALL BUSINESS CUSTOMERS

2016 Evaluation Report

Prepared for:

AEP Ohio



A unit of American Electric Power

April 20, 2017

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

312-583-5700
navigant.com



Submitted to:

AEP Ohio
700 Morrison Road
Gahanna, Ohio 43230

Presented by:

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

Contact:

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

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

Prepared by:

Jessica Minor-Baetens, Managing Consultant
734.794.4865
jessica.minor-baetens@navigant.com

Anusha Jagannathan, Senior Consultant
303.728.2542
anusha.jagannathan@navigant.com

Derya Eryilmaz, Managing Consultant
303.728.2537
derya.eryilmaz@navigant.com

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EXECUTIVE SUMMARY

This report presents the results and findings from the evaluation of the 2016 AEP Ohio Express Program for Small Business Customers (Express 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 findings are contained in the body of the report following this Executive Summary.

ES.1 Program Summary

The Express Program provides a one-stop, turnkey service to small businesses for energy efficient lighting and refrigeration equipment upgrades. Savings estimates are based on prescriptive formulas for simplicity and auditability, while tailoring key parameters, such as hours of use, on a fixture-by-fixture basis. The implementation contractor serves as the contact point for the program to simplify the participation process for small businesses with limited resources and energy efficiency expertise. In 2016, the Express Program completed 442 projects and achieved 11.4 GWh of *ex ante* reported annual energy savings, as shown in Table ES-1. This is approximately three-quarters the number of participants in 2015; however, the average savings per project is greater in 2016 than in 2015.

Table ES-1. Express Program Projects and Reported Ex Ante Savings

Metric	Ex Ante Reported Value
Number of Projects	442
Annual Energy Savings (MWh)	11,407
Peak Demand Savings (kW)	1,470

ES.2 Key Impact Findings

Table ES-2 shows the *ex ante* savings claimed by the program, the *ex post* verified savings, and the 2016 realization rates. The realization rate for 2016 was 80 percent for energy and 91 percent for demand. To estimate the *ex post* energy savings, the evaluation team independently used a fixed effects regression model based on participants' pre- and post-retrofit energy consumption data. The evaluation team applied engineering based adjustments to estimate *ex post* demand savings. In 2016, the program achieved 83 percent of the energy savings goal and 72 percent of the peak demand savings goal.

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

	2016 Program Goals ¹ (a)	<i>Ex Ante</i> Savings (b)	<i>Ex Post</i> Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	11,063	11,407	9,124	80%	83%
Demand Savings (MW)	1.844	1.470	1.330	91%	72%

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

ES.3 Conclusions and Recommendations from Program Year 2016

The 2016 Express Program evaluation resulted in six primary conclusions.

Key impact findings and recommendations include:

- Finding 1: The realization rate (defined as verified *ex post* savings divided by *ex ante* reported savings) is 80 percent for energy savings, and 91 percent for demand savings.** The realization rates improved from 2015, increasing seven percent for energy and three percent for demand. Likely causes of this increase include increased refrigeration savings, which have a higher realization rate, and the implementation contractor including more rigorous QA/QC steps in the audit tool.

 - Recommendation 1:** Navigant recommends the implementation contractor continue to focus on quality control to reduce instances of equipment not being installed, auditor training to assess accurate hours of use, working with vendors to ensure LED system wattages as installed are accurate, heating and cooling are accurately characterized, etc.
- Finding 2: LEDs and refrigeration measures are increasing in their contribution to the program, while fluorescents are starting to phase out.** The adoption of measures remained as diverse as in 2015, with the top three measures (interior LEDs, T8 fluorescents, and exterior LEDs) accounting for 53 percent, 19 percent and 15 percent of measures installed, respectively. Altogether, 68 percent of measures installed are LED related. T8 fluorescents decreased from 30 percent of measures installed in 2015 to 19 percent in 2016. Refrigeration measures increased from 1 percent of measures installed to 3 percent. Savings from refrigeration measures increased from 6 percent in 2015 to 14 percent in 2016.

 - Recommendation 2:** Continue to promote other measures outside of lighting.
- Finding 3: Customers are interested in installing other measures not offered by the Express Program.**

 - Recommendation 3:** Modify the program to include other measures outside of lighting and refrigeration, including HVAC, shell measures, and other mechanical equipment (e.g., motors, drives, food preparation and storage equipment).
 - Recommendation 4:** Channel Express Program participants to the Prescriptive Program if the customer is interested in installing measures the Express Program does

not incentivize. This could come in the form of a Key Performance Indicator for the implementer. Additionally, the implementer could act as the link for this population.

Key process findings and recommendations include:

Marketing and Participation

4. **Finding 4: The customer conversion rate (customers who participate in the Express program divided by all customers who receive an Express audit) for 2016 is approximately 25 percent**, which is below the implementation contractor's expected conversion rate of 30 to 50 percent. Of the customers who chose not to participate and also provided a reason for not participating, 70 percent indicated they changed their mind, 15 percent indicated a lengthy payback, nine percent said they had no funds, four percent went with a competitor, two percent did not believe the savings, and one percent cited landlord issues.
 - **Recommendation 5:** Utilize targeted marketing to promote the program to high electricity users. The implementation contractor can concentrate marketing resources where these will have the greatest impact. This customer group is likely more interested in saving money, so the projects likely will have shorter paybacks.
 - **Recommendation 6:** Consider partnerships with Chambers of Commerce, Small Business Advocacy Organizations, community groups, and trusted local partners in order to increase program awareness and participation. If customers hear about the program from a trusted source, they may be more likely to participate, resulting in increasing the conversion rate.
 - **Recommendation 7:** Attempt an interview of "lost participants", or those that receive an audit but choose to not participate in the program, in order to better identify the reasons they are not participating.

Program Characteristics and Barriers

5. **Finding 5:** Some customers would prefer working with a local contractor, or a contractor they know, rather than an appointed contractor. The implementation contractor recognizes there are customers who want to use a preferred contractor and will always make an effort to work with the customer. However, this appears to happen on a limited basis.
 - **Recommendation 8:** To encourage customer choice, allow customers to select an installation firm from a pre-certified list of contractors. Additionally, promote the certification to grow the contractor list.

Administration and Delivery

6. **Finding 6:** The implementation contractor introduced an automated seven step email system that walks customers and contractors through the installation process. The last email sent is when installation is complete.
 - **Recommendation 9:** The implementation contractor could add an eighth email to the customer with next steps to take, for example, to sign up for an online energy portal, or participate in other AEP Ohio EE/PDR program. Additionally, any QA/QC activity conducted by the implementer or the evaluator could trigger an eighth email to the contractor with information regarding the issues identified, along with possible solutions.

1. INTRODUCTION

This section provides an overview of the Express Program element of AEP Ohio's Business Energy Efficiency and Peak Demand Reduction (EE/PDR) portfolio, Navigant's objectives for this evaluation and a review of customer participation metrics. In addition, this section describes differences in how the 2016 program was implemented in comparison to the 2015 program.

1.1 Program Description

The Express Program provides turnkey energy audits free of charge with energy efficiency measure installation, and payment services to small businesses. The criteria for program participation in 2016 were either 1) annual usage of less than 200,000 kWh, or 2) a maximum of 100 kW billing demand, regardless of kWh usage.

The Express Program achieves the large majority of energy savings from lighting retrofit measures, including LED, T8, and lighting control measures, with the remainder of savings from refrigeration measures, such as ECM motors, compressor and fan management, anti-sweat heater controls, and LED case lighting. In 2016, the focus remained on LED measures, with LEDs accounting for the majority of installations. The program targets customers that typically do not participate in other business program offerings due to various market barriers, including lack of capital, inadequate energy expertise, or insufficient personnel to explore energy efficiency options. To address market barriers, the Express Program provides a free audit and higher equipment incentives than other business offerings, and provides a suite of services to streamline the customer experience.

The Express Program is marketed, administered, and delivered as a single program. The program is managed by an implementation contractor (Lime Energy) in coordination with AEP Ohio. The program is marketed to small businesses by the implementer's Energy Service Representatives (ESR) who make appointments to visit the customer and conduct the free energy assessment. The ESRs also market the program directly to customers in assigned geographic territories, and are able to target certain customer types, such as auto repair shops or small grocery stores.

The program model focuses on an integrated delivery of audit services, measure installation and application handling. The savings algorithms differ slightly from the Prescriptive Program's deemed savings approach by applying a more custom approach, which takes into account fixture-specific parameters relevant for lighting equipment, such as hours of use. The application is populated onsite in a tablet computer during the audit. After the audit is complete and the customer has agreed to move forward with the project, a contractor is assigned to the project to complete installation of identified measures. The measures are ordered, stored, and shipped by the implementer to reduce cost and improve cycle time. Once the contractor acquires the measures, it schedules and completes installation of the measures.

1.2 Evaluation Overview

The goals of the Express Program evaluation are to analyze the energy and demand savings (impacts) claimed by the program, and to review program processes to ensure the program is reaching the intended audience with quality and consistently delivered service.

1.2.1 Customer Eligibility

The core program processes and basic program theory of the 2016 program did not change from 2015. AEP Ohio business customers with annual energy consumption below 200,000 kWh and fewer than seven accounts in that business name can participate in the Express Program. Customers with peak billing demand up to 100 kW are also eligible to participate regardless of annual energy use. In addition to the annual consumption restriction, participants must be AEP Ohio customers and cannot be mercantile or managed national account customers. The additional criteria presume these other customer groups have adequate access to capital, as well as energy efficiency expertise and support at the corporate level.

1.2.2 Measure Offerings

For 2016, program offerings included lighting and refrigeration measures. As in previous years, projects must result in a reduction of energy usage at the project level, which allows the implementation contractor flexibility to bundle less efficient measures with more efficient measures to increase savings and reach more customers.

1.3 Evaluation Objectives

The three major objectives of this evaluation were to: (1) quantify energy and peak demand savings impacts in 2016, (2) determine key process-related program strengths and weaknesses, and (3) provide recommendations to improve the program. The evaluation sought to answer the following research questions:

1.3.1 Impact Questions

1. Were the energy and demand savings 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.)
3. What are the benefits, costs and cost effectiveness of this program?

1.3.2 Process Questions

Marketing and Participation

1. What customer market segments participate in the program?

Program Characteristics and Barriers

2. What portion of participation is driven by the same participants, year-upon-year, versus new program participants? What barriers exist in enrolling new participants?

Administration and Delivery

3. How effective are subcontractor training and feedback materials?
4. What QA/QC procedures are in place to improve realization rates?

5. What are the opportunities for program improvement?

1.4 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 and their implementation contractor.
- Audited savings – Savings recalculated by Navigant using the inputs specified in the data extract from AEP Ohio. Audited savings should equal ex ante savings where the algorithms were applied correctly by the implementation contractor and AEP Ohio.
- Engineering adjusted savings – Savings recalculated by Navigant using the Navigant-adjusted algorithms and inputs where applicable, based on the results of the deemed savings review.
- *Ex post* savings – final verified savings taking into account findings from all steps, including the engineering review and results of the billing analysis.

2. METHODOLOGY

This section describes the methodology used to conduct the impact and process evaluations, including a discussion of data sources and sampling. Table 2-1 summarizes the various activities undertaken for the audited impact and process evaluations. Impact verification was conducted using two methods, with a separate methodology used for energy savings and peak demand savings. The process evaluation was conducted by multiple methods as well, covering all relevant stages of program implementation.

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

Data Collection Type	Targeted Population	Supported Evaluation Activities
Tracking Data Review	All projects paid in 2016	Impact and Process Evaluation
Program Documentation Review	All available program documents from the implementation contractor	Process Evaluation
Deemed Savings Review	All measures included in 2016 projects	Impact Evaluation
On-Site Data Collection and Analysis	Sample of completed 2016 projects	Impact Evaluation
Billing Analysis	All projects paid in 2016 and pipeline customers	Impact Evaluation
In-depth Interviews and Follow-up Questions	Program staff and implementer	Process Evaluation

2.1 Data Sources

Data for evaluation of the Express Program was gathered through a variety of sources. The evaluation team conducted in-depth telephone interviews with the AEP Ohio Program Coordinator and the program implementer, reviewed tracking system data and performed onsite verifications. Finally, the team performed a billing analysis of participants to determine *ex post* energy savings.

2.1.1 Tracking Data

The Express Program evaluation team was able to extract key program participation data from the program-tracking database, which was provided by AEP Ohio as a comma separated values file. The tracking data used for this evaluation was extracted January 26, 2017, with earlier files used for preliminary analysis, and later files used as part of the billing analysis. The database consists of a measure level dataset with measure level impacts, application submittal and status data, and AEP Ohio recalculated energy and demand savings values, which represent the *ex ante* savings. The evaluation team found the data and tracking system complete, organized and containing all relevant information.

2.1.2 Program Documentation

The evaluation team also reviewed program materials developed by the implementation contractor and AEP Ohio, including the AEP Ohio and the implementers technical reference spreadsheets documenting savings algorithms, and program materials available from the program website¹.

2.1.3 Billing Data

For the regression analysis, the evaluation team utilized monthly billing data provided by AEP Ohio staff. The data included monthly billing data spanning January 2015 through February 2017, for 2016 and 2017 participants and pipeline customers. Key data fields included the premise number (used to merge the billing and tracking data), bill account number, dates of bill period, read code, and usage amount.

2.2 Tracking Data Review

Review of tracking data is designed to identify potential adjustments to *ex ante* reported savings for measures due to outliers, missing information, or tracking system data entry or calculation errors. The evaluation team identified key tracking fields, including project number, participant name and contact information, project status, building type, measure type, and *ex ante* savings. Next, the team summarized the tracking system data to identify the sectors and measures contributing the majority of savings. However, the evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

2.3 Deemed Savings Review

The deemed savings review is designed to identify potential parameter adjustments to *ex ante* reported savings for measures, should the evaluation team recommend an alternative default value for a specific measure. To provide consistency across the business sector portfolio, updated parameters are expected to be consistent with those used for estimating energy and demand savings for similar measures in other business program offerings. The deemed savings review serves as the basis for calculating peak demand savings and also provides insight for any discrepancies found in the billing analysis.

2.4 On-Site Data Collection and Analysis

On-site visits are designed to verify measure installations operating characteristics for projects throughout the service territory, and contribute to recommendations and findings from other components of the evaluation. The Navigant team conducted onsite data collection and analysis for a subset of projects selected from the technical review sample. A project-specific 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, while the data collection

¹ <https://www.aepohio.com/save/business/programs/ExpressProgram.aspx>

tasks within each were custom-designed to target any key uncertainties in the reported savings analysis. The default onsite M&V tasks included a customer interview, visual verification of measure installation and operation, spot measurements, reported measure quantities, measure nameplate data, verification of measure operating characteristics, including the schedule of operation, and HVAC system type.

2.5 Billing Analysis

A billing analysis of 2016 participants and pipeline participants serves as the basis for determining program energy savings. The variation-in-adoption (VIA) model takes advantage of the differential timing of program enrollment to identify program savings. The model essentially takes the perspective that the best comparison group for participants consists of those customers that enroll in the program in a later period. The use of pipeline participants as a comparison group accounts for other exogenous effects, such as macro-economic trends. Pre- and post-installation periods are determined on a project-by-project basis. The use of fixed effects accounts for project-specific characteristics that do not change over time, such as square footage of the premise.² Program savings are estimated through the use of a statistically adjusted engineering (SAE) model, which incorporates the *ex ante* claimed savings for each project in the regression. Because the billing analysis does not take into account time of day savings, the demand savings are verified by the engineering adjusted savings calculations.

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 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 Express 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 3.2.4.

2.7 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, in some cases the evaluation team might need to analyze a particular variable in the tracking data and find entries for that field are missing or incomplete. This would lead to a recommendation to improve data entry and recording as a process improvement for the program.

² The fixed effects account for the variation in energy usage *across* projects, while the remaining variables in the regression analysis account for the variation in energy usage *within* each project. The regression model explicitly accounts for seasonal variation in energy usage (which includes weather effects) and participation in the Express 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 3.2.3.

2.8 In-depth Program Staff Interviews

In-depth interviews were conducted with key staff from AEP Ohio and the implementer, as described in Table 2-2. Interviews were designed to provide insights into program function, identifying program strengths and areas for improvement, documenting changes to the program in 2016 and the effects of these changes, and identifying how, and to what extent, process recommendations from the 2015 evaluation report have been addressed during 2016. These interviews were conducted between October 2016 and February 2017, by the program process evaluation lead, and were recorded and transcribed verbatim for reference. In February 2017, the implementation contractor staff answered a set of detailed follow-up interview questions in-person, allowing for a deeper examination of key issues raised during on-sites. The guides used for these interviews are included in Appendix B. Detailed findings from these interviews are found in Section 3.2.1.

Table 2-2. Summary of In-depth Interviews

Data Collection Type	Targeted Population	Sample Frame	Sample Target	Sample Size	Timing
In-depth Telephone Interviews and Follow-up In-Person Interview	AEP Ohio Program Staff	Program Key Staff	Express Program Manager and Business Programs Manager	2	October 2016
	Lime Energy Program Staff	Program Key Staff	Express Program Coordinator, Associate Vice President	2	October 2016 – February 2017

2.9 Onsite Interview of Program Participants

The evaluation team conducted onsite interviews with customers who participated in the Express Program during 2016. The interview asked participants questions concerning program participation, benefits and barriers to participation, future participation plans, overall program experience, satisfaction with the program and satisfaction with AEP Ohio. The participant survey instrument is included in Appendix E and Section 3.2.2 provides detailed analysis of survey results.

2.10 Sampling Plan

The sample frames to support the process and impact activities are summarized in Table 2-3 and detailed in the following subsections.

Table 2-3. Summary of Sample Frames

Sample Use	Sample Frame	Size
Billing Analysis	Program participants	Attempted Census
Onsite Verification Visits	Program participants	20

2.10.1 Impact Sample

The Impact evaluation of program energy savings was based on a billing analysis of an attempted census of 2016 participants and pipeline participants as a comparison group. Appendix A includes additional details on the methodology. The attempted census achieves the impact goal of a relative precision of ± 10 percent at a 90 percent level of confidence.

Other impact questions were researched with less rigor since those data were only used to provide context for the billing analysis, as well as the *ex ante* savings and incentive calculations. The evaluation team reviewed measure inputs and savings to verify equations used to calculate savings and incentives, and to verify the application of valid fixture power, hours of use, and HVAC interaction factors. The evaluation team also performed site visits for 20 projects to verify equipment installation and efficient lamp wattage. These sites were selected from the tracking database randomly throughout the AEP Ohio service territory. Onsite verification activities included verification of retrofit equipment, spot measurements, HVAC system type, and hours of operation based on facility hours.

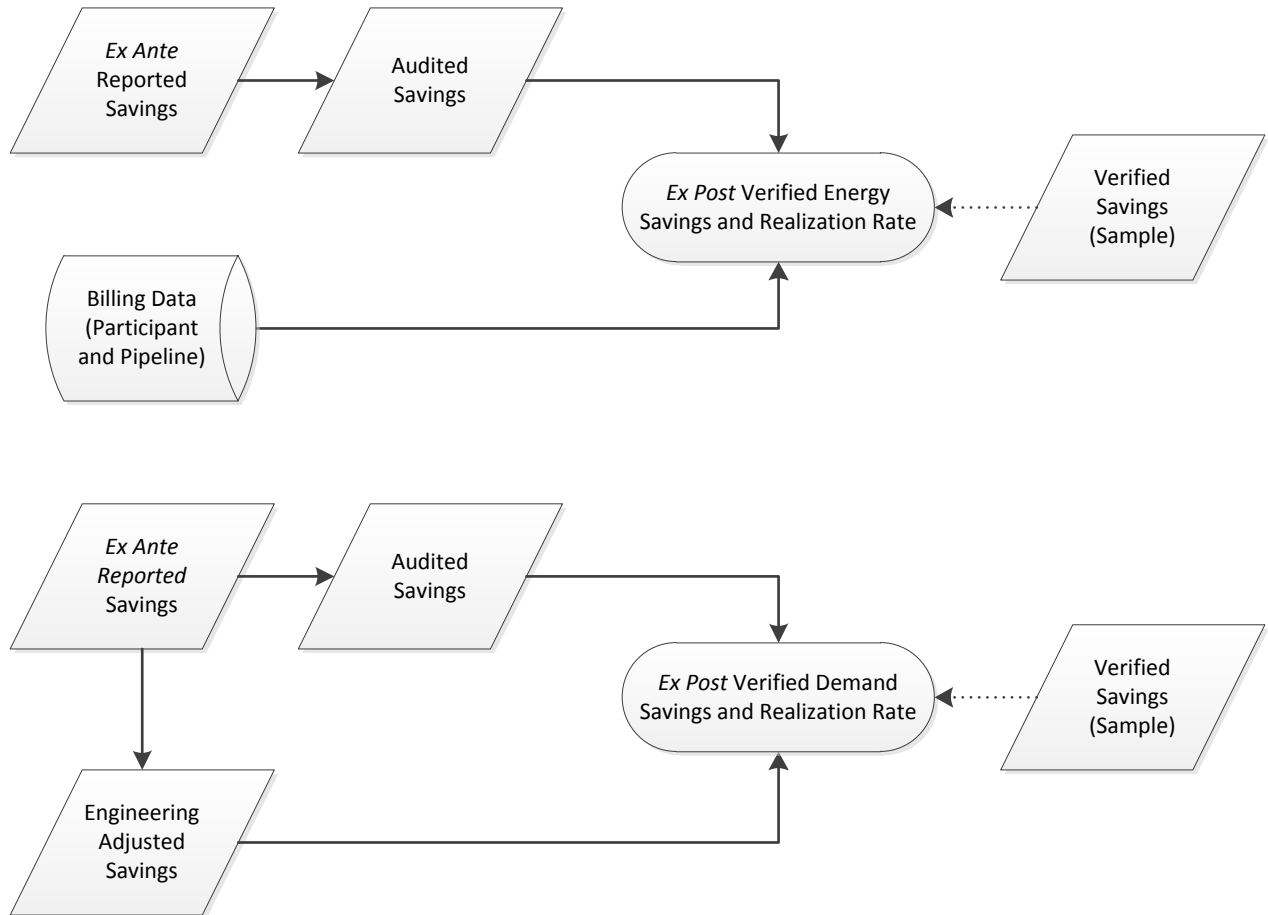
2.11 Ex Post Savings Evaluation Methods

The methodology for estimating *ex post* verified savings differs for energy savings and demand reductions. For energy savings, the billing analysis provides a robust estimate of realized savings, however, because the billing data is only collected at monthly intervals, it is not possible to derive a demand estimation. Therefore, for demand reductions, the evaluation team reviewed the tracking data and performed an engineering review of the deemed savings estimates, which were informed by the onsite verification visits.

2.11.1 Task Flow Schematic

The task flow for these activities is shown in Figure 2-1 for both energy and demand savings. Verified savings from the sample sites are used to inform the drivers of the realization rates, but are not a part of the calculations that determine *ex post* verified savings.

Figure 2-1. Energy and Demand Impact Evaluation Task Flow



3. EVALUATION FINDINGS

This section presents the detailed findings from the 2016 Express Program evaluation related to (1) audited impact findings, (2) process evaluation findings, and (3) cost effectiveness review.

3.1 Impact Evaluation Findings

The evaluation team performed a billing analysis to inform the *ex post* energy savings, and applied engineering-based adjustments to the AEP Ohio tracking data to inform the *ex post* demand savings. The results are shown in Table 3-1.

Table 3-1. 2015 *Ex Post* Savings and Realization Rates

Metric	Energy Savings (MWh)	Demand Savings (MW)
<i>Ex Ante</i> Reported Savings	11,407	1.470
<i>Ex Post</i> Verified Savings	9,124	1.330
Realization Rate	80%	91%

The 2016 program realization rate (defined as verified *ex post* savings divided by *ex-ante* reported savings) is 80 percent for energy savings, and 91 percent for demand reduction. The relative precision is ± 16 percent for energy and ± 10 percent for coincident demand at the 90 percent confidence level, two-sided. The energy precision value reflects uncertainty in the regression model parameter estimates. Because the regression model includes all participants with viable data, the sampling error is virtually zero, thus the savings estimates satisfy the 90 percent confidence and 10 percent precision targets.

3.1.1 Findings from the Audited Savings Review

This section provides a detailed description of impact findings for the 2016 Express Program, including verified energy and demand savings and realization rates. The evaluation team reviewed tracking data and recalculated the energy and demand savings values according to the methodologies outlined in the technical documentation, and from conversations with AEP Ohio staff. All relevant parameters, including pre- and post-quantities, pre- and post-wattages, HVAC interactive effects, coincidence factors and burnout quantities were either available directly in the tracking data or in lookup tables provided by AEP Ohio staff.

Observations from this review were project-tracking systems are well organized and contain sufficient documentation. Existing equipment and retrofits are adequately described to estimate savings and proposed equipment descriptions are thorough and consistent. Navigant successfully recalculated both energy and demand savings based on the parameters outlined in the tracking data, resulting in an audited realization rate of 100 percent for both energy and demand savings.

3.1.2 Findings from the Engineering Adjusted Savings Review

The evaluation team reviewed all measures further to verify methodologies, equations, and parameters for estimating energy and demand savings. The engineering adjusted realization rates were 99 percent for energy and 91 percent for demand. In 2016, the Express Program installed lighting measures including linear fluorescent (T5 and T8) retrofits, LED linear lamps (T8), LED screw-in lamps, LED wall packs and fixtures, LED exit signs, CFL lamps, lighting controls, light

disconnects, as well as refrigeration retrofit measures. The basis for AEP Ohio's *ex ante* reported savings are driven by the formulae outlined in the following sections.

3.1.2.1 *Lighting Parameter Estimates*

Energy and demand savings for lighting measures are calculated per measure from the following equations³:

Equation 1. Energy Savings

$$kWh.savings = [kW.base * (QTY.base - QTY.burnout) - kW.eff * QTY.eff] * Hours * HVAC.kWh$$

Equation 2. Demand Savings

$$kW.savings = [kW.base * (QTY.base - QTY.burnout) - kW.eff * QTY.eff] * CF * HVAC.kW$$

Where:

kWh.savings = energy savings (kWh)
kW.savings = demand savings (kW)
kW.base = connected kW of baseline equipment
kW.eff = connected kW of efficient equipment
QTY.base = quantity of baseline equipment
QTY.eff = quantity of efficient equipment
Hours = estimated annual hours of use
HVAC.kWh = energy interactive effect
HVAC.kW = demand interactive effect
CF = coincidence factor

The evaluation team reviewed the lighting parameters to determine whether these were reasonable and acceptable or required revision. The evaluation team reviewed inputs for fixture power, hours of operation, HVAC interactive effects, and coincidence factors. Individually, the team judged most of these parameters are reasonable, but should be revisited to ensure these both represent the climate and building characteristics of the AEP Ohio service territory, and align with other business program assumptions where relevant.

3.1.2.2 *Hours of Operation*

Prior Express Program Evaluation Reports^{4,5} identified over-estimated hours of operation as a driver of over-estimated reported program savings, while more recently, the 2014 Express Program Evaluation⁶ determined hours of use appear to

³ Refrigeration measure savings algorithms taken from New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Residential, Multi-Family, and Commercial/Industrial Measures Version 2, December 10, 2014.

⁴ Express Program for Small Business; Program Year 2012 Evaluation Report.

⁵ Express Program for Small Business; Program Year 2013 Evaluation Report.

⁶ Express Program for Small Business; Program Year 2014 Evaluation Report.

be reasonable. The approach used by the implementation contractor to estimate hours of use on a per-fixture bases allows for more accurate measure-level savings.

Navigant compared energy savings using deemed hours of use by building type for lighting measures consistent with other AEP Ohio business programs, to the energy savings using the per-fixture approach employed by the implementation contractor, and found energy savings were very similar (less than 2% difference). This indicates the hours of use estimates are consistent with energy savings estimates from other sources.

3.1.2.3 *Lighting Power*

In general, the evaluation team agreed with estimated fixture power listed in the technical reference spreadsheets on a per-fixture basis. The team acknowledges the custom approach taken by the implementation contractor to identify the specific wattage of the baseline fixture has the potential to yield accurate estimates. In practice, the auditors must take care to ensure the correct baseline efficiency is chosen and does not overestimate savings. The implementer has taken steps to ensure a more conservative baseline wattage is selected for savings calculations when unable to confirm the wattage in the field.

The tracking data contains a high-level field detailing the type of baseline fixture. These values typically correspond to several variations of lamp and ballast combinations. In 2014, Navigant identified baseline fixture wattages from the Draft 2010 Ohio Technical Reference Manual (TRM)⁷ are typically lower than those reported by AEP Ohio, creating the potential to overestimate savings.

In addition, the linear LED T8 retrofit lamp wattages, while generally consistent with manufacturer specification sheets, may not take into account additional power consumption of the electronic ballast under certain configurations (e.g. wired directly to line voltage versus an electronic ballast)⁸.

While the evaluation team did not determine the implementation contractor is overestimating baseline wattages from the documentation provided, the potential exists. Proper identification of baseline fixture and ballast type is critical to make accurate savings estimates. As shown in the onsite findings in Section 3.1.4, it is likely these issues play a role in the lower than 100% realization rate.

In 2016, Navigant conducted spot measurements of LED retrofit lamp wattages during on-site visits. However, the spot measurements taken generally did not align with the efficient wattages reported in the tracking data. The wattages for some cases were higher, and lower for others. For most spot measurements, it was not possible to determine which fixture identification (ID) matched which reading, and if the reading was for one lamp, one fixture, or for all fixtures in that group. Navigant recommends more robust field assessment for 2017, including a separate entry for each unique fixture type, which would include stated wattage, number of lamps, and ballast information. Also, circuit descriptions should show measure and fixture ID to provide a good point of cross reference.

3.1.2.4 *HVAC Interactive Effects*

Savings from more efficient lighting in conditioned spaces include HVAC interaction effects, depending on the type of heating and/or air-conditioning equipment used. The tracking data includes thorough HVAC information to advise this parameter. The evaluation team found the deemed values reasonable, although these are based on the New York TRM,

⁷ Table 8: Baseline and Efficient Fixture Wattages, page 173, State of Ohio Energy Efficiency Technical Reference Manual, August 6, 2010

⁸ http://images.philips.com/is/content/PhilipsConsumer/PDFDownloads/United%20States/ODLI20160302_001_UPD_en_US_LED-Lamps-PLt-1309BN_LED-T8-IF_Gen1.pdf

and climate data from Poughkeepsie NY, rather than Ohio. The evaluation team used these values again for 2016 since these take into account the HVAC system type found onsite, rather than making weighted assumptions on system type for a building type.

Last year, there were some lighting measure records that appeared to be in unconditioned spaces, but were still credited with HVAC interaction effects. This year, the locations marked “exterior” or “outside” were correctly marked with a zero (0) HVAC interaction factor in the tracking data. Nevertheless, the evaluation team recommends adding a new column to the tracking data which would clearly identify whether a specific measure is indoor or outdoor. This addition would be beneficial for both *ex ante* and *ex post* savings estimates.

3.1.2.5 Coincidence Factors

The coincidence factor is used to calculate the percentage of time an efficient measure operates during the peak summer period. The evaluation team found the coincidence factors AEP Ohio used to calculate demand savings were consistent with other business program offerings and match the values used by Navigant. The one building type where values are slightly different is auto repair. Navigant applied screw-in coincidence factor (CF) values for screw-in CFL and LED measures. This adjustment was the primary driver of the demand savings realization rate of 91 percent.

In addition, exit signs, which are assumed to operate 24/7, often were credited with deemed coincidence factors rather than using 1.0; this adjustment resulted in a minor increase in demand savings for exit signs.

3.1.2.6 As-Found Lamp Burn-Outs

As-found lamp-burn-out is also a potential source for savings over-estimates. Existing energy use depends on the number of lamps burning at the time of the contractor’s survey. Because lamps are most often replaced when a sufficient number have failed, and affect illumination or aesthetics, some burned-out lamps are expected in the baseline case in most businesses. New equipment presumably does not burn out within the first year, with most replacements having a rated lamp life of 8,000 hours for CFLs, 18,000 hours for linear fluorescent lamps, and 50,000+ hours for LEDs.

The implementation contractor accounts for burn-outs by taking note of the quantity of burnouts during the assessment and subtracting these from the baseline quantity, and in some cases applying a ratio of burnouts. The variety of quantities within the burnout data indicates the implementer is attempting to characterize this effect, and the evaluation team believes this is not a large contributor to the realization rate.

3.1.2.7 Refrigeration Measure Assumptions

Refrigeration measures in 2016 account for 14 percent and 10 percent of *ex ante* reported energy savings and demand savings, respectively, which is a slight increase from 2015. The evaluation team found the refrigeration assumptions based on the New York TRM appropriate, but notes similar measures are offered through other AEP Ohio business program offerings.

3.1.3 Findings from the Billing Analysis

The evaluation team conducted a regression analysis using monthly billing data from premises tied to 703 projects, including 442 completed 2016 projects, 17 pipeline completed projects for 2017, and 347 pipeline projects including pending and projected projects. Note these counts are after flattening the data to account for multiple projects at a single customer site and other cleaning steps. The VIA model implicitly assumes the best comparison group for participants are customers enrolling in the program in a later period. Pre- and post-installation periods are determined on a project-by-project basis. The use of fixed effects accounts for customer-specific characteristics that do not change over time, such as

square footage of the premise. The regression accounts for seasonality of savings due to HVAC interaction effects via the inclusion of seasonal binary variables. Program savings are estimated through the use of a Variation-in-Adoption model, which relies only on program participants to develop the counterfactual.⁹ In particular, customers who participate in the program at a later date serve as the control group for customers who participate in the program early on. This model also accounts for the variation in project size in the regression equation. For a detailed description of the regression model and results, see Appendix A.

The evaluation team estimates an energy savings realization rate of 0.80. That is, verified savings are equal to approximately 80 percent of *ex ante* savings reported in the tracking database. This corresponds to average annual program savings of 20,642 kWh per premise. The 90 percent confidence interval around this estimate is 17,260 kWh to 24,024 kWh per premise, with a standard error on the annual savings of 2,056, and relative precision of 0.16 for the realization rate. The uncertainty in the regression model may be driven by variability in the data and the lack of a sufficient number of post-period bills for a large number of projects. Total 2016 program savings are calculated from the energy realization rate times the total claimed savings for the Express Program in 2016, for a total of 9,124 MWh.

3.1.4 Findings from On-site Verification

Navigant conducted onsite verification visits for a total of 20 randomly-selected projects throughout the service territory. As discussed, the sample was stratified to ensure some refrigeration sites were visited. Because this process was designed to inform rather than serve as the basis for the impact evaluation, it is not necessary to obtain 90/10 confidence and precision for the sample.

Of the 20 sites, a total of 193 measure records, representing 879 individual measures, were verified. The evaluation team attempted to verify the parameters related to impact calculations onsite and assess any trends that may provide insight into process or operational findings, as well as a due diligence activity.

For the sample of sites visited, the energy realization rate is 96 percent, while the demand realization rate is 93 percent. During the on-sites, two percent of measures were not found installed, and four percent of lamps were burned out. Key findings from the on-site visits include:

1. **Overall, customers are satisfied with the program and the majority would participate again.** Cost was most often mentioned as the key driver for participation. Participants were also satisfied with the measures installed, but were interested in additional offerings.
2. **Hours of use continue to be realistic based on interviews, but may still overstate actual fixture hours.** The evaluation team verified reported hours of use based on data provided by the customer during the visit. Overall, the evaluation team verified hours at 97.7 percent of reported hours for the sample, similar to 98.6 percent in 2015. This result indicates the auditing team is consistently estimating hours appropriately, although Navigant did not meter hours of use to provide a more accurate determination.
3. **Linear T8 LED retrofit efficient wattages may underestimate system wattage.** In 2016, Navigant conducted spot measurements of LED retrofit lamp wattages during on-site visits. However, the spot measurements taken generally did not align with the efficient wattages reported in the tracking data. The wattages for some cases were higher, and lower for others. For most spot measurements, it was nearly impossible to determine which fixture ID matched which reading, and if the reading was for one lamp, one fixture, or all fixtures in that group. Navigant

⁹ Harding, M. and A. Hsiaw. Goal Setting and Energy Conservation. July 2013. Available at: http://www.stanford.edu/~mch/resources/Harding_Goals.pdf.

recommends more robust field assessment for 2017, including a separate entry for each unique fixture type which would include stated wattage, number of lamps, and ballast information. Also, circuit descriptions should show measure and fixture ID to provide a good point of cross reference.

3.1.5 Discussion of Impact Evaluation Results

3.1.5.1 Energy Savings

Based on the billing analysis and engineering adjusted savings review described in the previous sections, the evaluation team estimated the verified program energy and demand impacts resulting from the 2016 Express Program, as shown in Table 3-2. No further adjustments were made to verified kWh savings.

Table 3-2. Savings Estimates for 2016 Express Program

	2016 Program Goals (a)	<i>Ex Ante</i> Savings (b)	<i>Ex Post</i> Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	11,063	11,407	9,124	80%	83%
Demand Savings (MW)	1.844	1.470	1.330	91%	72%

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

The realization rate for energy is higher than the value found in 2015 (0.73), indicating AEP Ohio and implementation contractor staff have made changes to the program in 2016 resulting in improved impact savings estimates.

Ex ante energy savings as a percent of building energy consumption remain high. For the Express Program, the average energy use per project is 127,245 kWh and the average *ex ante* savings per project is 25,807 kWh, or 20 percent of energy consumption. This is similar to the 2015 and 2014 values of 23 percent and 19 percent, respectively.

The evaluation team concludes the *ex ante* estimates for the AEP Express Program continue to be overstated and are in line with the 2015 program overstatement of savings. Areas for possible inflation include hours of use estimate, HVAC interactive effects, coincidence factors, and baseline and efficient wattages. Realization rates greater than 70 percent are consistent with other realization rates for similar programs, regardless of the methodology used (deemed savings or billing analysis).

3.1.5.2 Demand Savings

Because the billing analysis does not estimate electric demand savings, the engineering adjusted savings review serves as the basis for demand savings. As noted earlier, the evaluation team reviewed the tracking data and deemed savings assumptions and determined these to be reasonable, resulting in a realization rate of 91 percent due to a variety of engineering-based parameters, as well as mismatches in the tracking data compared to installed fixtures.

3.2 Process Evaluation Findings

This section provides a detailed description of process findings for the 2016 Express Program.

3.2.1 Findings from In-depth Interviews with Program and Implementer Staff

During October 2016 and February 2017, Navigant conducted in-depth interviews with AEP Ohio's Express Program Coordinator, AEP Ohio's Business Programs Manager, and the implementation contractor, Lime Energy's Express Program Coordinator and Associate Vice President.

In-depth interviews reveal the Express Program is performing well. The AEP Ohio Program Coordinator described the Express Program as a reliable source of savings, with the flexibility and responsiveness needed to ramp up or slow down participation quickly, and as needed in order to meet portfolio-level goals. According to the AEP Ohio Business Programs Manager and the implementers program coordinator, the Express Program has built up momentum, and though participation is robust, there is still a large pool of untapped potential for participation.

Measure Distribution. According to the implementation contractor, program offerings in 2016 were consistent with 2015. Interior LEDs continue to grow as the dominant replacement measure (53% of measures installed), with LED tube retrofits (lamp and ballast) becoming extremely popular. Next to interior LEDs, other top measures include interior T8s (19%) and exterior LEDs (15%). Additionally, the implementation contractor opened a new warehouse in Hilliard Ohio, from which to ship materials. The new warehouse has made contractor material deliveries much easier as they no longer need to use a common carrier and the materials are picked correctly by the warehouse crew. This has led to an overall improvement in order accuracy.

Marketing and Outreach. The implementation contractor is responsible for outreach and marketing. According to the implementer, marketing was backed down in 2016 due to the popularity of the program and available 2016 incentive budget. Even though the amount of marketing changed, the methodology stayed the same. There are six Energy Service Representatives (ESR) whose main goal is to sell projects in their local region. The ESRs conduct street sweeps and network with business to spread program information through word of mouth. In addition to direct mail marketing pieces targeted to specific verticals (automotive, gas stations, churches, offices, etc.), the implementation contractor also cited new testimonials developed collaboratively with AEP Ohio in 2016. While the implementer has primary responsibility for outreach and marketing, the AEP Ohio outreach team has been successful at generating additional leads.

Falling Close Rates. The Program Coordinator cited falling close rates (translating audits into completed projects), from over 60 percent initially in 2015 to approximately 50 percent during 2015, as evidence the implementer has effectively saturated many niche markets, but he believes there is still a large untapped pool of small businesses with the potential for savings in AEP Ohio's territory. The close rate for 2016 is trending closer to 25 percent. It is unclear why the majority of customers choose not to participate as they most often do not communicate with the implementer after the initial audit.

Data Collection. Currently the implementation contractor does not track whether a customer owns or leases the building it occupies. Each project is dealt with on a case-by-case basis. While this one-on-one solution offering is beneficial, there is a missed opportunity for collecting and tracking this data point. Customers may behave differently whether owning or leasing the building. Understanding such trends across this customer segment should benefit marketing of the program.

Another data collection opportunity is to streamline the customer survey. AEP Ohio, the implementation contractor and often Navigant are all implementing customer satisfaction surveys. This can result in customer fatigue and customer confusion.

Contractor performance and management of contractor quality issues were identified as areas for improvement by the 2014 evaluation, and the implementation contractor Program Coordinator described a variety of steps his firm has taken to mitigate contractor performance issues. During 2015, the implementer evaluated the local contractors it partners with on a variety of metrics and downsized its contractor network across Ohio from 20 to 12 firms meeting program standards. In 2016, the field was narrowed even further down to seven contractors. According to the implementer, the overall quality of the contractors has increased this year. The implementer is making it a priority to work with contractors

who value their performance and possess solid communication skills, even if this means working with fewer contractors. If a contractor does a few jobs and the implementation contractor believes its skills are not up to par with what the implementer is looking for, the contractor is discontinued. The assistant construction manager is on the phone daily with all of the contractors participating in the program. The implementation contractor deployed an enhanced customer and contractor engagement platform in 2016. The platform is an automated seven step email system that walks the customer and contractor through the install process. Emails are sent at the time of (1) Proposal Delivery, (2) Proposal Acceptance, (3) Proposal Approval, (4) Material Shipment Notification, (5) Installation Schedule, (6) Installation Schedule Reminder, and (7) Installation Complete. There is an opportunity to add additional emails as part of the QA/QC effort and to channel customers to other AEP Ohio EE/PDR programs.

Improving Realization Rates. In 2016, the implementation contractor provided additional training on better identifying high wattage fixtures. The implementer held a team meeting focused around training where it cited scenarios where higher wattage exterior fixtures are typically found. The implementer touched on the likelihood of 1000W Metal Halide under 25 feet as extremely rare, and also provided training on different envelope sizes where a 1000W MH arc tube could be housed. The implementer provided binoculars for reading lamps when possible in high applications and advised ESRs they should not use 1000W MH as the existing fixture wattage unless this can be verified. Also discussed were the consequences of inaccurate auditing, which included inaccurate energy savings and potentially poor realization rate, but also how an inaccurate existing fixture wattage could lead to the incorrect proposed fixture for the application.

In addition to the continued reinforcement of accurate auditing on the part of the ESRs, a savings validation tool provides the necessary backup to ensure accurate audits are conducted. The implementation contractor has continued to revise the savings validation tool used in the field. The goal is to identify possible issues with data collected prior to leaving the customer site and submitting the project. The tool is tablet computer based, which allows for multiple efficiencies, as there is no transferring information from paper. The tool is prepopulated with customer and utility data from AEP Ohio. The ESR is able to populate a single identifiable field and the rest of the customer information auto populates based on information from AEP Ohio. This approach reduces possible errors in filling out the application. The ESR enters information about the heating and cooling equipment in order to calculate interactive effects. In order to calculate energy savings, the ESR also enters an hour code based on building type and a customer interview. After the ESR enters all pre-audit conditions into the tool, recommendations are then made for a replacement technology.

The tool works by processing the previous 12 months usage data to calculate a reasonable lighting load. At this point, the tool is checking for, what the implementer calls, points of fail. These include, but are not limited to, looking at the existing wattage to flag whether it is high, comparing kWh saved versus metered, and looking at the kWh to kW ratio. If the audit fails, the ESR investigates possible solutions, including lowering the hours of use or looking for another electric meter onsite. Only audits passing these validations are sold. Additionally, the tool is used to test proposals after project completion to ensure any changes in the scope made in the field during project installation did not cause a fail on the project.

Refrigeration Expertise. If the customer is interested in or if the ESR identifies refrigeration opportunities, a separate audit and a new application are required. The implementation contractor works with one contractor specializing in refrigeration. As popularity in refrigeration measures increases, a more streamlined application process would benefit customers. The program installed more refrigeration measures in 2016 (777) compared to 2015 (391). Furthermore, refrigeration accounted for 14 percent of overall program savings, up from three percent in 2015.

3.2.2 Findings from Participant Surveys

Program participant surveys contribute valuable insights to the process evaluation by providing direct insights into customer expectations, motivations and experiences. The evaluation team completed 20 in-person surveys with business customers participating in the Express Program during 2016. The survey included questions on program awareness,

payback considerations, experience with the proposal, audit and contractor, the effects of participation on energy bills, benefits and barriers to participation, future participation plans, overall program experience, satisfaction with the program, and satisfaction with AEP Ohio.

Overall, customers were highly satisfied with the program and with AEP Ohio. They reported satisfaction with the ease of participating in the program and the financing opportunity.

The major source of dissatisfaction stemmed from having to work with a contractor the customer did not select. Participants reported unprofessional contractors, not cleaning up after installation, and even not replacing measures identified for upgrades. The implementation contractor has removed unsatisfactory contractors from the program; however, if issues continue to arise, perhaps adding one or two more emails to the automated customer/contractor email process to follow up on completed work would identify complaints. Another option is allowing the customer to work with the contractor of their choice which could also improve customer satisfaction.

Additionally, participants reported dissatisfaction with not seeing energy savings from the project on the utility bills. Participants also reported not recalling specific items on the proposal. This feedback lends itself to opportunities for better customer communication.

3.2.3 Findings from Tracking Data Review

As part of Navigant's process evaluation, the process team thoroughly reviewed Express Program tracking data. Navigant's 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. Sections 3.2.3.1 through 3.2.3.3 present findings from the tracking data analysis.

3.2.3.1 Data Completeness and Quality

The availability of high-quality, complete data is critical in enabling successful process and impact evaluations. The process team completed a high-level review of Express Program tracking data, and an in-depth analysis of the completeness of a sample of key variables. The purpose of this process evaluation tracking data review is to gauge whether tracking data is sufficiently complete to support rigorous analysis and to identify potential areas for improvement.

Overall, the tracking data appears to be high quality. 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, etc. The process team analyzed data completeness for a sample of process-related variables. The results of this analysis are presented in Table 3-3.

The dataset Navigant reviews had already undergone revision and improvement by AEP Ohio staff. Key dates (with the exception of payment mailed date), participant telephone, contractor name and contractor contact were all 100 percent complete. However, key contact fields such as contractor email were often incomplete. While the participant email field, building type and payment approved date were 99, 98, and 93 percent complete, respectively, more than half of the contractor email entries were blank. Being able to identify the contractor for a given project is critical. If, for instance, the evaluation team decided to analyze differences in some aspect of project performance between contractors, only having 43 percent of contractor email addresses recorded could seriously hamper such efforts. Participant email entries improved from last year, improving from 90 to 99 percent complete. The Navigant process team believes 100 percent complete data is a reasonable target for key contact information.

Table 3-3. Key Variables Completeness Summary

	Participant Email	Building Type	Participant Telephone	Contractor Business Name	Contractor Contact
Missing	3	11	0	0	0
Complete	439	431	442	442	442
Percent Missing	1%	2%	0%	0%	0%
Percent Complete	99%	98%	100%	100%	100%

	Contractor Email	Project Completion Date	Proposal Signed Date	Payment Approved Date	Final Application Date
Missing	250	0	0	32	0
Complete	192	442	442	410	442
Percent Missing	57%	0%	0%	7%	0%
Percent Complete	43%	100%	100%	93%	100%

3.2.3.2 Participation Characteristics

Between 2015 and 2016, the number of projects and participants in the Express Program decreased by 23 percent and 30 percent, respectively. Small retail, auto repair, grocery, and businesses listed as “other” accounted for over 75 percent of Express Program projects in 2016. In terms of the contribution to total program level savings, businesses listed as “other”, small retail outlets, and auto repair shops generated the most savings; 40, 18 and 10 percent, respectively. The finding that the largest business type contributor to savings (40%) is simply listed as “other” suggests the need to revise how business type is recorded and entered. Under the current business type naming convention, there is no information about what type of businesses are generating over a third of all Express Program savings, as shown in Figure 3-1. Table 3-4 presents a comparison of building types counts for 2015 and 2016. Figure 3-1 shows energy savings by building type. Figure 3-2 shows projects, energy and demand savings by measure type. Figure 3-3 shows contributions of lighting measures to energy and demand savings.

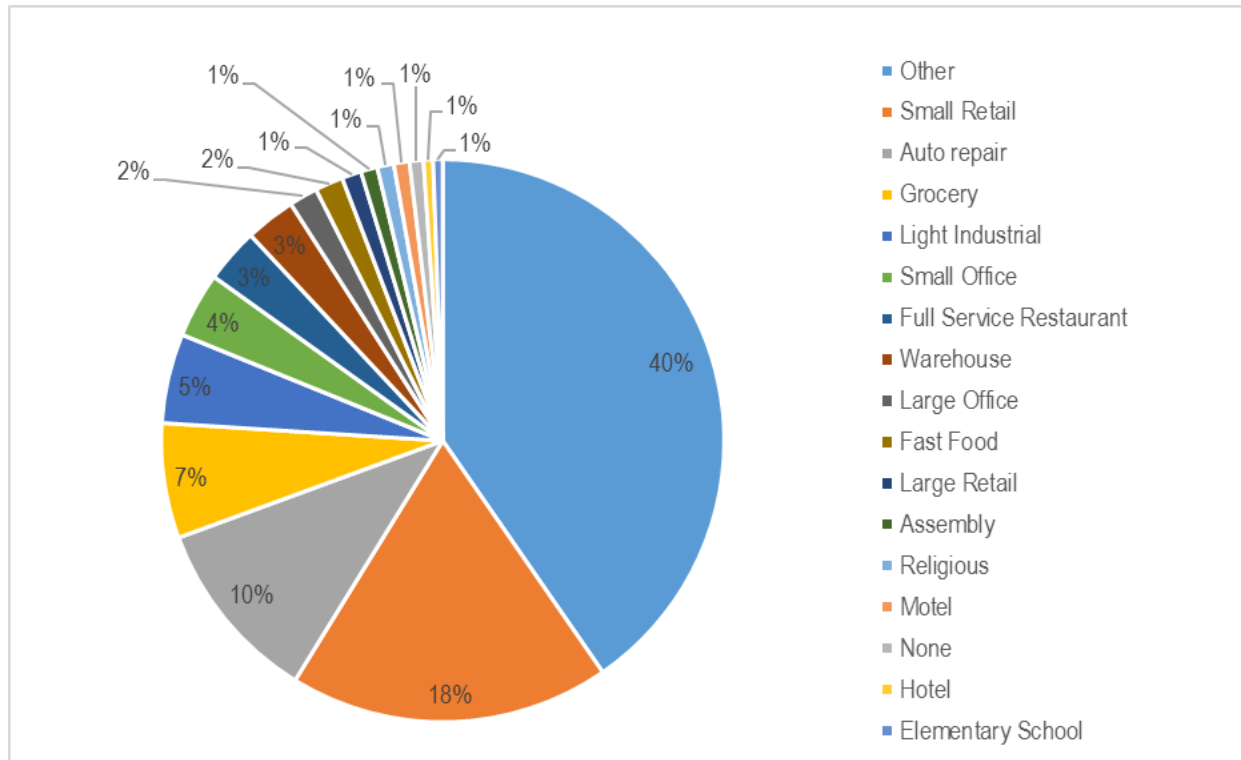
**Table 3-4. Project
Percentage by**

Type	2015 Projects	2015%	2016 Projects	2016%
Other	129	22%	127	29%
Small Retail	148	26%	105	24%
Auto repair	67	12%	39	9%
Small Office	61	11%	34	8%
Light Industrial	24	4%	25	6%
Grocery	42	7%	24	5%
Full Service Restaurant	27	5%	20	5%
Fast Food	28	5%	13	3%
Warehouse	14	2%	11	2%
Religious	5	1%	9	2%
Assembly	5	1%	8	2%
None	6	1%	7	2%
Motel/Hotel	1	0%	6	1%
Large Office	8	1%	4	1%
Large Retail	8	1%	3	1%
School	2	0%	3	1%
Hospital	0	0%	2	0%
Multi-family Low-rise	0	0%	1	0%
University/CC	1	0%	1	0%
Total	570	100%	442	100%

**Count and
Building Type**

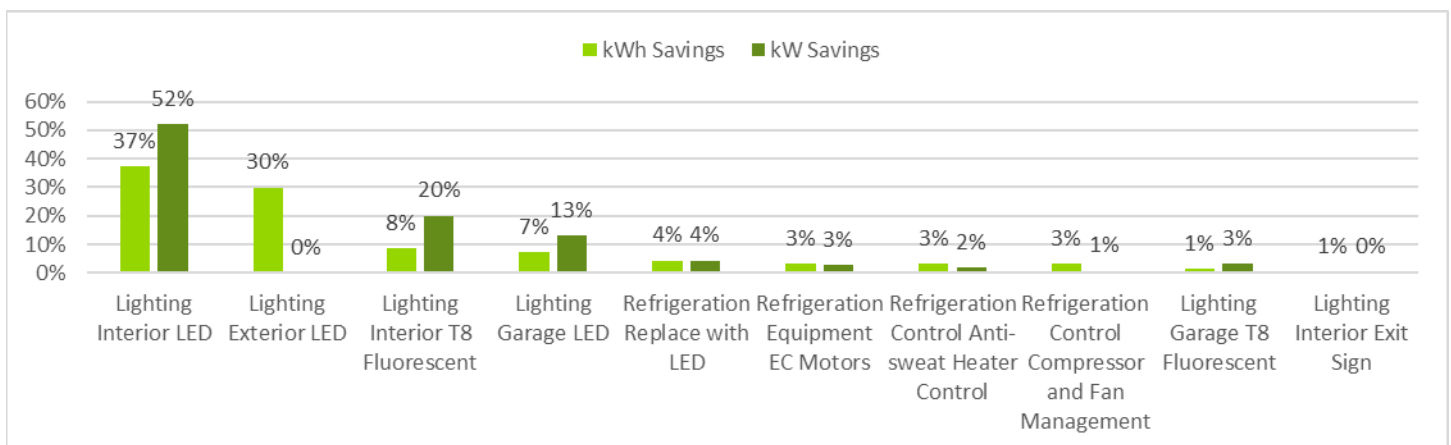
Source: Navigant Analysis

Figure 3-1. Contribution to Program Energy Savings by Building Type



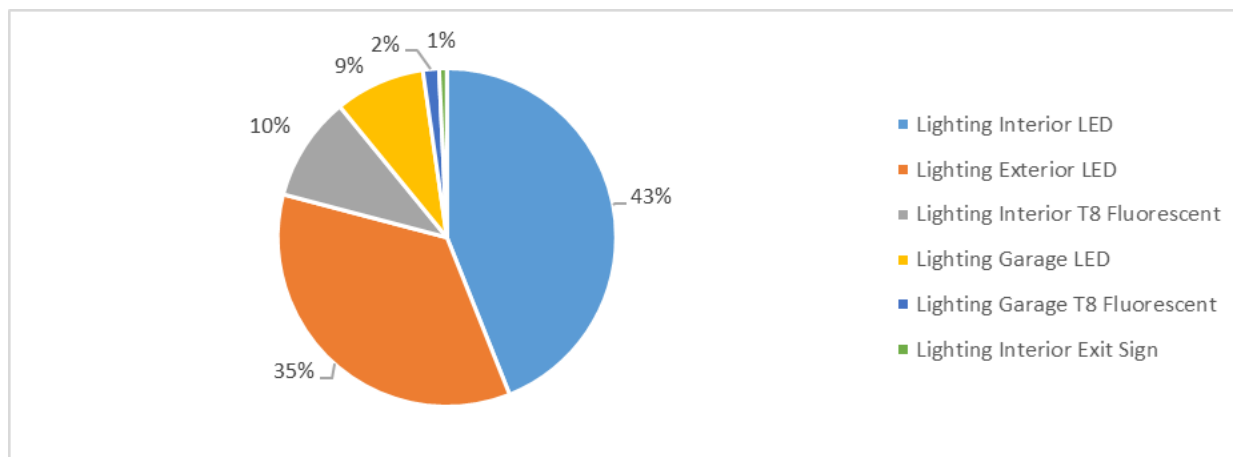
Source: Navigant Analysis.

Figure 3-2. Energy (kWh) and Demand (kW) Savings Contributions of Installed Measures in 2016



Source: Navigant Analysis

Figure 3-3. Energy Savings (kWh) Percentage of Installed Lighting Measures in 2016



Source: Navigant Analysis

3.2.3.3 Measures and Measure Types

Measure adoption under the program has become more diverse over time. LED lighting now dominates the total program measures installed. In 2016, interior LEDs, T8 fluorescents, and exterior LED measures accounted for 53, 19 and 15 percent of total measures installed, respectively. These three measures were dominant in terms of total measures installed, total energy savings and total demand savings, with the exception that exterior LEDs generated no demand savings. These top measures were followed distantly by garage LEDs, refrigeration equipment EC motors, interior exit signs, lighting controls, and garage T8 fluorescents.

3.2.4 Findings from Program Documentation Review

Well-designed and accessible program documents are critical to successful program implementation. These documents facilitate smooth program operation and provide a resource for program and implementer staff, as well as contractors, in order to ensure program expectations and intentions are understood.

The Express Program implementation contractor provided Navigant's process evaluation team with two key program documents in 2015: a program Process Flow Diagram and a Construction Administration Process document. The implementer was not able to provide an operations manual, which may not be developed. However, the two documents the implementer provided yield some useful insights. The implementation contractor made no revisions to these documents in 2016 and had no additional program documents to review. Navigant maintains the implementer would still benefit from updating the Process Flow Diagram to serve the larger purpose of facilitating better quality and developing a more comprehensive operations manual aimed at guiding best practices, answering practical questions, and informing key decision-making processes faced by program staff and contractors.

3.3 Cost Effectiveness Review

This section addresses the cost effectiveness of the Express Program for Small Business Customers. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. Table 3-4 summarizes the unique inputs used in the TRC test.

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

Item	Value
Measure Life	13
Participants	442
Annual Energy Savings (kWh)	9,123,764
Coincident Peak Savings (kW)	1,330
Third Party Implementation Costs	\$35,915
Utility Administration Costs	\$390,792
Utility Incentive Costs	\$2,759,933
Participant Contribution to Incremental Measure Costs	\$4,867,837

Based on these inputs, the TRC ratio is 1.2. Therefore; the program passes the TRC test. Table 3-5 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 3-6. Cost Effectiveness Results for the Express Program for Small Business

Test Results	Ratio
Total Resource Cost	1.2
Participant Cost Test	2.2
Ratepayer Impact Measure	0.6
Utility Cost Test	2.0

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

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions and Recommendations from Program Year 2016

The 2016 Express Program evaluation resulted in fifteen conclusions.

Impact findings and recommendations include:

1. **Finding 1: The realization rate (defined as verified *ex post* savings divided by *ex ante* reported savings) is 80 percent for energy savings, and 91 percent for demand savings.**
The realization rates improved from 2015, increasing seven percent for energy savings and three percent for demand savings. Likely causes of this increase include increased refrigeration savings, which have a higher realization rate, and the implementation contractor including more rigorous QA/QC steps in the audit tool.
 - **Recommendation 1:** Navigant recommends the implementation contractor continue to focus on quality control to reduce instances of equipment not being installed, auditor training to assess accurate hours of use, working with vendors to ensure that LED system wattages as installed are accurate, heating and cooling are accurately characterized, etc.
2. **Finding 2: LEDs and refrigeration measures are increasing in their contribution to the program, while fluorescents are starting to phase out.** The adoption of measures remained as diverse as in 2015, with the top three measures (interior LEDs, T8 fluorescents, and exterior LEDs) accounting for 53 percent, 19 percent and 15 percent of measures installed, respectively. Altogether, 68 percent of measures installed are LED related. T8 fluorescents decreased from 30 percent in 2015 to 19 percent in 2016. Refrigeration measures increased from 1 percent of measures installed to 3 percent. Savings from refrigeration measures increased from 6 percent in 2015 to 14 percent in 2016.
 - **Recommendation 2:** Continue to promote other measures outside of lighting.
3. **Finding 3:** Customers are interested in installing other measures not offered by the Express Program.
 - **Recommendation 3:** Modify the program to include other measures outside of lighting and refrigeration, including HVAC, shell measures, and other mechanical equipment.
 - **Recommendation 4:** Channel Express Program participants to the Prescriptive Program if the customer is interested in installing measures the Express Program does not incentivize. This could come in the form of a Key Performance Indicator for the implementer. Additionally, the implementer could act as the link for this population.
4. **Finding 4: Navigant conducted spot measurements of LED retrofit lamp wattages during on-site visits; however, the spot measurements taken generally did not align with the efficient wattages reported in the tracking data.**
 - **Recommendation 5:** Navigant recommends more robust field assessment for 2017, including a separate entry for each unique fixture type, which would include stated

wattage, number of lamps, and ballast information. Also, circuit descriptions should show measure and fixture ID to provide a good point of cross reference.

5. **Finding 5:** In the database, locations marked “exterior” or “outside” were correctly marked with a zero HVAC interaction factor in the tracking data. However, without a clear column indicating whether a measure is indoor or outdoor, errors and oversight could occur.
 - **Recommendation 6:** The evaluation team recommends adding a new column to the tracking data which would clearly identify whether a specific measure is indoor or outdoor. This addition would be beneficial for both *ex ante* and *ex post* savings estimates.

Process findings and recommendations include:

Marketing and Participation

6. **Finding 6:** The customer conversion rate for 2016 is approximately 25 percent, which is below the implementation contractor’s expected conversion rate of 30 to 50 percent. Of the customers who chose not to participate and also provided a reason for not participating, 70 percent indicated they changed their mind, 15 percent indicated a lengthy payback, nine percent said they had no funds, four percent went with a competitor, two percent did not believe the savings, and one percent cited landlord issues.
 - **Recommendation 7:** Utilize targeted marketing to promote the program to high electricity users. The implementation contractor can concentrate marketing resources where these will have the greatest impact. This customer group is likely more interested in saving money and the projects likely will have shorter paybacks.
 - **Recommendation 8:** Consider partnerships with Chambers of Commerce, Small Business Advocacy Organizations, community groups, and trusted local partners in order to increase program awareness and participation. If customers hear about the program from a trusted source, they may be more likely to participate, resulting in increasing the conversion rate.
 - **Recommendation 9:** Attempt an interview of “lost participants”, or those that receive an audit but choose to not participate in the program, in order to better identify the reasons they are not participating.

Program Characteristics and Barriers

7. **Finding 7:** Some customers would prefer working with a local contractor, or a contractor they know, rather than an appointed contractor. The implementation contractor recognizes there are customers who want to use a preferred contractor and will always make an effort to work with the customer. However, this appears to happen on a limited basis.
 - **Recommendation 10:** To encourage customer choice, allow customers to select an installation firm from a pre-certified list of contractors. Additionally, promote the certification to grow the contractor list.
8. **Finding 8:** Twenty percent of survey respondents reported dissatisfaction when they were unable to see energy savings from the Express project on their utility bills.

- **Recommendation 11:** Provide customers with more data so they are informed. This could come in the form of a portal where the customer has 24/7 access to more real time data, can ask questions, and review other energy saving opportunities for their business.
- 9. **Finding 9:** During the assessment, the implementation contractor is qualified to identify refrigeration savings opportunities; however, if the customer is interested in installing refrigeration measures, they have to schedule a second onsite with another contractor. The refrigeration project is treated as a separate project from the lighting project.
 - **Recommendation 12:** Streamline the process for the customer by scheduling the refrigeration equipment installer at the same time as the main contractor for obvious refrigeration customers like convenience stores.
- 10. **Finding 10:** The proposal the customer receives does not provide more information on how the owner can save more energy.
 - **Recommendation 13:** The proposal should include information about behavioral changes the customer could make to reduce energy consumption. Additionally, it should include recommendations for other measures to install and possibly receive rebates for through other EE/PDR programs.

Administration and Delivery

- 11. **Finding 11:** The implementation contractor does not track whether a customer owns or leases the building it occupies. The implementer deals with each project on a case-by-case basis.
 - **Recommendation 14:** The implementer should track whether customers own or lease a building. This would allow the implementer to see if there is a difference in participation based on whether a building is owned or leased, to more effectively target and market the program.
- 12. **Finding 12:** The implementation contractor introduced an automated seven step email system that walks customers and contractors through the installation process. The last email sent is when installation is complete.
 - **Recommendation 15:** The implementation contractor could add an eighth email to the customer with next steps to take, for example, to sign up for an online energy portal, or participate in other AEP Ohio EE/PDR program. Additionally, any QA/QC activity conducted by the implementer or the evaluator could trigger an eighth email to the contractor with information regarding the issues identified, along with possible solutions.
- 13. **Finding 13:** The largest business type contributor to savings (40%) is simply listed as “other”.
 - **Recommendation 16:** Revise how the “other” business type is recorded and entered.

Appendix A. FIXED EFFECT REGRESSION MODEL

This Appendix provides a detailed description of the fixed effects regression model used to develop savings from the billing data.

Data Cleaning

The tracking database included 439 projects in 2016, 20 pipeline projects completed in 2017, and 418 pending pipeline projects, for a total of 877 projects. Multiple projects tied to a single premise were combined for the purpose of the regression analysis. Usage data for bill accounts active at the time of participation were combined for all premises tied to a single project.¹⁰

Navigant excluded projects from the analysis if any of the following criteria were met:

1. Navigant combined estimated bills (those with read codes equal to E, EF, ET, H, HF, J, M, MF, and SR) with the following bill with an actual reading. Navigant excluded observations from the analysis if any of the following criteria were met:
2. The account number differed from the account number at the time of participation, indicating the tenant had changed
3. The observation occurred during the period that the work was being done (between the *workbegindate* and *workcompletedate*)
4. The observation corresponded to a bill cycle that ended prior to 2013 or greater than 2017
5. The billing record was a duplicate
6. The bill period was less than 20 days or greater than 75 days in length
7. The billing usage was determined to be an outlier, defined as greater than 100 times the median usage or less than one-hundredth the median usage
8. Observations for pipeline projects after the project work began
9. The regression analysis included usage data from 703 projects
10. Customers who also participated in the Prescriptive, Custom, and/or Self Direct programs in 2016

¹⁰ Usage data was combined by the month and year of the bill read date, due to differences in billing cycles for multiple accounts tied to a single project.

Regression Analysis

Navigant estimated a fixed effects regression model in which pipeline participants, and participants entering the program later in the year, serve as controls for participants that enter earlier in the year. The regression model takes advantage of the differential timing of program enrollment to identify program savings. The model essentially takes the perspective that the best comparison group for participants consists of those customers that enroll in the program in a later period. Use of fixed effects accounts for customer-specific characteristics that do not change over time, such as square footage of the premise.

The evaluation team expects slight seasonal variation of savings due to the interaction effects between lighting and the HVAC system. To account for the seasonality of savings, Navigant included seasonal binary variables. Seasonal binary variables allow energy usage to vary by season without impacting the overall savings estimate. These variables are sufficiently flexible to capture the effects of changes in weather and other factors that change by season, such as extended business hours during a holiday season. Program savings are estimated through the use of a Variation-in-Adoption model, which relies only on program participants to develop the counterfactual.¹¹ In particular, customers who participate in the program at a later date serve as the control group for customers who participate in the program early on.

This model relies on the assumption that, controlling for both customer and monthly fixed effects, neither energy use in month t , nor energy savings s months into the program, is correlated with the timing of program entry. Formally, the regression equation is given by:

Equation A-1. Regression Analysis

$$ADU_{it} = \alpha_i + \beta_s * SeasonYear_{st} + \sum_j \gamma_{j,s} * PostSeasonYear_{j,st} + \epsilon_{it}$$

Where i indicates the premise, t indicates the bill period, s indicates the season-year, j indicates the season, and

ADU_{it}	= Average daily usage (kWh) for premise i in period t
α_i	= The constant term ("fixed effect") for premise i
$SeasonYear_{st}$	= A series of binary variables taking a value of 1 if period t is in season-years. The eight seasons include spring 2015 through winter 2017. Fall 2014 is the baseline season because it is the first complete season of the analysis period.
$PostSeasonYear_{it}$	= A binary variable taking a value of 1 if the measure has been installed at premise i prior to period t for each season during year 2016 and winter 2017. For example, <i>PostSummer2016</i> takes the value 1 if the measure has been installed at premise i prior to period t , otherwise takes the value 0.
ϵ_{it}	= The model error for participant i in period t . Standard errors are clustered to account for heteroskedasticity and autocorrelation at the participant level.
β_s, γ_s	= Model parameters

¹¹ Harding, M. and A. Hsiaw. Goal Setting and Energy Conservation. July 2013. Available at: http://www.stanford.edu/~mch/resources/Harding_Goals.pdf.

Seasons are defined by the following cut-off dates:

Winter	January 1 – March 31
Spring	April 1 – June 30
Summer	July 1 – September 30
Fall	October 31 – December 31

Annual savings for each project are calculated as the estimated realization rate times the annual claimed savings for each project in the Express Program. The estimated realization rate is an output of the regression model, and is denoted as γ_s in the preceding equation.

Parameter estimates are given in Table A-1. As expected, the parameters for variables involving post are negative, and usage decreases after program measures have been installed. T-statistics greater than 1.64 indicate the parameter is statistically significantly different from zero at the 90 percent confidence level. In particular, note the post savings parameter, representing the estimated realization rate, is statistically significant.

Table A-1. Regression Model Parameter Estimates

Coefficient	Estimate	Std. Error	t value	Pr(> t)
winter2015	158.6551	74.9277	2.1174	0.0342
spring2015	165.6064	75.9646	2.1800	0.0293
summer2015	214.7843	75.7283	2.8362	0.0046
fall2015	150.5123	75.4686	1.9944	0.0461
winter2016	146.8123	74.7231	1.9648	0.0495
spring2016	157.7011	74.9786	2.1033	0.0355
summer2016	236.3179	75.3376	3.1368	0.0017
fall2016	147.0462	75.0538	1.9592	0.0501
winter2017	138.6690	74.9488	1.8502	0.0643
post.spring2016	-57.4889	6.3327	-9.0781	0.0000
post.summer2016	-62.2985	9.6403	-6.4623	0.0000
post.fall2016	-58.7486	7.1893	-8.1717	0.0000
post.winter2016	-47.6818	10.2487	-4.6525	0.0000
post.winter2017	-61.8469	9.1179	-6.7830	0.0000

Source: Navigant analysis

Coefficient	Estimate	Std. Error	t value	Pr(> t)
spring2015	165.5758	75.9504	2.1801	0.0293
summer2015	214.7521	75.7135	2.8364	0.0046
fall2015	150.4845	75.4552	1.9944	0.0461
winter2015	158.6204	74.9127	2.1174	0.0342
spring2016	157.6938	74.9704	2.1034	0.0354
summer2016	236.2776	75.3201	3.1370	0.0017
fall2016	146.9687	75.0250	1.9589	0.0501
winter2016	147.4895	74.9073	1.9690	0.0490
winter2017	137.3006	74.5423	1.8419	0.0655
post.winter	-59.0404	8.0008	-7.3793	0.0000
post.spring	-57.6101	6.3221	-9.1125	0.0000
post.summer	-62.3712	9.6128	-6.4883	0.0000
post.fall	-58.5765	7.1585	-8.1828	0.0000

Source: Navigant analysis

Appendix B. PROGRAM STAFF INTERVIEW GUIDE

AEP Ohio Evaluation for the Business Express and Retro-Commissioning Programs 2016 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.

AEP Ohio / Implementation Contractors

1. Has your role changed as RCx and Express Program Manager since we spoke to you in 2015?
2. How would you describe your interaction with the Business Programs Manager, Andy McCabe?
3. With respect to Lime, Nexant, CLEARResult, AEP OH staff and SPs do you think there have been any substantial changes in the roles and people assigned to the RCx and Express programs in the past year?
4. Are you still meeting biweekly with Nexant and Lime? Do you meet with CLEARResult? The Solution Providers?
5. Do the implementation contractors provide you with automated reporting?
6. [Express] Why was the marketing for Express left with Lime and not moved to CLEAR?
7. [RCx] What are the issues with the program tracking data from Nexant?
8. How active are account managers in the programs?

Participants / Customers

9. [Express] Do you know if Lime mined the data you provided them in order to target specific customers? Or are they still operating on a word of mouth basis?
10. [Express] Last year you mentioned a falling close rate for Lime (62% to 55%) because of customers with low hours of use. Have you considered partnering with the gas company? Perhaps offering a shared program would allow for cost effective installation of both gas and electric measures.
11. [Express] Have you seen an increase in refrigeration projects for Express in 2016?
12. [Express] Are you seeing repeat participants?
13. [RCx] Are you doing projects in new regions/with new customers for RCx with the CLEARResult Energy Advisors?
14. [RCx] Last year you said customers have the option of selecting Nexant as the SP if they didn't like the pricing from other RSPs, how does this work? Are multiple RSPs bidding on a single project?

15. [RCx] Do you have a sense how many RCx projects are coming from Self Direct participants?
16. [RCx] Can you walk us through the QA/QC procedures?
17. Are there any regions or segments you think are left behind?
18. Are you concerned a lot of your customers are going to opt-out in 2017?
19. Do you have a sense of how satisfied customers are with various aspects of the program (application process, interaction with implementation contractor or SP, etc.)?
 - a. Are you taking any steps to promote greater participant satisfaction?
 - b. Are you tracking the results from those steps? If so how and what are the results?
20. Do you have an idea how many of your customers could participate in Express and RCx but have not? If so, do you know why they choose not to participate?

Solution Providers

21. What does the application process look like to become a SP?
22. Are SPs generally focused on one program only? Or are they participating in other programs?
23. How often are you in contact with the SPs? What are you hearing from the SPs? And how do they provide feedback? (emails, calls, in person...)
24. Do you have a sense of Solution Providers' overall satisfaction with their participation in the program?
25. Are there ever any issues with any of the SPs? If so, how do you respond?
26. [RCx] Have you compared savings calculations from other sources to the Nexant calculations? Do you think any savings are left on the table? What are the SPs saying?
27. [RCx] Last year you said you now make the SPs stay through the completion of the project by paying 70% up front and the remaining 30% upon completion of the work. Have there been any complaints about this? Have any SPs dropped out? What is the range you pay for a study?

Offerings

28. [RCx] Last year you explained the process as: (1) we identify what's there, (2) then the commitment is made, (3) then the actual study is done. How do you "identify what's there"?
29. [Express] You offer 12 months interest free payment plans, what % of customers take advantage of this offer? Do you think financing is the key barrier to participation? What others? Is this something you would like to offer more widely?
30. Do you think there are measures you should add to either program?
31. Are there certain processes you think could be improved or on the flip side that work really well (e.g., communication, application processing, customer interaction, solution provider education, etc.)?
32. Of course energy savings goals are primary but are there other metrics you are tracking?
33. Are you following any innovative program designs/implementations?

Wrap-up

34. Are there any questions I didn't ask that you think I should have asked? I would love to hear any insights you have that have not come up during the course of our interview.
35. Do you have any questions for me OR things you think Navigant should research?

Appendix C. BUSINESS PROGRAMS MANAGER INTERVIEW GUIDE

AEP Ohio Business Programs Evaluation 2016 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, implementation contractors 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.

Appendix D. IMPLEMENTATION CONTRACTOR INTERVIEW GUIDE

AEP Ohio Evaluation for the Business Express Program 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.

AEP Ohio / Implementation Contractors

1. Has your role changed since we spoke to you in 2015?
2. With respect to AEP OH staff and Contractors do you think there have been any substantial changes in the roles and people assigned to the Express program in the past year?
3. Last year you said you meet with AEP OH face to face every two weeks and communication with Al Kohler is continual. Is that still the case?
4. Last year you said you send AEP OH weekly extracts about program activity, do you still do that? [Can you share?] Is this an extract of projects or a roll up summary or both?
5. Can you share your performance indicators?

Participants / Customers

6. Are you seeing any repeat participants in the program?
7. Are you seeing any benefit from CLEAResult acting as the Energy Advisors? (I know they are not formally contracted for this program but they may pass along leads.)
8. Are there any regions or segments you think are left behind?
9. Do you have a sense of how satisfied customers are with various aspects of the program (time to process incentive, application process, interaction with implementation contractor or SP, etc.)?
 - a. Are you taking any steps to promote greater participant satisfaction?
 - b. Are you tracking the results from those steps? If so how and what are the results?
10. Do you have an idea how many of your customers could participate in the program but have not? If so, do you know why they choose not to participate?
 - a. Do you have plans (or desire) to increase participation? If so, how do you plan to overcome those barriers?
11. Has the marketing changed in 2016?
12. Do you have any (other) program changes planned for 2017 (marketing or otherwise)?

13. Have you looked at the split of small business owners who own their building versus lease or rent? If so, how does this affect participation?

Contractors / Lime Energy Advisors

14. How often are you in contact with the contractors? How many actively participate? How about the energy advisors? How many are there?
15. What are you hearing from the contractors? And how do they provide this feedback? (email, calls, in person) ...
16. Do you have a sense of contractors' overall satisfaction with their participation in the program?
17. Are there ever any issues with any of the contractors? If so, how do you respond?
18. Last year there was talk about AEP OH providing Lime with a list of eligible AEP OH customers and you said you were not sure how much the energy advisors make use of it.
19. Can you provide any insight as to how you assign contractors (you say capacity and geography but what if there is more than one potential match)?
20. Can you talk about your QA/QC process? What % of projects does Lime visit after the Contractor is done? How are projects selected for inspection?
 - a. How often does Lime find a discrepancy which causes the contractor to return?
21. Is Lime also a Contractor? (Name included in list of contractors in tracking data)
22. How frequently do you follow up to schedule an audit and the customer is not responsive?
23. How frequently does a project show greater than 35% energy savings?
24. How frequently do you have change orders?
25. How often will the customer not sign off on a project once it's complete?
26. When Lime QA's the audits, how frequently do the ESRs have to make changes and go back to the customer?

Offerings

27. Have there been any significant changes to the program (delivery, measures, incentives, 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?
28. Do you think there are measures you should add to Express? For example, thermostats (and HVAC) have been left off the table on purpose, do you agree with this? Are the other small business programs Lime manages offering other measures?
29. Are there certain processes you think could be improved or, alternately, that work really well (e.g., communication, application processing, customer interaction, solution provider education, etc.)?
30. Of course energy savings goals are primary but are there other metrics you are tracking?
31. Are you following any innovative program designs/implementations?
32. Have you considered any collaborations with the gas utility? (We know the gas utility has a small budget so this may not be an option)
33. Do you expect to meet the program savings goal in 2016?
34. Can you share an example energy audit? Are other energy savings recommendations made? Or are only lighting and refrigeration (if applicable) reported on? Is the audit printed or emailed?
35. Is the application populated when the Lime auditor is on site? What kinds of application errors do you see? Are the errors frequent?
 - a. Last year you said the Energy Advisor may give an assessment on the spot or if more time is needed for the calculation they return with an estimate. How frequently is the return trip required?
36. Have you had any issues with the financing offering? (i.e., has anyone defaulted, etc.)
37. What % of audits are not cost effective? Is your close rate down or up from last year? Why is that?

38. Do you think there is overlap with your program and the prescriptive program? If so, do you think there are projects which would make more sense going through the Express program?

Recommendations from PY2015 Evaluation Report

39. [Realization Rate Improvements]: from the June 2016 meeting we discussed a number of items around improving the realization rate. One of the items was 'Better confirm high wattage existing measures' ideas included requiring photos and contractor verification. Did you put either of these in place?
- a. Can we schedule a walkthrough of the savings calculator tool?
40. [Contractor Communication Improvements]: A second category discussed was contractor communication improvements.
- a. Enhanced customer and contractor engagement platform: automated 7 step email system that walks customer and contractor through install process (was this implemented in August and can you share?)
 - b. [Contractor has concerns regarding feedback on their own performance]: did you develop structured feedback metrics / performance reviews? Are you planning a contractor breakfast to review best practices, processes, expectations, and address concerns? Did you create/provide them with updated communication information and simple process flow for handling unforeseen issues?
41. [Improve accuracy of SOW]: what training have you had for Energy Service Representatives (ESR)s? Have you improved ESR scoring and evaluation (DI reporting) on as built project?

Wrap-up

I would love to hear any insights you have that have not come up during the course of our interview.

42. Are there any questions I didn't ask that you think I should have asked?
43. Do you have any questions for me OR things you think Navigant should research?

Appendix E. PARTICIPANT INTERVIEW GUIDE

1. How did you first hear about the AEP OH Express program?
2. Have you participated in the AEP OH Express 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 Express 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 Express 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 Express 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 Express 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.

APPENDIX N



RETRO-COMMISSIONING PROGRAM

2016 Evaluation Report

Prepared for:

AEP Ohio



A unit of American Electric Power

May 11, 2017

Submitted by:

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

312.583.5700
navigant.com



Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

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

Submitted by:

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

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

Prepared by:

Emily Cross, Managing Consulting
802.526.5108
emily.cross@navigant.com

Jessica Minor-Baetens, Managing Consultant
734.794.4865
jessica.minor-baetens@navigant.com

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ES. EXECUTIVE SUMMARY

This document presents a summary of the findings and results from the evaluation of the 2016 Retro-commissioning (RCx) Program implemented by AEP Ohio for the program year January 1, 2016 through December 31, 2016.¹ This report is the fourth annual evaluation of the program. Following 2014, AEP Ohio decided to change the implementation contractor. Whereas the 2015 evaluation included a mix of projects from the different implementers, this report summarizes the activities of the first full year of the new implementation contractor following their new program design.

ES.1 Program Summary

Retro-commissioning helps commercial and institutional customers improve the performance and reduce energy consumption of their facilities through the systematic evaluation of *existing* building systems. Through the RCx Program, AEP Ohio offers to pay the entire cost of a retro-commissioning study if the customer commits to implement electric savings measures with a bundled payback period of 18 months. These low- and no-cost measures improve system operations, reduce energy use and demand, and, in many cases, improve occupant comfort. The incentive is service-based where the customer benefits from receiving a fully funded study that identifies inefficiencies in their building operation. The program targets medium to large commercial business customers with a building automation system. The RCx Program aims to streamline the typical retro-commissioning process to facilitate implementation of projects that yield savings. In addition to a program implementation contractor, the program depends on qualified Retro-commissioning Service Providers (RSP), identified and trained by the implementation contractor, to carry out program activities at customer premises.

ES.2 Program Participation

The AEP Ohio RCx Program is two-tiered, based on facility floor area² and on-peak demand. RCx Lite is offered to facilities between 50,000 and 150,000 square feet and minimum peak demand of 150 kW. RCx Standard is offered to facilities larger than 150,000 square feet and minimum peak demand greater than 500 kW. In 2016, the RCx Program had nine projects, of which three were RCx Standard. Table ES-1 provides a summary of 2016 RCx Program reported results.

Table ES-1. 2016 Retro-commissioning Program Reported Projects, Measures, *Ex Ante* Savings¹

Metric	RCx Standard	RCx Lite	<i>Ex Ante</i> Reported
Number of RCx Projects	3	6	9
Number of Measures Implemented	20	25	45
Annual Energy Savings (MWh)	1,034	601	1,634
Peak Demand Savings (MW) ²	0	0.0236	0.0236

Source: Evaluation analysis of AEP Ohio tracking data from February 13, 2017.

¹ Values in the table may not reconcile due to rounding.

¹ 2016 participation is based on final verification reports delivered to participants dated between January 1, 2016 and December 31, 2016.

² Size-based tiers are guidelines. AEP Ohio may assign projects to either program track based on project particulars.

² The program only calculated and reported demand savings for one of nine projects in 2016.

Among the nine projects submitted, there were six unique customers. One school district submitted multiple projects for different schools. Savings from a single hospital project comprised 38 percent of total program savings, and 60 percent of standard program savings. The single project reporting demand savings was a single school project. Five different RSPs conducted studies through the program in 2016, including the program implementer, who acted as an RSP for four of the projects.

ES.3 Data Collection Activities

Table ES-2 provides a summary of data collection activities for the 2016 RCx Program impact and process evaluations. The 2016 impact evaluation utilized interval billing data analysis for three projects with substantial *ex ante* savings relative to baseline annual energy use at the meter.

Table ES-2. Data Collection Activities for 2016 Retro-commissioning Program Evaluation

Data Collection	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis	RCx Program projects approved for payment for 2016	AEP Ohio Tracking Database	-	All	November 2016 to April 2017
In-depth Interviews	AEP Ohio Program Staff	Contact from AEP Ohio	Business Sector Manager and RCx Program Coordinator	2	September 2016 to October 2016
In-depth interview	Implementation Contractor Staff	Contact from Implementer	Program Coordinator	1	October 2016
In-depth Interviews	RCx Program Participants	Tracking Database	Sample of RCx Program Participants	4	December 2016 to March 2017
In-depth Interviews	RCx Program Service Providers	Tracking Database	Sample of Service Providers	4	December 2016
Application File Review	2016 RCx Program Participants	Tracking Database	Certainty Sample ¹	9	December 2016 to April 2017
Follow-up / On-site Verification	Application File Review Sample	Application File Review Sample	Representative sites by building type	3	March - April 2017

Source: Evaluation activities conducted from August 2016 through April 2017.

¹ Review file review methods varied among the projects and were determined based on project-level kWh savings contribution to the program (including Standard or Lite program tiers), representation of building types, representation of RSPs, availability of interval billing data, and size of *ex ante* energy savings relative to baseline building annual energy use.

ES.4 Key Evaluation Findings and Recommendations

ES.4.1 Key Impact Findings and Recommendations

The impact results for the 2016 RCx Program are shown in Table ES-3, including: the *ex ante* savings claimed by the program, the evaluated savings, and the 2016 realization rates. The realization rates for 2016 were 83.7 percent for energy and 93.7 percent for demand savings. In 2016, the program achieved 1,368.5 MWh *ex post* energy savings and 0.02212 MW peak demand savings. Reasons for adjustments to savings estimates were varied, including:

- Hours of use for schedule measures was based on building schedules which did not reflect all equipment
- Actual schedules were found to be different than assumed
- Motor and plant loading and sequencing were not updated to site specific values for the final verification phase RSP calculators submitted
- Unsupported assumptions regarding amount of outside air in baseline and efficient calculator models
- Default equipment efficiencies were not updated to site specific values for the final verification phase RSP calculators submitted
- Inaccurate engineering design inputs, such as ASHRAE design temperatures and typical meteorological year (TMY) data inputs, were found to be for locations far away from the project location

Table

ES-3.

	2016 Program Goals ² (a)	<i>Ex Ante</i> ³ Savings (b)	Evaluated Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Energy Savings (MWh)	7,305	1,634	1,368.5	0.837	19%
Demand Savings (MW) ⁴	1.5	0.0236	0.02212	0.937	1.5%

Savings Estimates for the 2016 Retro-commissioning Program¹

Sources: ¹ Values in the table may not reconcile due to rounding. ² AEP Ohio Volume 1: 2012 to 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011 (data for 2014). ³ Evaluation analysis of AEP Ohio tracking data from February 13, 2017. ⁴ The program only calculated and reported demand savings for one of nine projects in 2016.

The 2016 RCx Program impact evaluation resulted in several key findings and recommendations. While the program will not be recruiting new participants in 2017, all recommendations in this report are written as though the program is continuing, for documentation purposes.

1. **Impact Finding 1:** The 2016 *ex post* energy and demand savings did not achieve Plan Goals. The number of projects finalized in the 2016 calendar year was less than half of the expected twenty-one projects. Additionally, the program only calculated and claimed demand savings for one of nine projects.

- **Impact Recommendation 1a:** Increase program participation by targeting large commercial office buildings and business parks with multiple buildings, which are less complex than hospitals and schools.
 - **Impact Recommendation 1b:** Consider including a multi-year RCx offering, to increase participation and ease timeline issues.
2. **Impact Finding 2:** The tracking database has improved, including tracking of all measures and implementation status.
- **Impact Recommendation 2a:** Continue to maintain the tracking database while closing out pipeline projects in the coming calendar year, for quality control purposes.
 - **Impact Recommendation 2b:** Move the project number to the first column for the project-level tracking database.
3. **Impact Finding 3:** The calculators used were comprehensive in modeling savings, detailed and transparent in their assumptions in describing how each measure saves energy. However, calculations worksheets were not always updated with final site-specific values for key calculation inputs.
- **Impact Recommendation 3:** Require the RSP to perform site-specific updates to the calculators for key inputs such as:
 - a. chiller average efficiency
 - b. fan load factors
 - c. local ASHRAE design temperatures,
 - d. TMY weather data for closest possible location to the project
 - e. actual installed BAS schedules and setpoints
 - f. seasonal schedules where appropriate

While temporary or default values suffice for the investigation phase, and in some cases remain a reasonable value in the verification phase, site-specific values can result in differences in savings larger than a few percent, in aggregate.

4. **Impact Finding 4:** Discrepancies in projects involving outdoor air were responsible for a majority of low realization rate projects.
- **Impact Recommendation 4a:** As mechanical conditioning of outdoor air represents a substantial portion of building energy use, it is essential to validate outdoor air percentage assumptions for both the baseline and efficient case. This could be done by reviewing the latest balancing report, and physically inspecting outdoor air dampers and controls both before and after the project, for all modes of operation. The final verification phase calculator should be updated with verified values by the RSP.
 - **Impact Recommendation 4b:** Where uncertainty still exists in the amount of outdoor air in baseline or efficient cases, be conservative in percent outdoor air estimates with respect to the final calculated savings.
 - **Impact Recommendation 4c:** Consider performing multiple calculations (sensitivity analysis) to quantify the consequences of uncertainty in outdoor air calculations, to aid in determining the impact on total project savings.

- **Impact Recommendation 4d:** While economizers are not expected to save much energy during summer peak hours, there could be a negative impact on summer peak performance if the outdoor air damper was closed all the time in the baseline (cooling system serving shell load only), and is now open during summer hours to satisfy fresh air requirements (cooling system now serves outdoor air load in addition to shell load).
 - **Impact Recommendation 4e:** Use the closest possible TMY weather station data available to ensure outdoor air temperatures are in fact typical on a project specific basis.
5. **Impact Finding 5:** Calculation workbooks were inconsistent in their treatment of summer schedules, both within the same project and across projects. In some cases, this resulted in apparent double counting of savings between measures. In some instances, the RSP manually extracted relevant months from the annual analysis tab, and hard coded summer energy savings into the savings summary. No savings analysis was provided to substantiate summer demand savings claimed by the program.
- **Impact Recommendation 5a:** Treat summer schedules separately in savings calculations by using a separate tab for summer schedules, where the summer schedule of the building is different from the rest of the year, such as for schools and libraries.
 - **Impact Recommendation 5b:** Include demand savings calculations based on the definition for the utility performance period or PJM summer and/or winter performance period, as appropriate.

ES.4.2 Process Evaluation Findings and Recommendations

The 2016 RCx Program process evaluation resulted in several key findings and recommendations. While the program will not be recruiting new participants in 2017, all recommendations in this report are written as though the program is continuing, for documentation purposes.

1. **Process Finding 1:** The program successfully partnered with Columbia Gas.
 - **Process Recommendation 1:** Continue to pursue opportunities for collaboration with the gas utility.
2. **Process Finding 2:** The program did not achieve the *ex ante* goals due to projects being held up for a variety of reasons related to project timeline.
 - **Process Recommendation 2a:** Educate Service Providers to recognize ideal customers who are likely to submit and follow through on successful applications.
 - **Process Recommendation 2b:** Clearly communicate to all participating parties the expectation that the project must complete during the current calendar year.
 - **Process Recommendation 2c:** Make sure all participating contractors are included from the beginning of the project to ensure contractors are more inclined to participate and not hold up the timeline.
 - **Process Recommendation 2d:** Require the contractors to inform the implementer within an agreed upon timeframe if the end of year deadline cannot be met, to allow enough time for the implementer to recruit a replacement project.
3. **Process Finding 3:** Some participants reported to their Service Providers that participating in the training was difficult or not feasible for them.

- a. **Process Recommendations 3:** Provide more flexible or remote training opportunities for program participants. Options include hosting training in multiple locations or offering the training via WebEx.

1. INTRODUCTION

This section covers the Retro-commissioning (RCx) Program element of AEP Ohio's Energy Efficiency and Peak Demand Reduction (EE/PDR) Portfolio. The RCx Program was launched in 2013. Following the 2014 program year, AEP Ohio relaunched the program with a new implementation contractor, Nexant (The Implementer). The 2015 program year was the first year of the under the direction of the implementer, and the 2016 program year marks the first full year of the implementer-run program.

1.1 Program Description

The AEP Ohio RCx Program pays the full cost of retro-commissioning studies for non-residential, non-industrial customers who conduct retro-commissioning studies at their site, with technical assistance from Retro-commissioning Service Providers (RSPs) who are qualified by the implementation contractor in advance, and commit to implementing all feasible measures with a bundled simple payback of 18 months or less. No further implementation incentives are paid to Service Providers or participants. The free study is designed to reduce perceived risk to participants for moderately-expensive energy investigations.

Retro-commissioning is a process that helps commercial and institutional customers improve the performance and reduce energy consumption of their facilities through the systematic evaluation of *pre-existing* building systems. Low- and no-cost measures are identified and implemented to improve system operations, reduce energy use and demand, and, in many cases, improve occupant comfort. Examples include set point or schedule changes that can be managed from a Building Automation System (BAS). Once opportunities are identified by the free study, the RCx Program aims to streamline the typical retro-commissioning process to facilitate the implementation of projects yielding savings with minimal added investment.

The AEP Ohio RCx Program is two-tiered, based on facility floor area and minimum peak demands³. RCx Lite is offered to facilities between 50,000 and 150,000 square feet with peak demand between 150 kW and 500 kW. RCx Standard is offered to facilities with a minimum peak demand greater than 500 kW and larger than 150,000 square feet. The program is managed by a third-party implementation contractor in coordination with AEP Ohio. Program services are delivered by registered RSPs who have been pre-qualified by AEP Ohio and the implementation contractor. Either type of retro-commissioning study is offered to the customer at no cost if the customer commits a certain amount to implementing recommendations from the study. Both tracks also provide verification results to the customer.

1.2 Key Program Elements

The goals of the 2016 RCx Program are to contribute to the energy savings targets in AEP Ohio's EE/PDR Plan at or below the program budget, improve customer satisfaction with the program, and increase outreach to customers. The program is designed to appeal to diverse commercial and institutional customers. The following sections provide a summary of key program elements.

³ Size-based tiers are guidelines. AEP Ohio may assign projects to either program track based on project particulars.

1.2.1 Program Incentives

RCx Program incentives in 2016 are based on the type of project completed. To be eligible for program funding for retro-commissioning studies, RCx Lite and RCx Standard participants must commit to spend money to implement *all* identified measures with paybacks of less than 18 months. Table 1-1 lists the funding limits and customer commitment for projects.

Table 1-1. Incentive Parameters for 2016

Program Track	Study Funding	Customer Commitment
RCx Lite	Up to \$12,000	\$5,000
RCx Standard	Up to \$60,000	\$15,000

1.2.2 Participation Milestones

Participation in the program is designed to streamline the retro-commissioning process, yet ensure adequate savings are implemented. To achieve these competing goals, the program has defined milestones for each project.

Pre-Screening. Pre-Screening is required for all RCx projects to ensure adequate savings potential and customer willingness to implement measures as required by the program.

RCx Study. Customer must have a retro-commissioning investigatory study conducted by an approved AEP Ohio RSP.

Implement Measures. Once the RCx study is complete, the customer selects from optional measure bundles recommended by the RSP, and implements the recommended measures for the bundle selected. To qualify for full funding of the study, all measures with a payback of less than 18 months must be implemented.

Verification. All claimed measures must be documented and are subject to verification by the RSP and implementation contractor prior to the RSP being reimbursed by AEP Ohio for the cost of the RCx Study. Claimed measures may also be verified by the independent evaluator.

1.2.3 Measures and Incentives for 2016

Retro-commissioning measures address a broad spectrum of building operations and energy use. While capital measures may be identified and mentioned in the RCx study, these are not incentivized under the RCx program. Instead, capital measures are ideally channeled to other AEP Ohio EE/PDR programs, or deferred by the customer to be done later. Improved equipment scheduling to better match operation and occupancy, set-point optimization, improved controls, and deferred repairs qualify as eligible measures through the RCx Program. Measures submitted through the RCx Program address many building systems. In 2016, measures typically focused on Heating, Ventilation and Air Conditioning (HVAC) equipment and lighting system controls.

1.2.4 Service Provider Participation

AEP Ohio and the implementation contractor recruited and approved a network of RSPs for the program. Five different RSPs completed projects through the program in 2016, as shown in Table 1-2.

Table 1-2. 2016 Retro-commissioning Service Providers

Service Provider	RCx Standard	RCx Lite	Program Reported
A	-	1	1
B	-	1	1
C	1	3	4
D	1	-	1
E	1	1	2
Total	3	6	9

Source: Evaluation analysis of AEP Ohio tracking data from February 13, 2017.

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 RCx 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.)
3. Are paid incentives accurately calculated and documented, including payment eligibility, limits and caps?
4. What are the benefits and costs and cost effectiveness of this program?

1.3.2 Process Questions

The 2016 program year is the first year all projects were developed by the current implementer.

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 RSPs? Is it sufficient?

3. Is the program outreach to customers effectively increasing awareness of the program opportunities?
4. What is the composition of outreach to customers by AEP Ohio Business energy advisors and RSPs?
5. How often does outreach occur?
6. Are the messages within the outreach clear and actionable?
7. Are there missed opportunities to channel customers into other AEP Ohio programs?
8. Does the program attract RSPs who can successfully market and deliver the program?
9. What can be done to support on-going RSP acquisition?

Program Characteristics and Barriers

10. Is there customer confusion with all of the different groups involved? (i.e., AEP Ohio business outreach staff, the implementer, RSPs)
11. How do RSPs and the implementer energy savings calculations, and documentation, differ?
 - a. Do the differences create confusion?
 - b. Are potential program savings systematically left on the table based on the program calculation methodologies?
 - c. Do program timelines and processes adequately allow for baseline documentation requirements, where new Building Management System (BMS) data points may need to be installed and trended **prior to** measure implementation?
12. How do RSPs perceive the study funding and customer commitment cost?
13. Are funding arrangements adequate to attract qualified RSPs?
14. Does the program structure need to be changed to improve marketability and increase participant uptake?
15. Are there particular program characteristics that could be changed to improve customer satisfaction while maintaining program effectiveness?

Administration and Delivery

16. Do the program processes motivate the RSPs to participate?
 - a. Program tracking and data management
 - b. Internal program communications
 - c. Program staffing
17. Are verification procedures implemented in a manner consistent with program design? Is the implementation contractor meeting the verification goals?

18. Are program procedures documented and followed?

- d. What key operations metrics are monitored and how often are these reviewed and reported by the implementer and by AEP Ohio?
- e. Are the implementer and AEP Ohio quality assurance/quality control (QA/QC) procedures in place and effective?
- f. Are the implementer and RSP project files well-organized and complete?

To answer these process and impact questions, the evaluation included seven main activities:

- (1) desk review of project files and savings estimates
- (2) post-installation follow-up, on-site inspections, and interval billing data analysis for selected sites
- (3) in-depth interviews with AEP Ohio and implementation contractor key program staff
- (4) in-depth interviews with program participants
- (5) in-depth interviews with program Service Providers
- (6) review of tracking data for quality, completeness and process insights
- (7) process review of program documentation

While the program will not be recruiting new participants in 2017, for reporting purposes, the results and recommendations are presented as though the program is continuing. Many of the findings of the evaluation are relevant to successfully and efficiently completing existing pipeline projects developed in 2016.

2. METHODOLOGY

This section describes the methodology used to conduct the impact and process evaluations for the RCx Program. Table 2-1 summarizes the various activities undertaken for the impact and process evaluation.

The evaluation team reviewed program tracking data, which summarizes information on projects implemented through the RCx Program; however, the evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

Navigant reviewed program documents and the technical documents for sampled projects. The impact evaluation team also conducted follow-up with participant personnel in person for three strategically selected projects to confirm project parameters and final operations via spot check power metering, datalogging, trend data analysis, interval billing data analysis, and documentation of building automation system programmed settings.

Primary process evaluation activities included in-depth telephone interviews with AEP Ohio program staff and implementation contractor staff. In-depth telephone interviews were also conducted with program participants. In addition, the process evaluation team reviewed tracking data for completeness, quality and process-related insights. Program documentation such as operations manuals and training materials were also reviewed as part of the process evaluation.

Table 2-1. Summary of RCx 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	Key program operational documents	Process Evaluation
Application Technical Review	Sampled projects	Impact Evaluation
On-site verification and metering / Interval and trend data analysis	Selected projects	Impact Evaluation
Telephone Interviews	AEP Ohio Program Coordinator, implementation contractor program staff, program participants, and RCx Service Providers	Process Evaluation

2.1 Tracking Data Review

2.1.1 Impact Evaluation

The impact evaluation includes review of the tracking data to identify version control or data entry errors in *ex ante* reported savings, by comparing tracking system information with project file savings calculations. Additionally, Navigant used the tracking data review to determine the approach and on site strategy for each impact evaluation file review.

The evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements. The assessment of the tracking data and program activity is discussed in Section 3.2.1.

2.1.2 Process Evaluation

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.

The process evaluation team completed a thorough review of the tracking data and system with impact and process-related questions in mind. The findings and results of this analysis are presented in Section 3.3.4.

2.2 Data Sources Summary

The data collected for evaluation of the 2016 RCx Program was gathered during several activities including:

- In-depth telephone interviews with AEP Ohio and implementer program staff
- In-depth telephone interview with program participants
- In-depth telephone interviews with program Service Providers
- Tracking system data review
- Documentation technical review of a sample of projects
- Process-related document collection and review
- Follow-up and on-site measurement and verification at customer sites for a subset of projects selected from the technical review sample
- Fifteen-minute interval billing data

2.3 Sampling Plan

Samples for the impact and process evaluations targeted all participants and staff in the respective population frames.

Table 2-2 outlines the process sample targets and completes, and the impact sample strategy is described below in section 2.3.1.

Table 2-2. Summary of In-depth Process Interviews

Data Collection Type	Targeted Population	Sample Frame	Sample Target	Sample Size	Timing
In-depth Telephone Interviews	AEP Ohio Program Staff	Key AEP Ohio program staff	Program Coordinator Business Sector and Marketing Manager	2	September - October, 2016
	Implementer Staff	Key Implementer staff	Program Manager	1	October 2016
	RCx Service Providers ¹	2016 RCx Service Providers (n=4) ¹	Sample of RCx Service Providers	4	December 2016
	Program Participants	2016 Program Participants (n=9)	All participants	4	December 2016 – March 2017

¹ The implementer served as a Service Provider for four of the nine projects. The implementation contractor was not interviewed in its role as RSP, therefore the sample frame for Service Providers was four even though there were five active RSPs, including the implementer.

2.3.1 Impact Sample

Navigant targeted a certainty sample of nine projects for the impact evaluation, representing 100 percent of reported program energy savings. Based on International Performance Measurement and Verification Protocol (IPMVP) guidance, Navigant conducted each project evaluation with a level of rigor commensurate with the project contribution to program savings, with additional consideration to tier savings contribution within the Lite and Standard program tiers.

Based on this approach, Navigant completed detailed project reviews for six of the projects representing 87 percent of program energy savings, including three on site verifications representing 57 percent of savings, and billing data analysis representing 30 percent of savings. For the remaining 13 percent of program energy savings, Navigant performed a high-level review of the project files, then applied measure-level realization rates from similar measures evaluated in the detailed evaluations. Navigant considered representativeness by Tier, Measure Type, and RSP when applying similar realization rates. Navigant considers the realization rate representative of the program using this approach.

2.4 Project Documentation and Technical Review

2.4.1 Impact Evaluation

As part of the impact evaluation, Navigant conducted project documentation and technical review on a certainty sample of nine projects. The level of rigor for each project review depended on the contribution of the project to the overall program savings, with additional consideration for project contribution to the Lite or Standard program tier. Additionally, Navigant utilized interval billing data analysis for three projects to develop the evaluated *ex post* savings calculation.

For each selected project, Navigant performed a review of project documentation to assess the engineering methods, parameters and assumptions used to generate the *ex ante* reported savings and estimated incentives. One project, conducted at a hospital, represented 38 percent of program savings, and 60 percent of Standard tier savings. Therefore, this project received a high rigor review, including on site verification, metering, and datalogging, in addition to a comprehensive documentation review.

For each measure in the sampled projects, Navigant estimated *ex post* savings based on the review of project documentation, on site data, and engineering analysis. *Ex post* adjustments to *ex ante* savings were based on building-specific information, interval billing history, BAS trend data, customer-provided mechanical engineering drawings, manufacturer's performance data, and other documentation, to the extent it was judged more representative of the project than *ex ante* inputs or default measure savings assumptions.

Engineering-based energy and demand reduction algorithms were used to compute *ex post* savings, using data sources described in Table 2-1. For *ex post* calculations using pre-post interval billing data analysis, the above reasons likely represent the major reasons for savings adjustments, based on Navigant's review of the associated *ex ante* calculators.

2.4.2 Process Evaluation

From a process perspective, 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 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. Because 2016 was the second year for the current implementation contractor, program documentation was reviewed for any changes made for the 2016 program year.

The process evaluation team acquired all new or revised documentation for the RCx Program from the implementation contractor. The evaluation team reviewed this material for changes from the previous program year and to compare against observed current practice in the program. Findings and results of the program documentation analysis are provided in Section 3.3.5.

2.5 On-site and Follow-up Data Collection

Participation in the 2016 program totaled nine sites. Navigant sampled all nine sites for the impact evaluation, and from among these, conducted on-site verification for three projects, selected based on contribution to the overall program savings, and for representativeness across building types and RSPs. Navigant developed annual energy and demand savings impacts based on site verified data, supplemental information from on-site personnel, BAS trend data, interval billing data, and application information.

For projects utilizing interval billing data analysis, Navigant reviewed *ex ante* calculators to help explain the reason for discrepancies in *ex ante* calculations, such proximity of the typical weather data station to the actual project location, and the amount of outdoor air assumed in calculators for both the baseline and efficient cases.

2.6 Process Interviews

2.6.1 In-depth Program Staff Interviews

In-depth interviews were conducted with AEP Ohio and the implementation contractor key staff. 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 were addressed during 2016. These interviews were conducted between September and October, 2016, by the Navigant process evaluation lead, and were recorded and transcribed verbatim for reference. The interview guides used for these interviews are included in Appendix A.1 through A.3. Detailed findings from these interviews are found in Section 3.3.1.

2.6.2 RCx Service Provider Interviews

Between December 2016 and March, 2017 the evaluation team conducted in-depth telephone interviews with four RCx Program RSPs. The evaluation team recorded the interviews and transcribed them verbatim for reference. The team developed guides which highlighted key issues, particularly questions raised in prior evaluations. The interview guide used for these interviews is included in Appendix A.4. Detailed findings from this participant survey are provided in Section 3.3.2.

2.6.3 Participant Interview

The evaluation team conducted an in-depth survey with four participating customers to answer key process questions. All seven program participants from 2016 were invited to participate. In an effort to increase survey completion rates, Navigant contacted participants as soon as the project was deemed complete by the implementer. This tactic was successful, as the number of survey completes increased from 25 percent in 2015 to over 50 percent in 2016. The evaluation team recorded the interviews and transcribed verbatim for reference. Interview guides were developed to be open-ended and allow for a free-flowing discussion between interviewer and respondent, and real time interviewing flexibility. The team developed guides which highlighted key issues, particularly questions raised in the 2015 evaluation. The interview guide used for these interviews is included in Appendix A.5. Detailed findings from this participant survey are provided in Section 3.3.3.

3. DETAILED EVALUATION FINDINGS

This section presents the detailed findings from the 2016 RCx 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 tracking data delivered by AEP Ohio on February 13, 2017. As shown in Table 3-1, the 2016 RCx Program paid incentives on nine projects constituting 1,634 MWh of *ex ante* reported annual energy savings. As expected, the RCx Lite projects claim less savings on average than RCx Standard projects. The structure of the RCx Lite deliverable is very streamlined to reduce the engineering cost of retro-commissioning.

Table 3-1. 2016 Retro-commissioning Program Projects, Measures, and *Ex Ante* Savings¹

Metric	RCx Standard	RCx Lite	<i>Ex Ante</i> Reported
Number of Projects	3	6	9
Number of Measures	20	25	45
Annual Energy Savings (MWh)	1,034	601	1,634
Peak Demand Savings (MW)	0	0.0236	0.0236

Source: Evaluation analysis of AEP Ohio tracking data from February 13, 2017.

¹ Values in the table may not reconcile due to rounding.

Table 3-2 and Figure 3-1 provide a profile of 2016 RCx Program participation at the market segment level. Among 2016 RCx Program participants, there were two participating school districts which submitted a combined five projects, and two hospital/healthcare facilities. There are no commercial office buildings, government office buildings, or universities, which typically are mainstays of retro-commissioning programs.

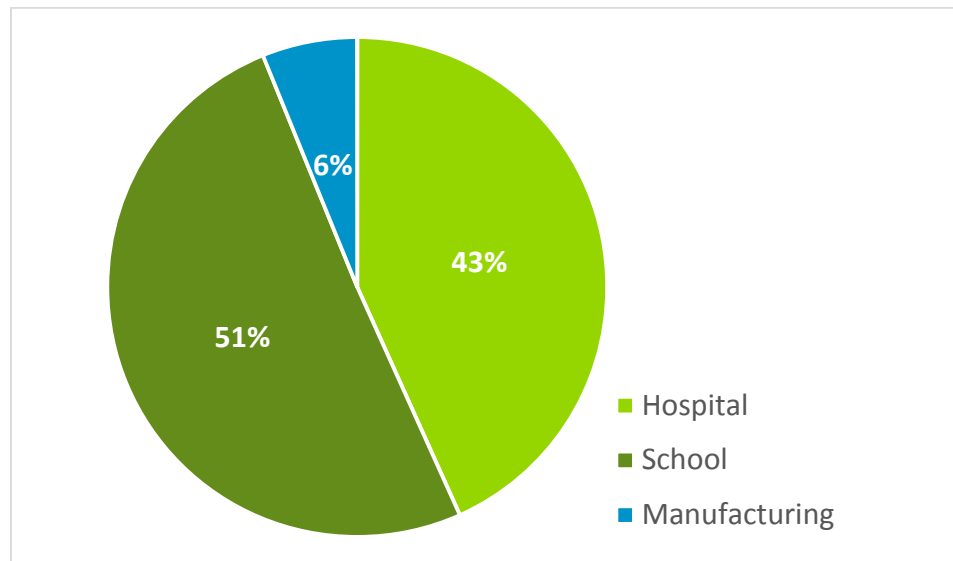
Table 3-2. 2016 Retro-commissioning Program Participation by Business Type¹

Business Type	Project Count		<i>Ex Ante</i> Reported Energy Savings (MWh)		<i>Ex Ante</i> Reported Demand Savings (MW)	
Hospital	2	22%	707	43%	0	0%
School (K-12, Library)	6	67%	827	51%	0.0236	100%
Manufacturing (Office)	1	11%	101	6%	0	0%
Total	9	100%	1,634	100%	0.0236	100%

Source: Evaluation analysis of tracking data from AEP Ohio database exports from February 13, 2017.

¹ Values in the table may not reconcile due to rounding.

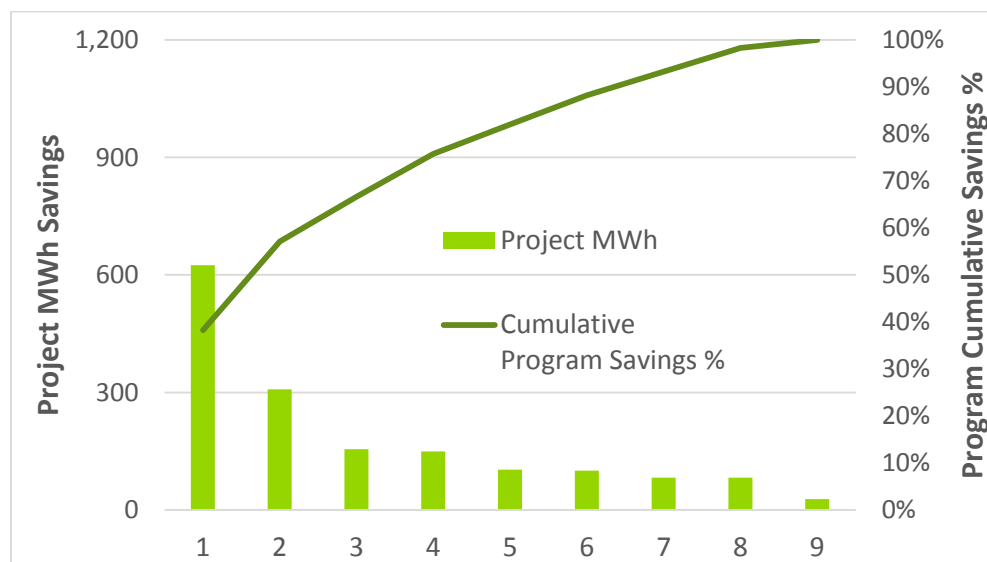
Figure 3-1. 2016 Retro-commissioning Program *Ex Ante* Energy Savings by Market Segment



Source: Evaluation analysis of tracking data from AEP Ohio database exports, February 13, 2017.

Figure 3-2 shows that only two projects (twenty-two percent) account for 57 percent of program savings, and four projects account for 76 percent of program savings. The largest project is the RCx Standard hospital project.

Figure 3-2. 2016 Distribution of Savings by Project

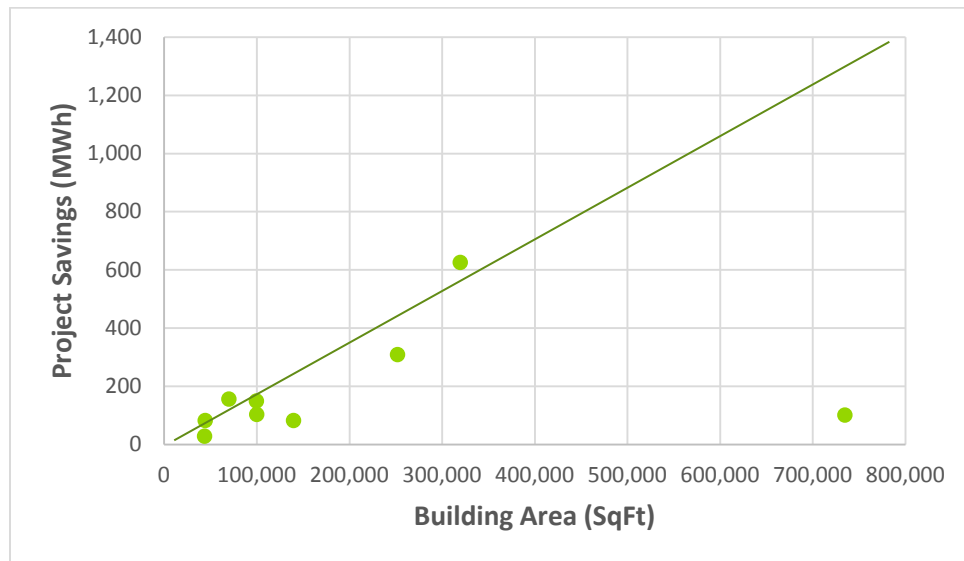


Source: Evaluation analysis of tracking data from AEP Ohio database exports from February 13, 2017.

Figure 3-3 plots *ex ante* MWh savings relative to building size. The figure shows most projects had less than 200,000 square feet of floor area. There is some correlation between savings and building footprint. The one outlier likely is due to some portions of the reported building square footage being out of scope

of the RCx project. The line on the figure depicts savings equal to one MWh per square foot, which is a useful benchmark for retro-commissioning projects. Points above the line indicate greater savings per square foot, with those below less savings per square foot.

Figure 3-3. RCx Savings and Building Size (SqFt)



3.2 Impact Evaluation Results

This section presents the results of the impact evaluation of the 2016 RCx Program.

3.2.1 Tracking System and Program Documentation Review

3.2.1.1 Tracking System

In early February 2017, the RCx Program evaluation team received project-level and measure-level tracking data exports from the AEP Ohio tracking database. AEP Ohio provided data in Excel spreadsheet format. The database extract spreadsheet includes 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.

For the most part Navigant found the data tracking system adequate. Navigant observed opportunities for clarification of column names. Key data for project contacts and milestone dates are complete. Savings in the table of measures accurately reflects the project totals in the project table. In some cases, Navigant found the customer financial commitment in the tracking database was below the application eligibility requirements, while in some instances the RSP study cost was above the eligibility cap stated in the 2016 RCx program application. While adequate for evaluation purposes, the evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

3.2.1.2 Project and Program Documentation

To support the engineering review, AEP Ohio provided project documentation in electronic format for each project. Documentation included scans of invoices, measure specification sheets and the application and files for the calculation spreadsheets (or scans), as well as verification reports.

Documentation in the RSP calculators was complete, comprehensive, and transparent, for all measures and all RSPs for both Lite and Standard program tracks, including measure descriptions and assumptions. However, files were inconsistent regarding meaningful filenames, which did not always include project name and number, and did not consistently have summary tabs in calculation files which clearly map to customer measure bundle final selections. Additionally, conventions such as rounding savings estimates to a round number were inconsistent among the different RSPs.

Where present, invoices supporting customer financial commitment generally did not match the tracking database. There was no supporting documentation in the project file to support RSP study costs covered by AEP Ohio.

3.2.2 Program Impact Results

RCx program realization rates for energy and demand savings were calculated as the total *ex post* evaluated savings divided by the total *ex ante* reported savings, for nine projects.

The realization rate is 83.7 percent for energy savings, and 93.7 percent for demand reduction. Reasons for changes to *ex ante* reported savings include the following:

- (1) **Hours of use for schedule measures was based on building schedules which did not reflect all equipment.** For one project, review of trend data revealed that the actual schedules for pump and chiller equipment was different from the air handler schedules. The efficient case air handler schedules followed the building schedule, however the efficient case hours of use for supporting equipment, such as pumps and chillers, are generally half an hour longer each day, decreasing savings for pump and chiller measures, compared with a 24-hour baseline schedule for all equipment.
- (2) **Actual schedules were found to be different than assumed.** For some projects, Navigant found programmed schedules and setpoints in the BAS were different than the final verification calculators submitted by the RSP. Some school project measures did not account for a reduced summer schedule. For one project, slightly different setpoints found in BAS trend data resulted in increased savings, whereas for other measures, this type of discrepancy decreased savings compared with *ex ante* estimates.
- (3) **Motor and plant loading and sequencing were not updated to site specific values for the final verification phase RSP calculators submitted.** For some projects, fan motor loads verified by Navigant using live, on site power meter spot checks, were lower, in general, than the assumed investigation phase load factor values in the RSP calculators. Similarly, the chiller plant load appears to have been greatly overestimated in the RSP calculator for the hospital project, compared to the trended values obtained by Navigant for the evaluation. Lower actual motor and plant loading impacted the operational demand of the equipment, in general reducing savings.

- (4) **Unsupported assumptions regarding amount of outside air in baseline and efficient calculator models.** Using interval billing data analysis, Navigant found a correlation between low evaluated savings projects, and projects where a substantial portion of project savings were claimed for outside air measures. For projects with measures which involved either reducing the amount of outside air, or repairing economizers, the percent of outside air does not appear to have been validated accurately by the RSP. Upon review of the submitted calculators, apparent reasons for the correlation between low measured savings, and low realization rates, include 100 percent outside air assumed in the baseline, where this may not be the case, and a flat assumed percent airflow in the efficient case. Outside air percentages do not appear to have been verified by the RSP after implementation. Further, the location the RSP assumed for the typical meteorological year (TMY) weather data was in some cases very different than the actual project location, which would have an impact on the calculated cooling energy in the calculators, impacting savings.
- (5) **Default equipment efficiencies were not updated to site specific values for the final verification phase RSP calculators submitted.** For example, for one project involving chiller energy savings, the average chiller efficiency in kW/ton used in most of the RSP calculations was higher than the site-specific chiller efficiency provided by the RSP in their other measure tabs for the same project. The part load efficiency range provided by the RSP was project-specific manufacturer's data. Since the default verification-phase kW/Ton value in the RSP calculator was higher than the actual average chiller efficiency from the manufacturer (which is in line with what Navigant expected for a chiller of that vintage), the Navigant evaluated savings for measures using chiller kW/ton as a key input, were lower than the *ex ante* value.
- (6) **Inaccurate engineering design inputs, such as ASHRAE design temperatures and typical meteorological year (TMY) data inputs, were found to be for locations far away from the project location.** For some projects, Navigant found that the ASHRAE design temperatures used, and the typical meteorological year (TMY) weather data used were for locations far away from the project location. This had an impact on savings for all measures that used weather and design temperature as key inputs to measure savings calculations.

Engineering-based energy and demand reduction algorithms were used to compute *ex post* savings. For *ex post* calculations using pre-post interval billing data analysis, a combination of the above reasons likely represents the major reasons for savings adjustments, based on Navigant's review of the associated *ex ante* calculators.

Navigant estimated the *ex post* program impacts resulting from the 2016 RCx Program, as shown in Table 3-3. Project-level MWh realization rates ranged from 0.08 to 1.30.

Table 3-3. Savings Estimates for 2016 Retro-commissioning Program¹

	2016 Program Goals ² (a)	<i>Ex Ante</i> ³ Savings (b)	<i>Ex Post</i> Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goals = (c) / (a)
Energy Savings (MWh)	7,305	1,634	1,368.5	0.837	19%
Demand Savings (MW)	1.5	0.0236	0.02212	0.937	1.5%

Sources: 1 Values in the table may not reconcile due to rounding. 2 AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011 (2014 data). 3 Evaluation analysis of AEP Ohio tracking data from February 13, 2017.

The RCx Program did not achieve the 2016 goals of 7,305 MWh energy savings and 1.495 MW of demand savings. Goal non-attainment is attributed to low participation.

3.3 Process Findings

The process evaluation findings are organized by Program Staff, RSPs, and Participants, followed by a discussion of the tracking system, and program documentation reviews.

3.3.1 AEP Ohio and Implementation Contractor Program Staff

During September and October of 2016, the Navigant evaluation team conducted in-depth telephone interviews with AEP Ohio's RCx Program Coordinator and Business Sector Manager, as well as the implementation contractor's RCx Program Manager (jointly referred to in this section as "program managers").

Missing goal. When interviewed, the program manager expected to significantly miss the program savings goals. He reported the main cause as not having the "proper carrot/stick to keep the RSPs and customers on schedule". He further clarified not all the Service Providers and/or customers are the causes; and that there were some on-time RSPs and customers. The program manager attributed some of the delays to the significant learning curve of the program requirements versus previous years. The implementer targets two to three months from application acceptance date to delivery of the investigation report, but some have taken over six months. The program manager knows some have experienced slower than expected progress in the investigation stage by the Service Providers. The implementer responded by working more closely with the RSPs. The implementer has a project coordinator assigned to each project so it could increase communication and provide more oversight. The most challenging aspect reported by the program manager is determining what it can do to motivate customers and RSPs to keep them on the intended schedule.

Customer type. According to the program managers, office space is a very good candidate to receive RCx services, whereas most participants have been schools and hospitals. Serving these two customer groups has exhausted the budget, and there has not been room to expand to other building types. Office space is part of the untapped market that the program manager believes would fit well with RCx.

Training. The implementer worked with the Midwest Energy Efficiency Alliance (MEEA), which is responsible for scheduling building operator certification (BOC) training, an eight-week course which meets one day per week. The training was held in Columbus, Ohio in 2016. To encourage persistence of measures, the goal is to further educate participating staff. Customers who sign up to participate in the RCx program are required to send someone to BOC training (the cost is covered by the RCx Program). MEEA set up meetings specifically for the AEP Ohio RCx program. According to the program manager, there is high interest in the training and the participants think it is a valuable benefit of participation. If the participant is interested in sending multiple people to the MEEA BOC training, it is directed to send additional staff to an alternative AEP Ohio training.

Qualified projects. The implementer reported situations where a project is too risky to qualify for the program. Reasons the project would not qualify for the program include: the customer is already operating at a 95 ENERGY STAR® rating, the Service Provider is unable to identify many operational type improvements, or the customer is already planning on making controls upgrades.

In this last example, the customer can participate in the RCx program, but only after updating controls. The first year using this implementer, six out of 22 projects did not qualify. This year, only two or three did not qualify. Another issue affecting project qualification is educating Service Providers to recognize ideal customers who are likely to submit successful applications. Applicants that come through the business program outreach contractor have the benefit of meeting with a knowledgeable contact about the planned measures before embarking on the application process.

RCx Service Providers (RSPs). If a customer highly values a contractor who is not a current program RSP, the implementer will assess the contractor and determine whether it is qualified to participate in the program. In 2016, one particular contractor was requested twice. The implementer contracted with the RSP, however this ended up increasing the contracting and communication time.

The program manager also talked about RSP performance scoring. The implementer tracked and gathered RSP performance metrics in 2016, but will not report the results until 2017. Items tracked include quality of deliverables, on time reporting, and activity in the program.

Partnership. RCx Service Providers are contracted for an electric-only RCx study, so the agreed to cost only includes assessment of electric savings. The implementer includes a disclaimer saying it has not verified gas savings claims, however, it is acceptable if an RSP does so in the course of the project. Gas savings reported by the RSP is currently above and beyond the RSP statement of work with the implementer.

In response to a 2015 recommendation to explore gas savings opportunities, AEP Ohio partnered with Columbia Gas on a 2016 project. AEP Ohio paid for the study and contracted with the RSP to increase the scope and look for gas savings in addition to electric savings. Columbia Gas provided payment for measures related to gas savings to offset the cost of the study. The program manager reported the project is going well and suggested another collaboration effort could happen with the gas utility in the future. However, the Columbia Gas program is voluntary and the budget is very small, which is a challenge to continued and consistent collaboration. There might be a few unique circumstances where the utilities can partner.

The program manager estimates a 15 percent increase in assessment costs with the inclusion of gas measures. He reported this is not necessarily reflective on the added gas savings, as there are some efficiencies especially if the measure is eliminating simultaneous heating and cooling, for example. For the RCx Lite program there are calculators which already have the gas calculations available, but these are not included in the standard AEP Ohio tool. RCx Lite would therefore be the most efficient program tier to cost-effectively partner with Columbia Gas.

3.3.2 Retro-commissioning Service Provider

During the 2016 process evaluation, the evaluation team conducted interviews with four participating RCx Service Providers who completed a project.

Schedule. All the RCx Service Providers reported staying on schedule as one of their main concerns. They reported the customer's inability to get the contractors onsite or the customer's change in personnel as reasons for schedule delays. The implementation contractor has a schedule which the Service Providers found beneficial. However, one of the Service Providers reported that it seems like every project is different and something tends to come up during the course of the project to alter the schedule.

For example, the controls contractors are working directly for the customer, not the RSP. Another Service Provider discussed the lack of cooperation from the customer's control contractor. He said there are several layers of communication when you are working with management firms and contractors. The customer was very supportive of the project, but the controls contractor would not show up for meetings. One of the Service Providers found implementation issues and the contractor had to go back and correct the issues, which caused a significant delay to the verification portion of the project.

Paperwork. Program paperwork begins with the investigation stage. A Service Provider reported there is a large investment up front even before you know whether you have an approved project. This phase includes vetting a project for compliance with program rules, which entails filling out approximately 15 pages of questions. One of the Service Providers said it helps the customer fill out some of the paperwork to keep the process moving forward, and may refer to HVAC contractors to answer some of the questions, who may not be willing to make themselves readily available. All the Service Providers reported the application process, including the template, was more tedious than it needs to be. One Service Provider said, "for instance a typical application for us took 60 hours on a standard job. There's a lot of work and background that goes into just completing the application." One Service Provider estimated it spends four or five times longer preparing the report than for a typical RCx study outside of the program, that has largely the same information. Others reported they could have completed the report with 50 to 60 percent the effort, but the implementers QA process was very rigorous.

One Service Provider said it had to scale back what they would do on a normal RCx project to fit into the program. This puts the Service Provider in a tough spot, as the customer is likely missing out on recommendations the Service Provider would do for the same amount of money, if the customer paid the RSP directly. The RSP caveated statements by reporting it still believes the AEP Ohio RCx program is still of good value to the customer.

Another area of concern for one Service Provider was acquiring quotes for the work and reported when the customer is working exclusively with a particular mechanical contractor, sometimes the contractor does not want to cooperate with the Service Provider.

Savings Calculators. Service Providers recommended the savings calculators could be improved by including the ability to make assumptions with fewer inputs for quicker, streamlined calculations. The same Service Provider reported someone knows all the information necessary to put into the calculator, but has to go to several people, which is time consuming. Additionally, the requirement for using the standard calculators and not allowing Service Providers to use their own engineering calculations was frustrating to some. One Service Provider reported having significant technical disagreements with some of the standard calculators and not having the ability to make adjustments.

Offerings. Service Providers continued to report the RCx program as a little confining. They uncover energy saving measures they would like to include in the report, but these are too costly or beyond the scope of RCx. Other Service Providers said they end up feeling they are forcing some things to make sure the customer complies with RCx when their time and funds would be better spent on other things. However, since the customer is already committed to spend a certain amount, it moves forward with the project. For example, a customer wanted to alter services and utilize a chilled water loop in more than one way, but because there was so much piping cost, it was beyond the RCx Program. Another Service Provider said the biggest issue is working within the RCx Program measure list and said the study may uncover bigger and better measures, but the customer has to do certain things to check the box for the program.

Incentive structure. Two Service Providers thought AEP Ohio paying for the study in full was generally a good structure. However, both suggested moving away from a dollar spend threshold for the customer to an incentive structure where the customer pays for a percentage of the study and then is qualified to receive incentives for measures the customer elects to install. Both Service Providers thought customers like to receive the “backside” rebates and that customers may feel like they are not getting what they paid for. The implementer does a good job of trying to explain the payment requirements up front, but some customers are disappointed at the final incentive.

Training. Service Providers reported some participants had a hard time with the class they were encouraged to attend. Because of where the client is located, driving hours for a class on a weekly basis was not feasible. Recommendations include making the class a single three-day commitment rather than a recurring class over a period of eight weeks.

3.3.3 Participants

The Navigant evaluation team conducted four in-depth interviews of the 2016 program participants.

Satisfaction. Participants reported very high satisfaction with the program and high satisfaction with AEP Ohio. One participant said the most difficult part of participating was the transition of its staff, as this person relies on staff expertise. Another participant said the process was easy because it did not have to do the evaluation and did not have to come up with the ideas, it just had to select which items to do. One hospital site reported the recommendations were sometimes tough to implement as the site is open 24/7 and serves critical areas.

Marketing. One participant reported finding out about the program from its board and recommended promoting the program through trade associations. Another participant reported it would not have known about the program had the Service Provider not told them. In this instance, the program is working as designed, the savings are directly attributable to program outreach and activities.

Report. One participant recalled the report including recommendations to replace equipment because some of it was at end of life. However, the participant did not move forward with these recommendations and, “[doesn’t] want to replace something just because it’s end of life. [They] would rather limp along and if it totally fails [they] have the money to replace it. [They] don’t want to spend the money any sooner than [they] have to.” The same customer did report seeing cost savings on the electric bill from the scheduling changes made to the building, and said it received fewer complaints from building staff about temperature controls.

A participant from the school category thought the RCx program was a good entry point to the AEP Ohio EE/PDR offerings and looked at the program as a way to improve what was already there and then it could move on and replace other equipment. This customer recalls the report included equipment replacement recommendations, but at the time it did not make sense for them to pursue those measures. The same customer reported, “One of the main benefits is the study, it shows there are savings and that we are fiscally responsible to tax payers. We knew we would save money but to have AEP [Ohio] come in and show us the numbers and have the other company walk through it and make sure they knew what we were trying to do made it much easier to sell to the board...”

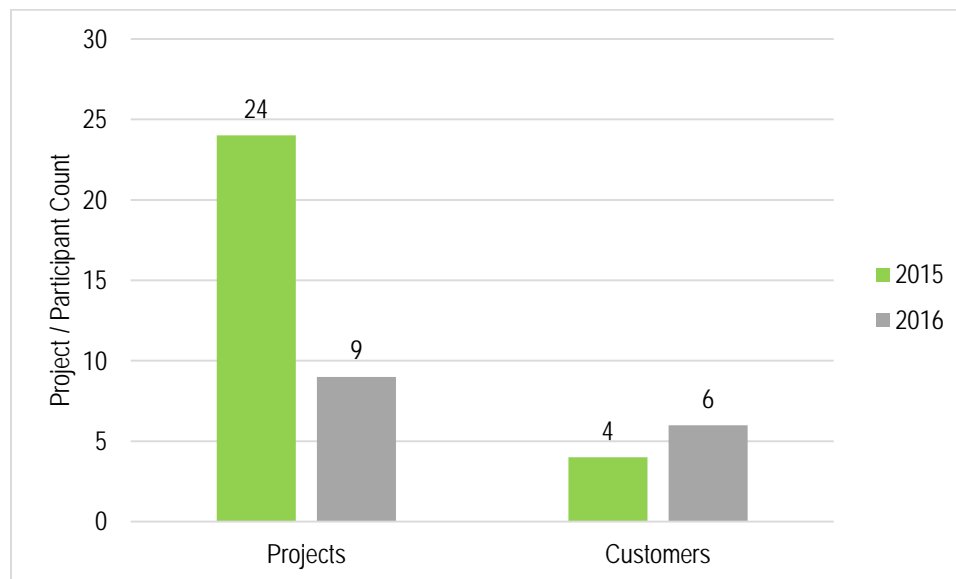
3.3.4 Findings from the Tracking Data Review

The evaluation team reviewed the RCx Program tracking data to answer process-related research questions. Sections 3.3.4.1 through 3.3.4.2 present findings from the tracking data analysis.

3.3.4.1 Participation Characteristics

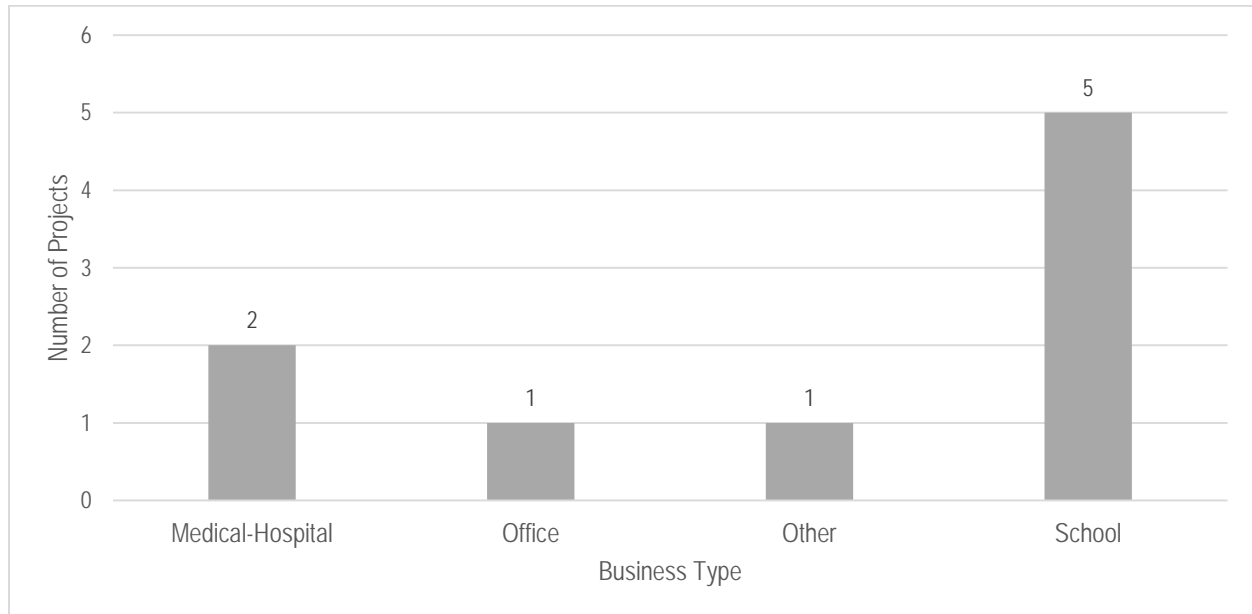
Tracking data analysis reveals while the number of projects dropped by more than half between 2015 and 2016, the number of participants increased, as shown in Figure 3-4. During 2015, four participants completed 24 projects through the RCx Program. By comparison, the 2016 RCx Program was more consolidated. In 2016, six participants completed nine projects.

Figure 3-4. Participation Changes, 2015 vs. 2016



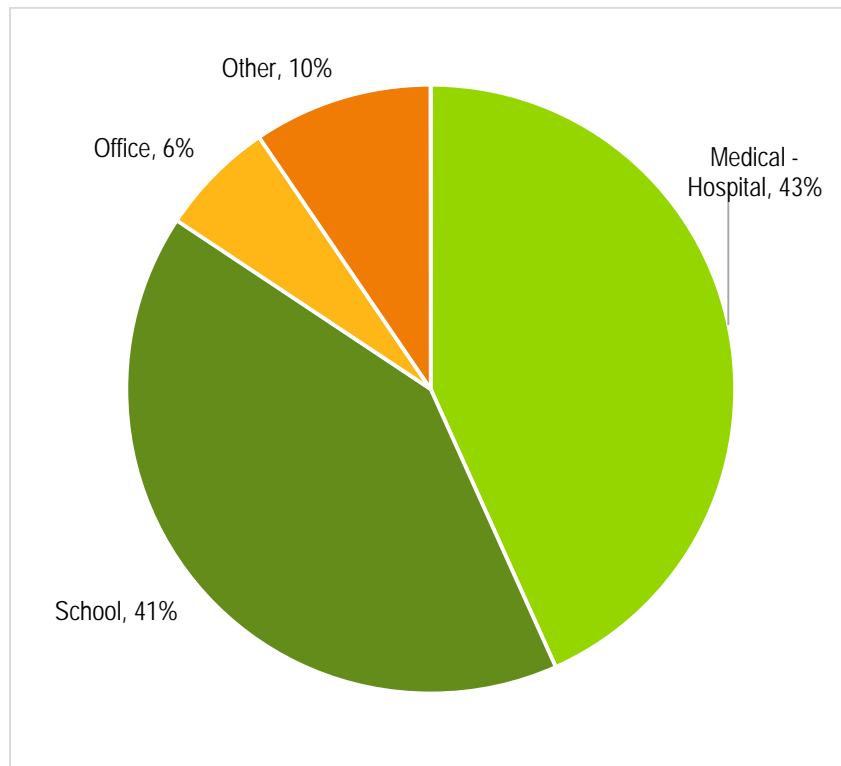
The mix of business types participating in the RCx Program changed dramatically between 2015 and 2016, however, due to the small sample size in the program, this is not surprising. With six unique participants in 2016 and four in 2015, changes in sector composition year-upon-year are likely to be large. In 2016, the majority of projects were completed in schools (five projects), followed by medical/hospital facilities (two projects), office/manufacturing (one project) and “other (Library)” (one project), as shown in Figure 3-5.

Figure 3-5. Projects by Business Type, 2016



In 2016, the bulk of savings were generated by medical/hospital projects (43 percent), closely followed by schools (41 percent). Although there were five school projects and two medical/hospital project in 2016, medical/hospital projects contributed more to per project to total savings than schools, as shown in Figure 3-6. The 'Other' project was a Library characterized as School in one of the tracking databases, bringing the total School/Educational savings up to 51 percent.

Figure 3-6. Building Type Contribution to Total Savings, 2016



3.3.4.2 Measures and Measure Types

Retro-commissioning is a holistic process that considers all energy systems in order to reduce energy costs, return systems to functionality and improve occupant comfort. Figure 3-7 shows all the savings comes from the two predominant measure types – scheduling and optimization.

Figure 3-7. Measure Count and Savings by Measure Type, 2016

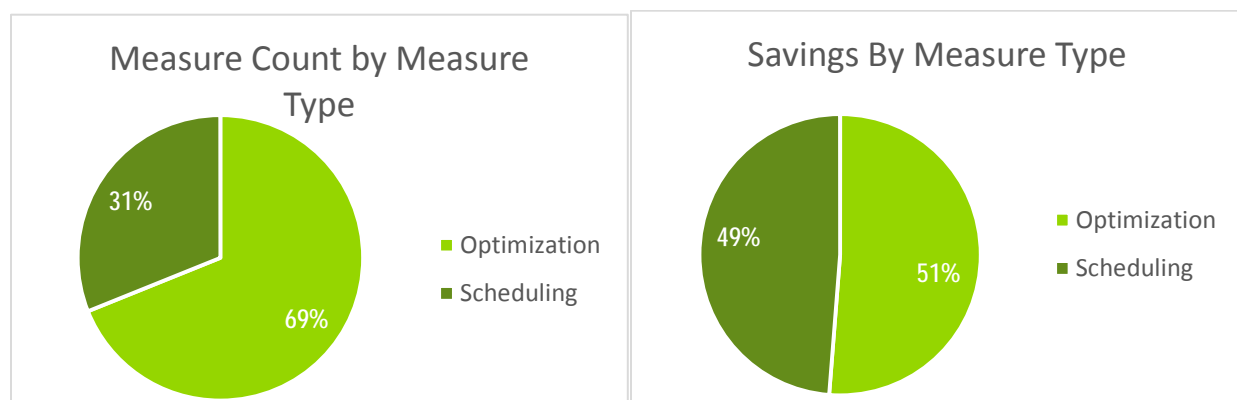
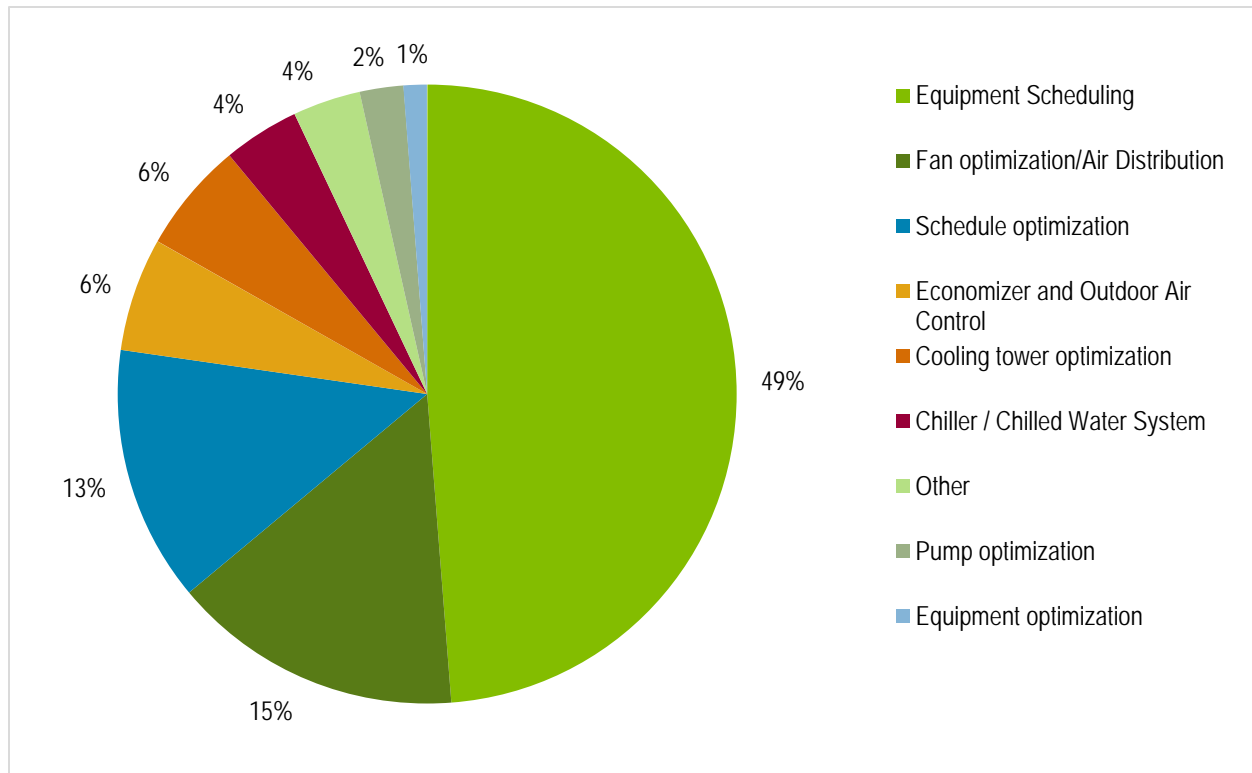


Figure 3-8 demonstrates there is a well-rounded mix of end-uses addressed, indicating the preferred, holistic approach to retro-commissioning.

Figure 3-8. Percent Savings by End-Use, 2016



3.3.5 Program Documentation Review

Thorough and up-to-date program documentation materials are an essential part of a smooth-functioning program. Clear and comprehensive program documents ensure program and implementer staff and RSPs are all working from the same common set of assumptions, and know where to find needed information. Effective program documentation improves the quality of work and program cost-effectiveness by helping ensure all parties are following effective and efficient protocols and procedures.

The Service Provider Program Manual provided to and reviewed by Navigant in 2015, was not changed in 2016 and therefore, was not reviewed again. A summary description of the document follows. The process evaluation team reviewed the following additional documents provided by the implementation contractor:

- AEP Ohio RCx Fact Sheet
- RCx Diagnostic and Calculation (D&C) Plan
- RCx Lite and Standard Program Calculations and MV Guidelines v1.1
- RCx Investigation Report Template v2

A new document introduced in 2016 was the **AEP Ohio RCx Fact Sheet**. This is a one page fact sheet for the RSP to use when marketing the program. There is an opportunity for the RSP to include its logo on the sheet, fulfilling the request for a cobranded fact sheet. In 2016, one Service Provider interviewed used the fact sheet.

The RCx D&C (Diagnostic and Calculation) Plan is designed for the implementation contractor to use in assessing projects, and also maps out the plan for verification by the RSP. The design of the plan successfully provides the RSP an opportunity to think about how measurement for each recommendation will be done before and after implementation, resulting in rigorous quality control.

The AEP Ohio RCx Calculator provided by the implementation contractor for use by all contractors in the program provides uniformity of calculations throughout the program and plays a key role in quality control. The implementation contractor communicated to the evaluation team that it leveraged its real-world experience with other utility programs to design the best possible tool for use with AEP Ohio's program.

The Calculator contains a detailed "instructions for use" and a "notes" documentation section, which helps to ensure the tool is used correctly, and measure savings calculations are transparent. In 2016, the implementer realized the calculators required more time than expected to learn. In response to this issue, the implementer created newer, simpler calculators to roll out in time for the January 2017 training. The implementer said it also will be less flexible in trying to revise the calculator to fit measures for which the calculator was not designed.

The Measurement and Verification Methods and Guidelines documents provide thorough guidance to contractors on specific methods and calculation approaches to be used by contractors on all projects to ensure standardized, best-practice methods are used. This document is an excellent reference which provides clear and accessible information contractors can use to ensure they are meeting program quality expectations. Separate versions of the document are provided for the Lite and Standard program tracks, which ensures contractors have clear guidance for the program version in which they participate. By providing explicit and thorough guidance, these documents help to set expectations at the start of new projects and facilitate high quality work throughout.

The Investigation Report template is required for the standard program (only the Customer Selection Form is required for the Lite program to help cut costs). This template helps the customer visualize different scenarios, encourages it to take on more than the minimum commitment, provides additional expertise by the Service Provider to recommend what it would do if it were operating the building (bundle #2).

The Program Manual is comprehensive and covers key aspects of program design and implementation, including customer communications, differentiation between Lite and Standard programs, expectations and guidelines for contractor performance, guidelines on qualifying measures, and project phases and timelines. For example, the Program Manual provides contractors with specific guidance on allowable project duration, and consequences for not meeting these guidelines.

The manual specifies all projects are assigned a "Required Implementation Date", Standard projects are not to exceed 120 days, and Lite projects are not to exceed 60 days, and clarifies the program will not pay for the study if the work is not completed by the Required Implementation Date. The Manual also clearly communicates to contractors how its performance in the program will be monitored and assessed.

The Manual contains a transparent description of the annual RSP scoring process relative to program expectations and other RSPs. Key RSP performance indicators include the number of projects completed, the quality of deliverables, the value of projects, and customer satisfaction. Explicitly stating expectations and performance criteria up front helps contractors perform well in the program, and linking performance expectations to real outcomes holds contractors accountable, and leads to higher quality work.

3.4 Cost Effectiveness Review

This section addresses the cost effectiveness of the 2016 RCx Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-4 summarizes the unique inputs used in the TRC test.

Table 3-4. Inputs to Cost-Effectiveness Model for AEP Ohio Retro-commissioning Program

Item	2016
Measure Life	5
Participants	6
<i>Ex Post</i> Annual Energy Savings (kWh)	1,368,494
<i>Ex Post</i> Coincident Peak Savings (kW)	22.120
Third Party Implementation Costs	\$568,941
Utility Administration Costs	\$150,361
Utility Incentive Costs	\$437,364
Participant Contribution to Incremental Measure Costs	\$221,818

The cost effectiveness analysis is based on evaluation *ex post* impacts. Based on these inputs, the TRC ratio is 0.4 and the program does not pass the TRC test for the program in its entirety. Table 3-5 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 3-5. Cost-Effectiveness Results for Retro-commissioning Program

Test Results for Retro-commissioning Program	2016
Total Resource Cost	0.4
Participant Cost Test	4.1
Ratepayer Impact Measure	0.2
Utility Cost Test	0.3

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Impact Evaluation Findings and Recommendations

The impact results for the 2016 RCx 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. The realization rates for 2016 were 83.7 percent for energy and 93.7 percent for demand savings. In 2016, the program achieved 1,368.5 MWh *ex post* energy savings and 0.02212 MW *ex post* demand savings. Reasons for changes to *ex ante* reported savings include the following:

- **Hours of use for schedule measures was based on building schedules which did not reflect all equipment.** For one project, review of trend data revealed that the actual schedules for pump and chiller equipment was different from the air handler schedules. The efficient case air handler schedules followed the building schedule, however the efficient case hours of use for supporting equipment, such as pumps and chillers, are generally half an hour longer each day, decreasing savings for pump and chiller measures, compared with a 24-hour baseline schedule for all equipment.
- **Actual schedules were found to be different than assumed.** For some projects, Navigant found programmed schedules and setpoints in the BAS were different than the final verification calculators submitted by the RSP. Some school project measures did not account for a reduced summer schedule. For one project, slightly different setpoints found in BAS trend data resulted in increased savings, whereas for other measures, this type of discrepancy decreased savings compared with *ex ante* estimates.
- **Motor and plant loading and sequencing were not updated to site specific values for the final verification phase RSP calculators submitted.** For some projects, fan motor loads verified by Navigant using live, on site power meter spot checks, were lower, in general, than the assumed investigation phase load factor values in the RSP calculators. Similarly, the chiller plant load appears to have been greatly overestimated in the RSP calculator for the hospital project, compared to the trended values obtained by Navigant for the evaluation. Lower actual motor and plant loading impacted the operational demand of the equipment, in general reducing savings.
- **Unsupported assumptions regarding amount of outside air in baseline and efficient calculator models.** Using interval billing data analysis, Navigant found a correlation between low evaluated savings projects, and projects where a substantial portion of project savings were claimed for outside air measures. For projects with measures which involved either reducing the amount of outside air, or repairing economizers, the percent of outside air does not appear to have been validated accurately by the RSP. Upon review of the submitted calculators, apparent reasons for the correlation between low measured savings, and low realization rates, include 100 percent outside air assumed in the baseline, where this may not be the case, and a flat assumed percent airflow in the efficient case. Outside air percentages do not appear to have been verified by the RSP after implementation. Further, the location the RSP assumed for the typical meteorological year (TMY) weather data was in some cases very different than the actual project location, which would have an impact on the calculated cooling energy in the calculators, impacting savings.

- **Default equipment efficiencies were not updated to site specific values for the final verification phase RSP calculators submitted.** For example, for one project involving chiller energy savings, the average chiller efficiency in kW/ton used in most of the RSP calculations was higher than the site-specific chiller efficiency provided by the RSP in their other measure tabs for the same project. The part-load efficiency range provided by the RSP was project-specific manufacturer's data. Since the default verification-phase kW/Ton value in the RSP calculator was higher than the actual average chiller efficiency from the manufacturer (which is in line with what Navigant expected for a chiller of that vintage), the Navigant evaluated savings for measures using chiller kW/ton as a key input, were lower than the *ex ante* value.
- **Inaccurate engineering design inputs, such as ASHRAE design temperatures and typical meteorological year (TMY) data inputs, were found to be for locations far away from the project location.** For some projects, Navigant found the ASHRAE design temperatures used, and the typical meteorological year (TMY) weather data used were for locations far away from the project location. This issue had an impact on savings for all measures that used weather and design temperature as key inputs to measure savings calculations.

Table 4-1. Program Savings and Realization Rate for 2016¹

	2016 Program Goals ² (a)	<i>Ex Ante</i> ³ Savings (b)	Evaluated Savings (c)	Realization Rate RR = (c) / (b)	Percent of Goals = (c) / (a)
Energy Savings (MWh)	7,305	1,634	1,368.5	0.837	19%
Demand Savings (MW) ⁴	1.5	0.0236	0.02212	0.937	1.5%

Sources ¹ Values in the table may not reconcile due to rounding. ² AEP Ohio Volume 1: 2012 TO 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011 (2014 data). ³ Evaluation analysis of AEP Ohio tracking data from February 13, 2017. ⁴ The program only calculated and reported demand savings for one of nine projects in 2016.

The 2016 RCx Program impact evaluation resulted in several key findings and recommendations. While the program will not be recruiting new participants in 2017, all recommendations in this report are written as though the program is continuing.

1. **Impact Finding 1:** The 2016 *ex post* energy and demand savings did not achieve Plan Goals. The number of projects finalized in the 2016 calendar year was less than half of the expected twenty-one projects. Additionally, the program only calculated and claimed demand savings for one of nine projects.
 - **Impact Recommendation 1a:** Increase program participation by targeting large commercial office buildings and business parks with multiple buildings, which are less complex than hospitals and schools.
 - **Impact Recommendation 1b:** Consider including a multi-year RCx offering, to increase participation and ease timeline issues.
2. **Impact Finding 2:** The tracking database has improved, including tracking of all measures and implementation status.
 - **Impact Recommendation 2a:** Continue to maintain the tracking database while closing out pipeline projects in the coming calendar year, for quality control purposes.

- **Impact Recommendation 2b:** Move the project number to the first column for the project-level tracking database.
3. **Impact Finding 3:** The calculators used were comprehensive in modeling savings, detailed and transparent in their assumptions in describing how each measure saves energy. However, calculations worksheets were not always updated with final site-specific values for key calculation inputs.
- **Impact Recommendation 3:** Require that RSPs perform site-specific updates to the calculators for key inputs such as:
 - a. chiller average efficiency
 - b. fan load factors
 - c. local ASHRAE design temperatures,
 - d. TMY weather data for closest possible location to the project
 - e. actual installed BAS schedules and setpoints
 - f. seasonal schedules where appropriate
- While temporary or default values suffice for the investigation phase, and in some cases remain a reasonable value in the verification phase, site-specific values can result in differences in savings larger than a few percent, in aggregate.
4. **Impact Finding 4:** Discrepancies in projects involving outdoor air were responsible for a majority of low realization rate projects.
- **Impact Recommendation 4a:** As mechanical conditioning of outdoor air represents a substantial portion of building energy use, it is essential to validate outdoor air percentage assumptions for both the baseline and efficient case. This could be done by reviewing the latest balancing report, and physically inspecting outdoor air dampers and controls both before and after the project, for all modes of operation. The final verification phase calculator should be updated with verified values by the RSP.
 - **Impact Recommendation 4b:** Where uncertainty still exists in the amount of outdoor air in baseline or efficient cases, be conservative in percent outdoor air estimates with respect to the final calculated savings.
 - **Impact Recommendation 4c:** Consider performing multiple calculations (sensitivity analysis) to quantify the consequences of uncertainty in outdoor air calculations, to aid in determining the impact on total project savings.
 - **Impact Recommendation 4d:** While economizers are not expected to save much energy during summer peak hours, there could be a negative impact on summer peak performance if the outdoor air damper was closed all the time in the baseline (cooling system serving shell load only), and is now open during summer hours to satisfy fresh air requirements (cooling system now serves outdoor air load in addition to shell load).
 - **Impact Recommendation 4e:** Use the closest possible TMY weather station data available to ensure outdoor air temperatures are in fact typical on a project-specific basis.
5. **Impact Finding 5:** Calculation workbooks were inconsistent in their treatment of summer schedules, both within the same project and across projects. In some cases, this resulted in

apparent double counting of savings between measures. In some instances, the RSP manually extracted relevant months from the annual analysis tab, and hard coded summer energy savings into the savings summary. No savings analysis was provided by the RSP to substantiate summer demand savings claimed by the program.

- **Impact Recommendation 5a:** Treat summer schedules separately in savings calculations by using a separate tab for summer schedules, where the summer schedule of the building is different from the rest of the year, such as for schools and libraries.
 - **Impact Recommendation 5b:** Include demand savings calculations based on the definition for the utility performance period or PJM summer and/or winter performance period, as appropriate.
6. **Impact Finding 6:** The formulas in some of the calculators were locked and invisible, preventing review of the calculator analysis methodology.
 - **Impact Recommendation 6:** Make the equations in all measure calculators visible to improve quality control and increase accuracy of savings estimates. It is possible to lock the cells, but still allow a user to view the equations.
 7. **Impact Finding 7:** In some cases, savings for selected measures appear to have been left on the table in the calculator.
 - **Impact Recommendation 7:** Ensure secondary impacts, such as from exhaust fans serving kitchen air handlers, are captured in *ex ante* calculations. Ensure secondary schedules such as summer schedules are consistently addressed where substantially different from the rest of the year.
 8. **Impact Finding 8:** Some customers did not spend the minimum required amount for each project, even though they did several measures. Additionally, some project incentive costs exceeded the eligibility caps for the RCx study.
 - **Impact Recommendation 8a:** Revisit whether the stated program-required customer spend amounts are too high for the low-cost measures typically proposed for the RCx program, particularly for customers who may have centralized control or similar systems at multiple locations.
 - **Impact Recommendation 8b:** For very large projects with high savings, some flexibility on the incentive is desirable to maintain customer satisfaction, and obtain savings for high opportunity projects.

4.2 Process Evaluation Findings and Recommendations

The 2016 RCx Program process evaluation resulted in several key findings and recommendations.

1. **Process Finding 1:** The program successfully partnered with Columbia Gas.
 - **Process Recommendation 1:** Continue to pursue opportunities for collaboration with the gas utility.
2. **Process Finding 2:** The program did not achieve the *ex ante* savings goals due to projects being held up for a variety of reasons related to project timeline.

- **Process Recommendation 2a:** Educate Service Providers to recognize ideal customers who are likely to submit and follow through on successful applications.
 - **Process Recommendation 2b:** Clearly communicate to all participating parties the expectation that the project must complete during the current calendar year.
 - **Process Recommendation 2c:** Make sure all participating contractors are included from the beginning of the project to ensure contractors are more inclined to participate and not hold up the timeline.
 - **Process Recommendation 2d:** Require RSPs to inform the implementer within an agreed upon timeframe if the end of year deadline cannot be met, to allow enough time for the implementer to recruit a replacement project.
3. **Process Finding 3:** Some participants reported to their Service Providers that participating in the training was difficult or not feasible for them.
- b. **Process Recommendations 3:** Provide more flexible or remote training opportunities for program participants. Options include hosting training in multiple locations or offering the training via WebEx.
4. **Process Finding 4:** Many RCx Service Providers suggested during in-depth interviews that one of the largest barriers to participation in the RCx Program is the exclusion of non-RCx (capital expense) measures offered through the RCx Program.
- **Process Recommendation 4a:** AEP Ohio should work collaboratively with the implementation contractor and RSPs to develop best practices in how to approach cases where customers may be discouraged from participating in the RCx Program due to restrictions on non-RCx measures.
 - **Process Recommendation 4b:** Encourage channeling of capital expense measures through appropriate Business Custom or Business Prescriptive Programs. Request RSPs list (though not analyze) capital measures in reports, and refer those ideas to appropriate Solution Providers for other programs. Consider offering a bonus incentive for channeling projects that are implemented within a set timeframe.
5. **Finding 5:** Many RCx Service Providers find the program requirements rigorous but time consuming. One result is leaving the customer with a report that is not as robust as it could be. A less robust report is due to budget constraints at the end of the project. Budget constraints at the end of the project are due the amount of effort needed, and budget spent, in the investigation phase at the beginning of the project.
- **Process Recommendation 5a:** The implementation contractor should continue developing program procedures and protocols, but carefully review to ensure they are justified. For example, the implementer could meet with the RSPs to determine key information to collect for purposes of initial vetting a project, rather than imposing rigid requirements across all projects.
 - **Process Recommendation 5b:** The implementation contractor should change their QA/QC process to leverage the experience and modeling tools of the RSPs, when initially qualifying projects, to reduce the amount of communication and documentation required during project qualification.
 - **Process Recommendation 5c:** To improve the realization rate while respecting the RSP's time and available budget, the implementation contractor should weigh the benefits of highly

detailed and uniform modeling and documentation requirements in the initial program stages, and encourage the RSPs to emphasize post-installation validation in the final version of the calculators.

- **Process Recommendation 5d:** The implementation contractor should update the program application to explicitly mention the customer should make as-built mechanical drawings available to the RSP.
- **Process Recommendation 5e:** The RSP and the implementation contractor should review the calculator assumptions together before each program year, and release an agreed-upon standardized calculator to be utilized throughout the year.
- **Process Recommendation 5f:** Allow the RSP to input their own assumptions in the investigation phase calculator for specified project level information, rather than imposing assumptions the RSP may not agree with. This will allow for quicker project screening in the early stages of a project, without sacrificing accuracy in the final verification phase calculator, which should be standardized. It is unlikely the RSP investigation grade analysis would render a wrong screening decision given the RSPs are prequalified professionals.

APPENDIX A. RCX PROVIDERS.IN-DEPTH INTERVIEW INSTRUMENTS

A.1 AEP Ohio Business Programs Manager Interview Guide

AEP Ohio Business Programs Evaluation 2016 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, implementation contractors 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.

A.2 AEP Ohio RCx Program Manager Interview Guide

AEP Ohio Evaluation for the Business Express and Retro-Commissioning Programs 2016 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.

AEP Ohio / Implementation Contractors

1. Has your role changed as RCx and Express Program Manager since we spoke to you in 2015?
2. How would you describe your interaction with the Business Programs Manager, Andy McCabe?
3. With respect to Lime, Nexant, CLEARResult, AEP OH staff and SPs do you think there have been any substantial changes in the roles and people assigned to the RCx and Express programs in the past year?
4. Are you still meeting biweekly with Nexant and Lime? Do you meet with CLEARResult? The Solution Providers?
5. Do the implementation contractors provide you with automated reporting?
6. [Express] Why was the marketing for Express left with Lime and not moved to CLEAR?
7. [RCx] What are the issues with the program tracking data from Nexant?
8. How active are account managers in the programs?

Participants / Customers

9. [Express] Do you know if Lime mined the data you provided them in order to target specific customers? Or are they still operating on a word of mouth basis?
10. [Express] Last year you mentioned a falling close rate for Lime (62% to 55%) because of customers with low hours of use. Have you considered partnering with the gas company? Perhaps offering a shared program would allow for cost effective installation of both gas and electric measures.
11. [Express] Have you seen an increase in refrigeration projects for Express in 2016?
12. [Express] Are you seeing repeat participants?
13. [RCx] Are you doing projects in new regions/with new customers for RCx with the CLEARResult Energy Advisors?
14. [RCx] Last year you said customers have the option of selecting Nexant as the RSP if they didn't like the pricing from other RSPs, how does this work? Are multiple RSPs bidding on a single project?
15. [RCx] Do you have a sense how many RCx projects are coming from Self Direct participants?

16. [RCx] Can you walk us through the QA/QC procedures?
17. Are there any regions or segments you think are left behind?
18. Are you concerned a lot of your customers are going to opt-out in 2017?
19. Do you have a sense of how satisfied customers are with various aspects of the program (application process, interaction with implementation contractor or RSP, etc.)?
 - a. Are you taking any steps to promote greater participant satisfaction?
 - b. Are you tracking the results from those steps? If so how and what are the results?
20. Do you have an idea how many of your customers could participate in Express and RCx but have not? If so, do you know why they choose not to participate?

Solution Providers

21. What does the application process look like to become a RSP?
22. Are SPs generally focused on one program only? Or are they participating in other programs?
23. How often are you in contact with the RSPs? What are you hearing from the SPs? And how do they provide feedback? (emails, calls, in person...)
24. Do you have a sense of Solution Providers' overall satisfaction with their participation in the program?
25. Are there ever any issues with any of the RSPs? If so, how do you respond?
26. [RCx] Have you compared savings calculations from other sources to the Nexant calculations? Do you think any savings are left on the table? What are the RSPs saying?
27. [RCx] Last year you said you now make the RSPs stay through the completion of the project by paying 70% up front and the remaining 30% upon completion of the work. Have there been any complaints about this? Have any RSPs dropped out? What is the range you pay for a study?

Offerings

28. [RCx] Last year you explained the process as: (1) we identify what's there, (2) then the commitment is made, (3) then the actual study is done. How do you "identify what's there"?
29. [Express] You offer 12 months interest free payment plans, what % of customers take advantage of this offer? Do you think financing is the key barrier to participation? What others? Is this something you would like to offer more widely?
30. Do you think there are measures you should add to either program?
31. Are there certain processes you think could be improved or on the flip side that work really well (e.g., communication, application processing, customer interaction, solution provider education, etc.)?
32. Of course energy savings goals are primary but are there other metrics you are tracking?
33. Are you following any innovative program designs/implementations?

Wrap-up

34. Are there any questions I didn't ask that you think I should have asked? I would love to hear any insights you have that have not come up during the course of our interview.
35. Do you have any questions for me OR things you think Navigant should research?

A.3 RCx Implementation Contractor Interview Guide

AEP-Ohio Evaluation for the Retro-commissioning Program 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

1. Has your role changed since we spoke to you in 2015 and if so, how?
2. With respect to CLEAResult, AEP Ohio staff and the RCx Service Providers, do you think there have been any substantial changes in the roles and people assigned to these programs and firms you are typically working with (RCx Service Providers) in the past year compared to previous program years? If so, what were they?
3. How often do you meet with the Program Manager for AEP Ohio's RCx Program and in what manner? Do you feel information between you and AEP Ohio's PM is shared in a timely manner? If not, what can be done to improve this situation?

How often do you interact with CLEAResult? Can you delineate their role versus Nexant's role?

Program Changes, New Measures, Measure and Participant Mix and Incentives

4. Have you seen any changes to the mix of measures being claimed or the participant types, in the RCx Program in 2016 relative to 2015?
5. 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

6. Do you expect to meet the program savings goal in 2016 (for instance are the number of applications on track)?

Program Theory, Participation, Market Barriers and Barriers to Participation

7. Could you briefly describe the process for participation in the RCx Program from the customer perspective? Are there any areas for improvement?
8. In your own words, what are the market barriers addressed by the RCx Program, and how does the program overcome them? (we are looking for cause and effect relationships)
9. What do you see as the key barriers to RCx Program participation, and how is the program overcoming these? Have the utility program staff, Nexant and RCx Service Providers been successful at removing these barriers to participation? If so, how, if not, why?

Marketing and Promotion

10. Please describe the RCx Program marketing approach in your own words. Include all relevant components, and describe how effective you think they are.
11. Is the current level of marketing sufficient, and if not how could marketing for the RCx Program be improved?
12. Do Nexant and the RCx Service Providers communicate their marketing practices to AEP Ohio so that utility staff have a good understanding of how marketing is being handled? Are the utility program staff and RCx Service Providers receptive to suggested changes to marketing?
13. Have you developed case studies in 2016?

Program Process Overall

14. What processes work really well in the RCx Program, and what processes need improvement? (e.g., communication, review and verification of projects, customer interaction, marketing, relationship between utility, Implementation Contractor and RCx Service Providers, etc.)
15. 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?)
16. How is QA/QC currently handled for this program, and what improvements could/should be made?
17. Are there any new documents Nexant has generated since 2015 that you think are useful in explaining program logic, functioning, steps, rules and requirements, etc.? Can you share copies of these with us?

Service Providers

18. How thoroughly do RCx Service Providers cover AEP Ohio's service territory?
19. What are you hearing from Service Providers? And how do they provide this feedback?
20. Do you have a sense of RCx Service Providers' overall satisfaction with their participation in the Prescriptive program in 2015 and in working with the Nexant and the utility? Have you noticed or heard any changes from past years?

21. Are RCx Service Providers meeting your expectations for the RCx Program? If not, what could be improved?
22. Are there ever any issues with and of the Service Providers? If so, how do you respond?
23. Have any Service Providers been removed from the program?
24. Did AEP Ohio offer trainings or marketing materials in 2016 to help support Service Providers or Nexant market the program?

Customer Interest, External Factors, Strengths and Weaknesses

25. 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?
26. Last year you said the turnaround time from application received to application accepted was about a month which could be improved, has it?
27. Last year you said you could be flexible if a customer highly values a contractor who is not a current program Service Provider. Has this happened?
28. Of course energy savings goals are primary but are there other metrics you are tracking?

Wrapping Up

29. 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.4 RCx Service Provider Interview Guide

AEP-Ohio Evaluation for the Business RCx Program 2016 RCx Service Provider 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.

Target Duration: 30 minutes

Roles and Protocols

1. How long has your firm participated in the RCx Program? Did you participate in previous years before Nexant managed the program? If so, what differences do you see?
 - a. Did you participate in the Lite and/or Standard program?
 - b. How many projects did you do this year? Did you want to do more?
 - c. Does your firm participate in any other utility RCx programs?
 - d. Does your firm participate in any other AEP Ohio EE/PDR programs?
2. How often do you meet with Nexant, AEP Ohio or the customer? Do you feel information sharing and communication is good between the parties? What areas for improved communication or information sharing do you see?
3. What does data handling, data entry and data transfer to Nexant look like from the contractor's perspective? Are there areas for improvement, streamlining or additional QC?
4. Can you walk me through the process from start to finish of an RCx project from your firm's perspective, including interactions with the customer and Nexant?
 - a. What does the investigation phase look like? How long does it usually last?
 - b. (If applicable) Do you like how involved Nexant is in the process?

- c. How many times did you go back and forth with Nexant during the calculation phase?
 - d. What does the process look like when the customer is selecting the ECMs?
 - e. How long is given / how long does it take the customer to implement the ECMs?
 - f. Do you do a final verification or Nexant? Or both?
 - g. Through all of these steps, where do you see the biggest hold ups occur?
 - h. If you find capital measures, do you also participate in AEP Ohio's Prescriptive or Customer programs?
5. What is your firm's overall satisfaction level in participating in the program? Are there things you would like to see changed in the program that would make it a better experience from your firm's perspective? (Calculator tools, reports, application, etc.)
 6. Are there changes to the program which would encourage or allow you to bring more projects into the program or increase participation?
 7. Do you see any obstacles in the way the program is designed or delivered that are discouraging participation EITHER by customer or Service Providers?
 8. What aspects of the program do you see as strengths? And what areas for improvement do you see in the program? (Can either be program design, delivery, management by Nexant, etc.)
 9. Do you feel there are adequate and robust QA/QC protocols built into the program, specifically provided by Nexant?
 10. If a problem arises with a project, how is it handled? How is the problem communicated to both Nexant and the customer? What types of problems might arise, and how would these be resolved?
 11. How do you feel about the training, support, and documentation you received from Nexant? What aspects were most/least useful? Are there any things you would change? And why?
 - a. (If applicable) Any changes to how training was done previously?
 12. Have you received feedback from Nexant? If so, do you feel this is valuable? What aspects are most/least valuable to you?
 13. What marketing or outreach tactics result in your bringing in RCx projects? Are there any ways Nexant or AEP Ohio could better support you through provision of marketing materials or services that might help you bring in additional projects?
 - a. Did you receive any leads from Nexant or AEP Ohio?
 - b. Did you use the new cobranded fact sheet?
 14. Do you intend to participate in the RCx Program in 2017? Why or why not?

15. Can you give us any insights into the customer's perspective on this program—both positive and negative feedback you may have received?

Thank you very much for talking with me today. If additional questions arise, would it be alright to contact you by email?

A.5 RCx Participant Interview Guide

AEP Ohio Evaluation for the Retro-commissioning Program 2016 Participant In-Depth Interview Guide

Name: _____ Date: _____

Title: _____ Company: _____

Contact Info: _____ Project Number: _____

Interviewer: _____

Interviews will be recorded and transcribed.

Identify Appropriate Respondent

Q1. Hello, this is <INTERVIEWER NAME> calling from Navigant Consulting on behalf of AEP Ohio. This is not a sales call. May I please speak with <CONTACT> ? <HE/SHE> is expecting my call. [if appropriate based on email communication]

[IF NEEDED]: my understanding is that <CONTACT> is responsible for making energy-related decisions for your firm at <SERVICE ADDRESS> and was listed as the primary contact when <Company> participated in AEP OHIO Ohio's Retro Commissioning Program. May I please speak with him/her?

1 No, this person no longer works here → Is there someone else that is involved with facility improvements or building operations that might be familiar with <company>'s participation in AEP OHIO Ohio's Retro Commissioning program? [Repeat introduction with new contact]

2 No, this person is not available right now [ask when available, leave message, or reschedule]

3 Yes – CONTINUE TO Q2

97 No, other reason (THANK & TERMINATE)

Q2. [IF PASSED TO NEW RESPONDENT, READ THE FOLLOWING, OTHERWISE SKIP TO NEXT SENTENCE] Hello, my name is <INTERVIEWER NAME> calling from Navigant Consulting on behalf of AEP Ohio.

We're calling to ask you a few questions about your firm's recent participation in the Retro Commissioning program. This survey will take between 20 to 30 minutes of your time, and will provide AEP Ohio with valuable feedback on how to improve the program.

[IF NEEDED] Navigant is an independent consulting firm hired by AEP Ohio to learn about customer experiences with its Comprehensive Retro-commissioning and Retro-Commissioning Lite programs and to help AEP Ohio improve its programs for the future.

[IF NEEDED] This is a very important fact-finding survey with companies that have recently participated in an energy efficiency program sponsored by AEP Ohio. We are NOT interested in selling anything, and we are primarily interested in gaining your feedback on the Comprehensive Retro-commissioning and Retro-Commissioning Lite programs to help AEP Ohio improve the services it provides to its customers in the future. Your responses will not be connected with your firm in any way and will be summarized with responses from other businesses that we interview.

1 Yes → continue to Q3

2 No → [Describe program and ask if they were involved. If still no recall → Can I speak with someone who is likely to be responsible for facility improvements?]

3 There is no one here with information on that address/wrong address – THANK & TERMINATE

Q3. Great. Are you the person responsible or were you involved with your company's decision to participate in the program, or were you the main point of contact with AEP Ohio?

1 Yes → Great. We would like to ask you some questions about this program, which should only take about 20 to 30 minutes. Is now a good time, or is there a time we can call you back this week?

2 No → Ask for contact name and repeat introduction in Q2.

Now I'd like to ask you about the project you submitted. Our records show that you participated in the [Comprehensive Retro-Commissioning / Retro-commissioning Lite] aspect of the program. Throughout our conversation I will refer to the program simply as the RCx (read as: "Retrocommissioning") program. [If necessary: Retro-Commissioning Lite is more appropriate for small commercial/institutional buildings]

Program Awareness and Application Process

- P1.** Do you remember how you first learned about the RCx program? Explain?
- P2.** Since then, have you heard about the program from other sources? Which? [If they say SERVICE PROVIDER—“What type of Service Provider or contractor told you about the program?”]
- P3.** What were the circumstances surrounding your decision to participate in the program?
- P4.** What role did the RCx Service Provider (i.e. contractor) play in your decision to participate in the program? [Probe: “Who was first involved in the decision to move forward with this project and submit an application?”]
- P4.** Previous to the RCx project you completed under the RCx program in 2016, have you completed any other RCx projects in the last 5 years? If so, were any of the other projects also conducted through AEP Ohio’s RCx program?
- P5.** Can you spend just a few minutes and describe the process that you went through to participate in the program? Was this process difficult? What made the process difficult/easy for you?
- P6.** Who was primarily responsible for preparing the application for the program? Was it someone within your organization, one of the RCx Service Providers, or someone else?
- P7.** Did you consult any resources such as the AEP Ohio website or an AEP Ohio account representative about the program? [Probe: If the respondent visited the website, what task was accomplished there?]
- P8.** Did you receive a brochure or leaflet from the AEP Ohio or Nexant about the RCx program?
- P9.** Could the participation process be made easier for you? If so, how?

Incentives

- I1.** Did you feel having the RCx study paid for the program made you less worried about whether the study would find energy saving measure for you to implement?
- I2.** Most energy conservation measures (ECMs) identified through the program are designed to have 18 month or shorter payback periods. Are you satisfied with the payback period for the ECMs identified as part of your RCx project? Explain.

Communication

C1. Did you receive any materials describing the RCx program and its benefits? Did your AEP Ohio business manager, or your Retro-Commissioning Service Provider talk to you about the program? If more than one person discussed the program with you, was there any confusion around multiple points of contact at any point in the program?

C2. How would you describe communications between your organization and your RCx Service Provider during your program participation? [ask the name of the RCx Service Provider, if it has not already come up during the interview]

C3. Did you have any contact with Nexant or AEP Ohio about the program? How would you describe communications between your organization and Nexant (or your organization and AEP Ohio) during your program participation?

C4. Were there any communication issues with Nexant? If so, please describe.

C5. What sorts of setpoint or control recommendations did your RCx Service Provider (contractor) contribute (e.g. night set-backs, cooling setting, heating setting, airflow recommendations, ventilation recommendations...)? Did you implement any of these setpoint or control recommendations, and are they working well?

C6. Did you receive recommendations to replace equipment or did you replace equipment as part of the RCx program? If so, did your contact mention other AEP programs that may provide a rebate for the equipment?

C7. Are you likely to act on recommendations for additional equipment retrofits or replacements to save energy? Which ones? How soon?

C8. Has a representative from the program (if asked: AEP Ohio or Nexant) visited your facility to verify the details of your RCx program participation? How did that process work? Were you satisfied with this process? If not, what could be improved?

Program Improvements

PI1. What are the main benefits to your firm of participating in the program? Are there any drawbacks to participating in the RCx program? Explain.

PI2. Overall, how satisfied are you with the RCx program?

PI3. Did the RCx service and scope of work meet your expectations? Was the depth of investigation and analysis appropriate to your needs?

PI4. How do you think the program could be improved? [Probe: "Are there elements in the program that should be modified to make it work better? If so, what would you recommend? Why do you think this change is needed?"]

P15. Does the RCx program influence your satisfaction with the utility overall?

Awareness of Other Programs

A1. Aside from the RCx program that we have been discussing, are you aware of other AEP Ohio programs that are designed to promote energy efficiency for businesses like yours?

A1a. (If yes) Which programs do you recall? (Accept multiple answers, do not provide suggestions)

A1b. (If listed some programs) Have you participated in any of these programs? Which ones?

Firmographics

F1. Can you briefly summarize your role at your company? What are your main responsibilities?

F2. What is the primary business activity at the facility where the RCx measures were implemented?
[Record one—don't read list]

- 1 Office
- 2 Retail (non-food)
- 3 College/University
- 4 School
- 5 Grocery Store
- 6 Restaurant
- 7 Health Care
- 8 Hospital
- 9 Hotel or Motel
- 10 Warehouse/Distribution
- 11 Construction
- 12 Community Service/Church/Temple/ Municipality
- 13 Industrial Process/ Manufacturing/ Assembly – type?
- 14 Condo Assoc./Apartment Mgmt.
- 15 Other (Please specify) _____
- 98 Refused
- 99 Don't Know

F3. About how many full-time occupants work at this location? (clarify: "An estimate is fine")
[record number; 98 = Refused, 99 = Don't know]

F4. Does <COMPANY> own or lease this facility?

- 1 Own
- 2 Lease
- 98 Refused
- 99 Don't know

F5. (Ask if F4 = "Lease", otherwise skip) Does <COMPANY> pay the electricity bill at this leased facility?

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

F6. Is <COMPANY> headquartered in Ohio or elsewhere?

- 1 HQ in Ohio
- 2 HQ elsewhere
- 98 Refused
- 99 Don't know

F7. Do you have any other comments or suggestions for us?

Those are all the questions I have for you today. Thank you so much for your time. Your insights are extremely valuable to AEP Ohio. Have a wonderful day!

APPENDIX O



DATA CENTER PROGRAM

2016 Evaluation Report

Prepared for:

AEP Ohio



A unit of American Electric Power

May 10, 2017

Submitted by:

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

312.583.5700
navigant.com



Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

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

Contact:

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

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

Prepared by:

Keith Downes, Associate Director
802.526.5103
keith.downes@navigant.com

Neil Curtis, Managing Consultant
802.526.5119
neil.curtis@navigant.com

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EXECUTIVE SUMMARY

AEP Ohio's Data Center Program supports customers to achieve higher levels of energy efficiency in facilities with data centers. The program is designed to overcome customer barriers to implementing energy efficiency improvements through technical assistance and incentives, tailored to a project's annual energy savings. Any AEP Ohio business customer that operates a data center is eligible to apply for technical assistance and incentives through the program. Program incentive applications must be submitted within six months of the completion of the project. The program is delivered by an implementation contractor (Willdan) on behalf of AEP Ohio.

The program goal for 2016 was set as 7,979 MWh in energy savings and 0.99 MW in peak demand savings. A secondary goal was to ensure the program is available to customers of all sizes, therefore, program staff sought a range of project sizes included in the program. Total 2016 *ex ante* demand savings amounted to 2.43 MW, total 2016 *ex ante* energy savings reported for the program amounted to 18.99 GWh, exceeding the annual energy savings targets.

Program Participation

The Data Center Program entered its fourth year of operation in 2016. AEP Ohio completed 40 projects in 2016, which is between the 36 projects completed in 2014 and the 46 completed in 2015. As in previous years, some customers completed multiple projects throughout the year. Overall, 15 unique customers completed projects in 2016, a *decrease* from 32 unique customers in 2015 and 23 unique customers in 2014. Five of the customers who participated in the program in 2016 completed multiple projects, with one customer completing ten projects and one customer completing thirteen. In total, the projects included implementation of 42 unique measures. Table ES-1 below summarizes the key program indicators for 2016, with comparable numbers for 2014 and 2015.

Table ES-1. Program Summary

	2014 Total	2015 Total	2016 Total	2016 Average per Project
<i>Ex Ante</i> Incremental Project Cost	\$4,228,266	\$4,572,719	\$5,319,318	\$132,983
Reported Floor Area	511,027	3,484,065	605,300	15,929
Amount of Incentives	\$1,083,131	\$866,480	\$1,079,969	\$27,427
<i>Ex Ante</i> Energy Savings (MWh)	13,571	12,251	18,990	475
<i>Ex Ante</i> Demand Savings (MW)	1.55	1.35	2.43	0.061

Table ES-2 shows the number of projects and savings by economic sector, based on information reported in the tracking database. Navigant identified inconsistencies and inaccuracies in the data base reporting of Economic Sector. Economic Sector descriptions have been updated throughout this report to reflect Navigant's recommendations, as described in Section 3.1.

Table ES-2. Summary of Savings by Economic Sector

Economic Sector	Number of Projects	Ex Ante Savings	
		Energy kWh	Demand kW
Colocation / Cloud Hosting	8	13,666,134	1843
Finance, Insurance, Real Estate	3	1,184,570	131
Government	1	245,773	50
Healthcare	1	72,741	8
Industrial/Manufacturing	2	37,339	4
Military	1	2,099,229	239
Retail Trade, Service	1	1,260,082	121
Telecommunications	23	424,415	31
Total	40	18,990,283	2430

Note: Totals may not sum due to rounding.

The program application form asks participants to indicate how they had learned of the program. The tracking database shows most participants indicated they initially heard of the Data Center Program through an AEP Ohio Account Representative, while two customers learned of the program from their contractor / Solution Provider.

The tracking database also recorded whether a Solution Provider was involved in implementing the efficiency project. Overall, the measure tracking database shows twelve different Solution Providers were involved with 40 projects completed during the year. Both the number of Solution Providers and the number of projects completed are in between the levels reported in 2014 and 2015, with 2014 the lowest levels of participation and 2015 the highest. In 2016, six projects (15%) were reported to be “self-performed” without the assistance of a Solution Provider. One project did not have the Solution Provider source in the measure tracking database. Navigant identified inconsistencies between the measure tracking data and project tracking data: one of the Solution Providers identified in the measures tracking database was not included in the project tracking data file.

Data Collection Activities

Primary data collection included in-depth qualitative interviews with AEP Ohio program managers and implementation contractor staff, and review of program tracking data. Marketing activities, application forms and other program inputs were also analyzed.

As part of the impact study, 89 percent of the claimed *ex ante* energy savings underwent an engineering review of the project files. Twenty-five percent of the *ex ante* savings were subject to an on-site review. Table ES-3 provides a profile of the impact measurement and verification (M&V) sample stratification and the level of review within each stratum.

Table ES-3. Impact Sampling Strata and Achieved Sampling

Stratum by Approach and Energy Savings	Number of Buildings	Strata weight by Energy	Number of Desk Reviews	Number of On-site Reviews ¹
Large (>1,000 MWh/yr)	6	86.0%	6	2
Medium (>100 MWh/yr, ≤1,000 MWh/yr)	7	10.8%	2	0
Small (≤ 100 MWh)	27	3.2%	1	1
Total	40	100%	9	3
Percent of Ex Ante Savings			89%	25%

Key Evaluation Findings and Recommendations

The following sections summarize the findings of Navigant's evaluation and recommendations to further improve the Data Center Program.

Key Impact Findings and Recommendations

Table ES-4. Impact Savings, Realization Rate and Precision of Sample

	2016 Program Goals ¹	Ex Ante Savings (b)	Ex Post Savings (c)	Realization Rate RR = (c) / (b)	Overall Relative Precision at 90% Confidence	Percent of Goal = (c) / (a)
Metric	(a)					
Annual Energy Savings (MWh)	7,979	18,990	21,399	1.13	4.85%	268%
Coincident Peak Reduction (MW)	0.99	2.43	2.73	1.12	4.66%	276%

Source: ¹AEP 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 *ex post* energy and summer coincident demand savings for 2016 are 21,399 MWh/year and 2.73 MW, respectively. The realization rate (RR) for energy is 1.13 and the RR for demand is 1.12. These

¹ On-site reviews are a sub-set of desk reviews. All projects in the sample received at least a desk review, while some received an on-site review in addition to the desk review. If a project received both an on-site and a desk review it is counted in both the on-site and desk review totals.

results are shown in Table ES-4. Both energy demand reduction exceeded the goal of 90 percent confidence at 10 percent precision.

Other key impact findings and recommendations include:

1. A CRAC unit replacement project used a savings analysis method that was deemed obsolete in the 2015 evaluation report. The project used an ASHRAE 90.1 baseline calculation method for fan energy, rather than the California (CA) Baseline document.²

Impact Recommendation 1a: Create a document that provides acceptable savings calculation methodologies for common measures. Update the methodology document annually after the evaluation report is released.

Impact Recommendation 1b: Acceptable baselines will change for the 2017 evaluation period due to state law requiring an as-found baseline. The implementation contractor should meet with AEP Ohio and Navigant to ensure clarity on the new requirements.

2. The sampled cell tower project used an inappropriate baseline based on ASHRAE 90.1 for the cooling system. Billing analysis and site metering found the *ex ante* calculations to be inflated nearly three times the actual amount.

Impact Recommendation 2a: Always check that *ex ante* savings estimates pass a sanity test relative to the utility billing data. Have project reviewers check savings relative to billing information.

Impact Recommendation 2b: Revise cell tower projects to use an as-found baseline in 2017.

3. Three identical new construction data center projects underestimated savings. The projects' *ex ante* calculations relied on the CA Baseline document to determine the baseline and metered data to determine the as-built case. The actual IT load relative to IT capacity affects both the baseline and as-built energy analysis when using this method. The *ex ante* loading was determined early in the data center ramp up process, while the *ex post* calculations had the benefit of data once the data center was more fully operational and loaded.

Impact Recommendation 3a: Starting in program year 2018, switch the baseline basis to ASHRAE 90.4 Energy Standard for Data Centers, which does not depend on actual loading, but instead relies on facility design and equipment specifications.

Impact Recommendation 3b: If ASHRAE 90.4 cannot be used, require the data center to be more fully operational and loaded before the project is completed. At least 25 percent IT load is recommended.

4. Three identical new construction projects have well documented *ex ante* baseline costs, but the actual project cost was a figure provided by the participant without any supporting materials. Invoices were not provided, nor was there any detail regarding how the value was determined or what equipment was included. Data Center Program terms and conditions require that invoices are submitted and the invoices be itemized sufficiently to separate the incremental project cost from the costs of other services not related to the energy efficiency project.

² The California Energy Efficiency Baselines for Data Centers can be found at:

http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/hightech/data_center_baseline.pdf

Impact Recommendation 4: Incentives should not be provided until extensive supporting materials are submitted detailing how incremental cost is determined. This information may include supporting materials provided by the participant or its Solution Provider establishing the baseline cost.

Key Process Findings and Recommendations

The process review found the program has been successful in meeting its participation and energy savings goals. The program processes appear to be reasonable, easy for customers to access, and well accepted by participants. The program continues to have a broad range of participating customers and is available to data centers of different sizes.

Other key process findings and recommendations include:

1. 2016 saw a decrease in the number of projects, unique customers, and Solution Providers compared with 2015. The program is overly reliant on a few very large projects to meet energy savings goals. The only formal Data Center Program activity for Solution Providers in 2016 was the annual meeting, where high performers were recognized. Many customers rely on third-party contractors to manage their data centers; these contractors can identify energy efficiency opportunities and promote the AEP Ohio Data Center Program, including IT load efficiencies, which are currently underrepresented.

Process Recommendation 1a: Expand efforts to establish a network of Solution Providers for the program. AEP Ohio should reward contractors who promote the program, encourage early program involvement, identify savings opportunities for their trusted clients, and close projects for AEP Ohio.

Process Recommendation 1b: Train implementation contractors and Solution Providers to leverage customer project activity by evaluating IT rooms for additional opportunities not currently under consideration.

2. Per the database, only four of the 40 completed project applications were submitted prior to the date of project completion; one project application was submitted on the date of project completion. There are four projects in the database with no project application submittal date. One project application was received 253 days after project completion. The eligibility criteria for the program indicate applications must be submitted within six months of project completion.

Process Recommendation 2a: Clarify application submittal date language to be consistent to program staff and across customer facing documentation (including the "AEP Ohio Data Center Brochure 2015-16" document).

Process Recommendation 2b: Consider the eligibility of projects with an application date more than six months after the completion date to determine if this is a data entry issue or if these projects should not have been eligible. Projects over six months old may be served through the Self Direct Program if the project meets that program's requirements.

Process Recommendation 2c: Develop quality control procedures to ensure data transferred from customer applications and analysis documents into program database is correct and meets program eligibility criteria.

3. Based on the Data Center Program's custom project analysis and procedures, customers are only informed of their incentive amount through a reservation letter. Reservation letters are issued upon receipt of project application or pre-project application. Since only four projects are recorded as submitting a pre-project application, most customers completed their projects in absence of program information about their project specific incentive amount. Project pre-applications would allow the implementation contractor an opportunity to review the proposed project and suggest enhancements or additions, thus maximizing comprehensiveness and savings.

Process Recommendation 3a: Encourage early involvement in the program by requiring participants to submit a pre-application prior to project completion to be eligible for the program. Ensure data entry is accurate for pre-application dates

Process Recommendation 3b: Provide customers an incentive commitment letter within 10 days of receiving the pre-application.

Key Tracking System Findings and Recommendations

The following recommendations are offered to further improve the value of the tracking data.

1. The average elapsed time between the project inspection and issuing the incentive is 139 days, or five months. This time seems quite long, however, there is no indication in the tracking database when the program received all the project information required to complete the project and pay the incentive. The elapsed time is significantly more than the advertised four to six weeks listed in the program documentation between project completion and incentive payment.

Tracking Data Recommendation 1: Add new fields to the database recording when the application and all required information is complete, as well as when the project is approved for payment, so the actual project processing time can be properly tracked and monitored. The goal of this recommendation is to identify specific issues contributing to project incentive delays, and develop processes that improve the customer experience and project work flow.

2. In past reviews, Navigant noted several fields in the tracking database were found to be incomplete. In 2016, several fields were identified with either missing data or no explanation why the data is missing. Currently, it is not clear if a blank field indicates information was not required, has not yet been entered, or if it is missing on the actual application.

Tracking Data Recommendation 2a: Institute an administrative process to obtain missing information, or note why it has not been included in the database.

Tracking Data Recommendation 2b: All data fields should be clearly defined as binary fields for consistency; a code should be used to explicitly indicate if a field does not apply to a measure or project. This designation will help make it clear where staff follow-up may be required to complete a task (i.e. an inspection) or obtain data (i.e. if the inspection has been completed but not recorded). Examples include:

- a. **NPA:** No Pre-Application
- b. **NI:** Not Inspected

1. INTRODUCTION AND PURPOSE OF STUDY

1.1 Program Overview

AEP Ohio's Data Center Program supports customers to achieve higher levels of energy efficiency in facilities with data centers. The program is designed to overcome customer barriers to implementing energy efficiency improvements through technical assistance and incentives, tailored to a project's annual energy savings. Any AEP Ohio business customer that operates a data center is eligible to apply for technical assistance and incentives through the program. Program incentive applications must be submitted within six months of the completion of the project. The program is delivered by an implementation contractor (Willdan) on behalf of AEP Ohio.

The program goal for 2016 was 7.98 GWh for energy savings and 0.99 MW of demand savings. A secondary goal was to ensure the program is available to customers of all sizes, therefore, program staff sought a range of project sizes included in the program. Total 2016 *ex ante* energy savings amounted to 18.99 GWh and total 2016 *ex ante* demand savings amounted to 2.43 MW, exceeding the targets for the year for both energy and demand savings.

1.2 Evaluation Objectives

This report presents the findings from the AEP Ohio Data Center impact and process evaluations for program year 2016. The objectives of the evaluation are to: (1) quantify energy and summer peak demand savings impacts at the meter because of the 2016 program activities; (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.

1.3 Evaluation Methods

Program impacts were evaluated in terms of energy and demand savings. A portion of the completed project population was sampled with the intention of achieving 90% confidence and a 10% precision on both the program energy and demand savings estimates.

The *ex post* energy and demand savings of the sampled projects were determined by engineering review of the project files, engineering review of the *ex ante* savings analysis, and/or site verification of the installed components of the energy efficiency measures included in the project. Summer coincident peak savings is determined by engineering analysis of the savings potential during the peak period, or by adjusting demand savings with a published coincidence factor for summer peak demand.

Data collection activities are summarized in Table 1-1. Primary data collection efforts included in-depth telephone interviews with program staff at AEP Ohio and the implementation contractor (the program implementer). Navigant's interviews with AEP Ohio staff and the implementation contractor, and analysis of other available support materials provided an understanding of program logic, expected inputs, outputs and outcomes.

Table 1-1. Summary of Data Collection Activities

Data Collection Type	Targeted Population	Supported Evaluation Activities
Review of Program Documentation	Program documentation and marketing materials new for 2016	Process Evaluation
Secondary Literature Review	Publicly-available evaluations of other utility data center programs and available reports on Data Center Energy Management	Impact and Process Evaluation
In-depth Telephone Interviews	Implementation Contractor, AEP Ohio Program Coordinator	Process Evaluation
Project File Review	Sample of completed projects	Impact and Process Evaluation
On-site Verification	Sample of completed projects	Impact Evaluation
Tracking Data Review	All program participants	Impact and Process Evaluation

2. METHODOLOGY

This section describes the methodology used to conduct the process and impact evaluations. A high-level overview of the steps taken to collect and analyze the data for this evaluation is described in Section 2.1. These steps are followed by a discussion of the research questions guiding the evaluation and the tasks completed as part of the process evaluation, including the review of tracking data, the marketing activities and participation. Finally, the methods used for primary data collection tasks and in analyzing the impact and process data are discussed.

2.1 Overview of Approach

The evaluation was driven by three overarching objectives: (1) quantify energy and summer coincident demand savings impacts from the program during 2016 and compare to prior years; (2) determine key process-related program strengths and weaknesses and identify ways in which the program can be further improved and; (3) determine program cost-effectiveness. To meet these objectives, the evaluation team undertook the following activities.

1. **Evaluation Questions.** Established evaluation questions as part of developing the 2016 evaluation plan with AEP Ohio staff.
2. **Tracking Data Review.** Reviewed the program tracking data collected by the implementation contractor and provided to the evaluation team by AEP Ohio.
3. **Review of Marketing Activities.** Reviewed the overall marketing activities and approach as implemented by the implementation contractor and AEP Ohio.
4. **Review of Participation.** Reviewed program participation by economic sector, size of data center, and completion date.
5. **Primary Data Collection.** Performed primary data collection, including in-depth interviews with program managers, a file review for a subset of randomly selected projects, and on-site verification for a subset of the projects selected as part of the file review.
6. **Methods Used to Analyze Impact Data.** Quantified energy and coincident peak demand reduction savings by reviewing project files. File reviews included verifying baseline selection, determination of incremental costs, quantifying operation hours, reviewing all inputs and assumptions, and engineering algorithms selected. Where uncertainties still existed in the savings calculations, on-site visits were conducted. On-site visits included clarifications of the project scope, requests for missing supporting documentation, verification of equipment specifications and quantities, and collection of energy management system data, as well as metering where required.
7. **Methods Used to Analyze Process Data.** Assessed the effectiveness of the program processes by analyzing program documents, the results of in-depth interviews with program staff at AEP Ohio and the implementation contractor, and review of program tracking data.

2.2 Key Evaluation Questions

Navigant worked with AEP Ohio to identify several evaluation questions regarding the Data Center Program. As the program completes its fourth year, some of the questions focused on how the program has changed since its first year of operation. The evaluation sought to answer the following questions.

2.2.1 Impact Questions

1. Were the impacts reported by the program achieved? If not, why not?
2. What were the realization rates and what were primary factors driving the realization rates? (Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings.)
3. What were the quantifiable benefits and costs of the program? How cost effective was the program in achieving its goals?

2.2.2 Process Questions

Marketing and Participation

1. What are the key interests and motivations for potential and actual participants? Does the program address any of these motivations beyond the financial incentives offered?
2. What customer market segments or types of projects participate in the program? What are the key motivations and barriers relevant to specific segments or project types? How can barriers be overcome? Can communications more effectively target key motivations?
3. How was the program marketed to the target audience? Are marketing and communication efforts sufficient to meet current and future program participation goals?
4. What type of support is the implementer providing to the program participants? Is this support sufficient to attain targeted levels of participation?
5. How did customers become aware of the program? What marketing strategies could be used to boost program awareness?

Program Characteristics and Barriers

1. Would a reallocation of budget between incentive spending and marketing spending increase program participation and savings?
2. Are there particular program characteristics that could be changed to improve customer satisfaction or participation while maintaining program effectiveness?
3. What are the key barriers to participation in the program? Which barriers affect decisions by eligible customers who do not participate, and how can these be addressed by the program? Do these barriers vary by sector or participant characteristic?
4. How many participants applying to the program drop-out before completion of their project? Where this occurs, what causes participants to drop out of the program?

Administration and Delivery

1. Have any changes been introduced to the program since the last evaluation? If so, how, why, and what has been the impact of the change on program performance?
2. 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? Navigant will review:
 - a. Program tracking and data management

- b. Required forms
 - c. Impact to timeline
 - d. Ease of use
 - e. Internal program communications
 - f. Program staffing
3. Does the program tracking system provide adequate information for program evaluation?
 4. What are the opportunities for program improvement?

Community Impact

1. Does AEP Ohio/the implementer award customers with completed energy efficient projects with any acknowledgment (certificate, plaque, occupant communications, etc.) that can be used to publicize their achievements within their organization or community?
2. Has AEP Ohio/the implementer documented any case studies that can be used to demonstrate the benefits of the program?

2.3 Tracking Data Review

Program tracking data is critical for determining the impacts of the Data Center Program. A copy of the program tracking data collected by the implementation contractor was provided by AEP Ohio to the evaluation team. The tracking data was received after the end of the program year and included all projects which received an incentive by December 31, 2016.

- The evaluation team reviewed all the fields recorded on the application forms and cross checked the collected data fields against the fields recorded in the tracking database to identify data fields essential for consideration in the impact and process evaluations.
- Key data fields in the database were reviewed to identify missing, incomplete, or inconsistent data.
- The data collected was also reviewed to identify any additional information that would be helpful in evaluating program performance. However, the evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

2.4 Review of Marketing Activities

Marketing collateral, application forms and other materials available from the AEP Ohio web site were reviewed and outreach activities were discussed with program managers.

2.5 Review of Participation

The evaluation team used the program tracking data to analyze participation by several key factors, including type of business, project size and complexity and milestone dates. The analysis focused on metrics such as number of participants and impact results. The results of this analysis are presented, in part, in the discussion of program activity in Section 3.1.

2.6 Primary Data Collection

Primary data collection for the process evaluation included in-depth interviews with both the program implementation contractor and AEP Ohio program manager, and review of program tracking data. Marketing activities, application forms, and other program inputs were also analyzed.

Discussion guides were developed to allow a structured but open-ended interview. A free-flowing discussion resulted between interviewer and respondent and real time interviewing flexibility was achieved. Staff experienced in program evaluation was used to perform the interviews. Interviews were conducted by telephone to provide flexibility to the respondents' schedules.

2.7 Methods Used to Analyze Impact Data

Completed projects were divided into three strata based on *ex ante* energy savings. A random sample was selected from each stratum to be analyzed. Desk reviews were conducted on all sampled projects which included engineering calculations of energy savings claims and verification of baseline and retrofit assumptions. If uncertainties in the savings calculation existed, an on-site verification was conducted. Site visits inspected equipment specifications and quantity, verified hours of operation, collection of energy management system data and/or metering where required, and answered any outstanding questions. Results of the verification reviews were statistically applied to the entire population to determine *ex post* savings.

2.7.1 Impact Sample of Project Files

The impact sample was chosen to achieve a 90/10 level of confidence and relative precision for the engineering review. The program was evaluated at the project level. The selected projects were sorted from largest to smallest energy savings and placed into strata, attempting to achieve a relatively even distribution of energy savings cumulative standard deviation between strata. This approach minimizes the overall sample size and resulted in a total sample of seventeen projects to be selected for application documentation and engineering review. In the end, Navigant sampled 89 percent of the reported program energy savings.

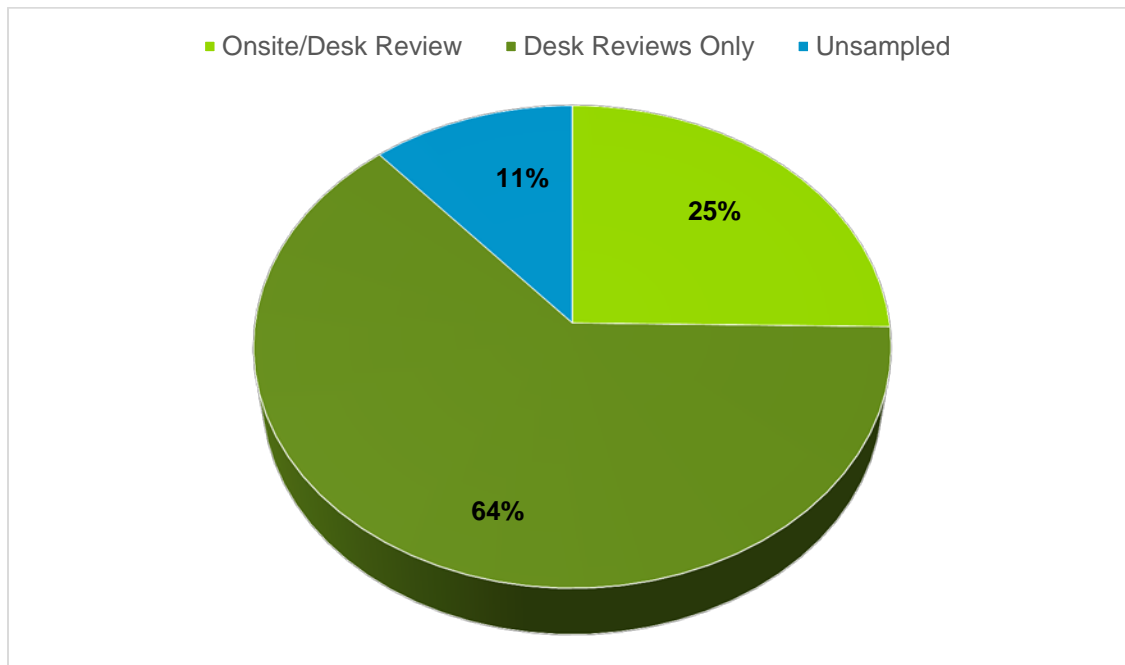
Table 2-1. Impact Sampling Strata and Achieved Sampling

Stratum by Approach and Energy Savings	Number of Projects	Strata weight by Energy	Number of Desk Reviews	Number of On-site Reviews ³
Large (>1,000 MWh/yr)	6	86.0%	6	2
Medium (>100 MWh/yr, ≤1,000 MWh/yr)	7	10.8%	2	0
Small (≤ 100 MWh)	27	3.2%	1	1
Total	40	100%	9	3
Percent of <i>Ex Ante</i> Savings			89%	25%

³ On-site reviews are a sub-set of desk reviews. All projects in the sample received at least a desk review, while some received an on-site review in addition to the desk review. If a project received both an on-site and a desk review it is counted in both the on-site and desk review totals.

Table 2-1 provides a profile of the impact measurement and verification sample and the populations within each stratum. Figure 2-1 illustrates the total *ex ante* energy savings claim and the proportion of which went through desk review only or desk review coupled with an on-site review.

Figure 2-1. Impact Sampling as a Percent of *Ex Ante* kWh Savings



2.7.2 Ex Post Energy Savings Calculation

Energy savings calculations were conducted using standard engineering practices to determine custom savings in data centers. Where possible, lifetimes were applied to the Data Center Program measures consistent with lifetimes applied to other AEP Ohio business programs. Retrofit projects used a baseline of the existing equipment, while replace-on-burnout (ROB) or new construction project baselines were determined using a variety of sources, including the applicable energy code, ASHRAE 90.1-2010 for computer room air conditioning, the “California Energy Efficiency Baselines for Data Centers, Statewide Customized New Construction and Customized Retrofit Incentive Programs, Revision 1”⁴ (CA Baseline document) and standard ROB custom project analysis procedures where applicable.

2.7.3 Realization Rates Calculation Method

Realization rates for each stratum were calculated with the following equation:

$$RR = \frac{\sum_{sampled} E_{ex-post}}{\sum_{sampled} E_{ex-ante}}$$

⁴ The California Energy Efficiency Baselines for Data Centers can be found at:

http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/hightech/data_center_baseline.pdf

Where:

E = the energy savings or demand reduction for each project in the stratum

Realization rates in each stratum were applied to the project population of that stratum with the following equation:

$$E_{i,ex-post} = RR_{stratum} * E_{i,ex-ante}$$

3. DETAILED EVALUATION FINDINGS

3.1 Program Activity

The Data Center Program entered its fourth year of operation in 2016. AEP Ohio completed 40 projects in 2016, which is between the 36 projects completed in 2014 and the 46 completed in 2015. As in previous years, some customers completed multiple projects throughout the year. Overall, 15 unique customers completed projects in 2016, a *decrease* from 32 unique customers in 2015 and 23 unique customers in 2014. Five of the customers who participated in the program in 2016 completed multiple projects, with one customer completing ten projects and one customer completing thirteen. In total, the 40 projects included implementation of 42 unique measures. Table 3-1 summarizes the key program indicators. Total *ex ante* energy savings reported for the program amounted to 18,990 MWh, and *ex ante* demand reductions reported under the program totaled 2.43 MW.

Table 3-1. Ex Ante Program Summary

	2016 Total	Average per Project
Incremental Project Cost	\$5,319,318	\$132,983
Reported Floor Area	605,300	15,133
Amount of Incentives	\$1,079,969	\$27,427
Ex Ante Energy Savings (MWh)	18,990	475
Ex Ante Demand Savings (MW)	2.43	0.061

The average project size reported for the program was 15,133 square feet, however, there was a wide range of project sizes within this average, representing the diversity of facilities served by the Data Center Program. The reported floor area for all projects in 2016 ranged from a low of 240 to 100,000 square feet. In 2016 there were twenty-three telecommunication projects, each with less than 500 square feet. Additionally, six buildings served by eight projects were 50,000 square feet or greater. Excluding the twenty-three telecommunication projects, the average 2016 project square footage is 39,893.

Table 3-2 shows the number of projects and savings by economic sector, based on information reported in the tracking database. Navigant found business types and segments reported by AEP Ohio to be both incorrect and inconsistent. For example, of the 23 nearly identical telecommunications projects, 20 were reported as “Other/Miscellaneous, Communication Equip” and 3 were reported as “Other/Miscellaneous, Unknown”. The reporting nomenclature should accurately describe the business types and segments representing much of the program’s projects. Navigant recommends descriptions for the reported Business Types and Segments that accurately represent the breadth of customers who have participated. Table 3-3 compares Navigant’s recommended descriptions with those reported in the tracking data.

Two of the projects in the tracking database were recorded with a business type of “Data Center” with no indication of the economic sector or sectors served. While this is an improvement from 2015 when 24 percent (eleven) projects were not categorized with sector served, Navigant continues to recommend program staff identify the type of business for each project and record this information in the database.

Table 3-2 and subsequent tables and figures present the participation by economic sector based on Navigant's interpretation of entries in the tracking database.

Table 3-2. Summary of *Ex Ante* Savings by Economic Sector

Economic Sector	No. of Projects	<i>Ex Ante</i> Savings		Incentive (\$ / kWh savings)
		Energy (kWh)	Demand (kW)	
Colocation / Cloud Hosting	8	13,666,134	1843	\$0.0540
Finance, Insurance, Real Estate	3	1,184,570	131	\$0.0700
Government	1	245,773	50	\$0.0700
Healthcare	1	72,741	8	\$0.0700
Industrial/Manufacturing	2	37,339	4	\$0.0641
Military	1	2,099,229	239	\$0.0636
Retail Trade, Service	1	1,260,082	121	\$0.0700
Telecommunications	23	424,415	31	\$0.0700
Total	40	18,990,283	2430	\$0.0578

Note: Totals may not sum due to rounding.

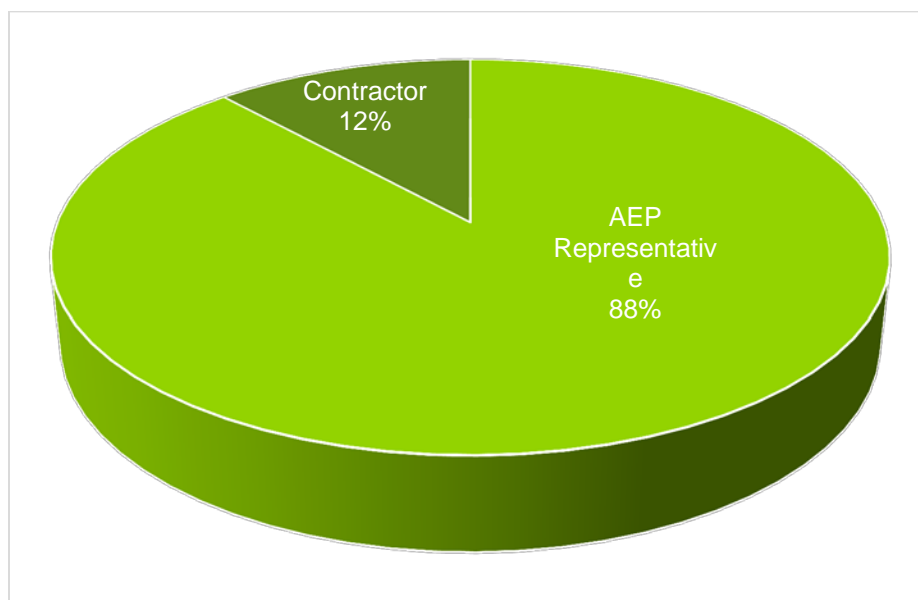
Table 3-3. Recommended Economic Sector Description

Navigant Recommended Economic Sector Description	AEP Ohio Reported Business Type, and Segment
Colocation / Cloud Hosting	Data Center, Heavy Const
	Data Center, Communication Equip
	Data Center, Retail Trade
	Data Center
	Large Retail/Service, Misc Services
Finance Insurance, Real Estate	Large Retail/Service, FinInsRealEstate
	Large Office, FinInsRealEstate
Government	Government/Municipal, State Govt
Healthcare	Large Office, Whlse Trade-NonDurable
Industrial/Manufacturing	Data Center,
	Industrial/Manufacturing,
Military	Government/Municipal, Federal Govt
Retail Trade, Service	Large Retail/Service, Whlse Trade-NonDurable
Telecommunications	Other/Miscellaneous, Communication Equip
	Other/Miscellaneous, Unknown

All businesses participating in 2016 projects indicated project data center equipment operated 24/7 (8,760 hours per year).

The application form for the program asks participants to indicate how they had learned of the program. As shown in Figure 3-1, the tracking database shows 88 percent of participants indicated they initially heard of the program through an AEP Ohio Account Representative, while 12 percent learned of the program from their contractor (Solution Provider). Navigant notes many customers in 2016 are repeat customers from previous years. This suggests AEP Ohio would be well served by developing an additional category of “Repeat Participant” to accurately describe how all active customers learn about and engage with the program.

Figure 3-1. How Participants Learned of the Program



The tracking database recorded whether a Solution Provider was involved in implementing the efficiency project. The database shows 12 different Solution Providers were involved with 17 unique projects completed during the year⁵. While this amount is a *reduction* from the levels reported in 2015 when 27 Solution Providers were involved with 44 projects, it represents an increase over 2014 when 7 Solution Providers participated. As Figure 3-2 shows, twenty-two percent of the projects were reported to be “self-performed,” that is without the assistance of a Solution Provider. Navigant identified inconsistencies between the measure tracking data and project tracking data: one of the Solution Providers was not included in the project tracking data file.

⁵ While there were 40 projects in 2016, Navigant combined the twenty-three telecommunications projects into two unique projects for this analysis, acknowledging the implementation consistencies for these two sets of identical projects. Additionally, there were three identical new construction projects which were counted as one unique project.

Figure 3-2. Percentage of Projects Utilizing a Solution Provider

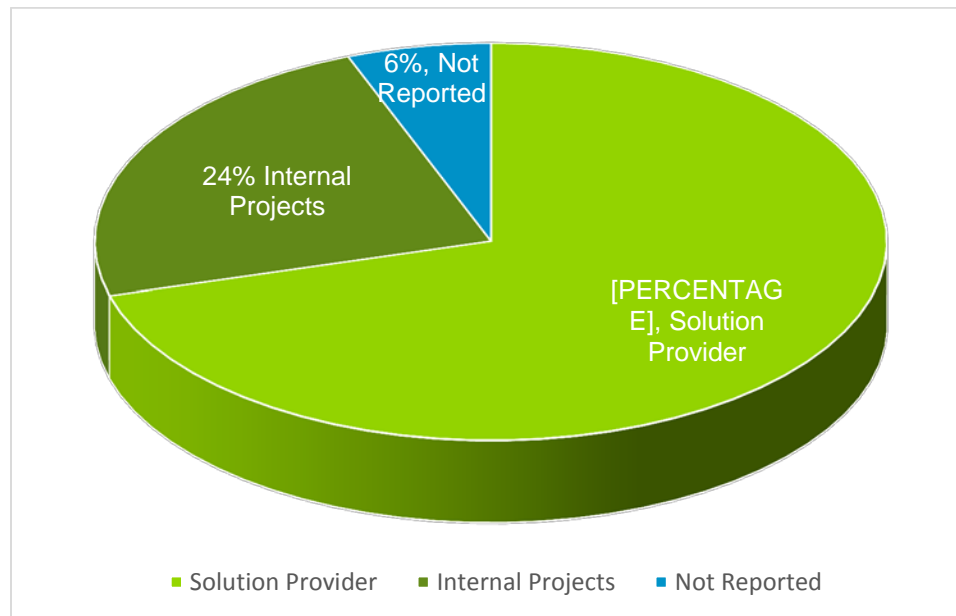


Figure 3-3. Projects and Savings by Economic Sector

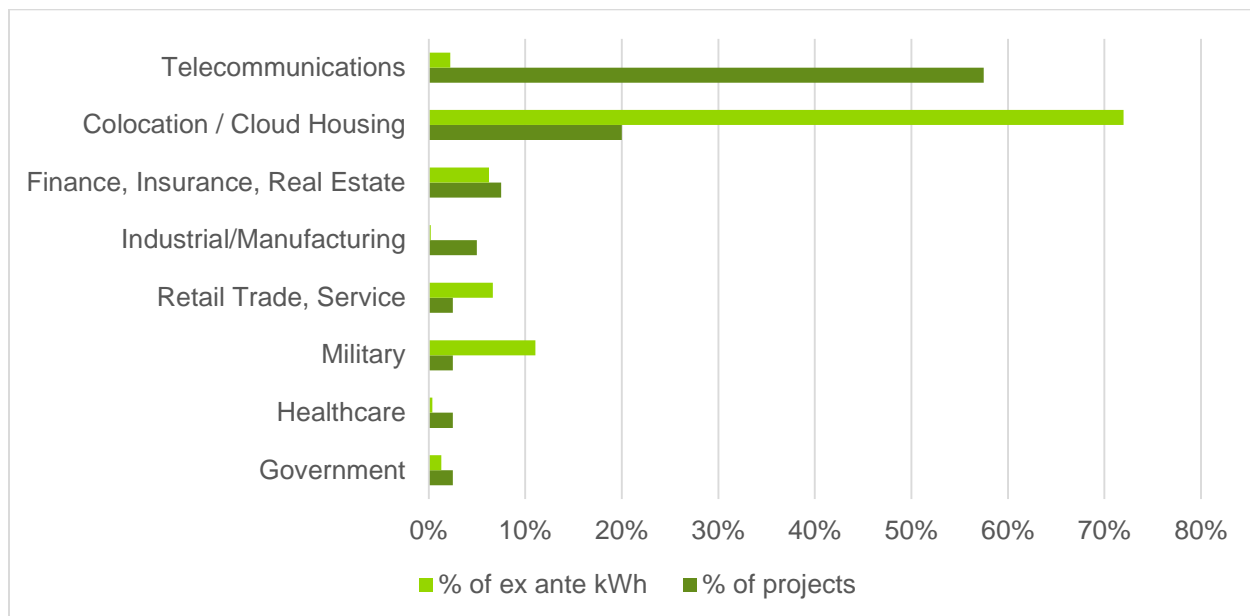


Figure 3-3 illustrates the distribution of projects and *ex ante* savings by economic sector. As the chart shows, the largest number of projects came from the telecommunications sector (58%) and from the colocation / cloud hosting sector (20%). Most *ex ante* savings (72%) came from the colocation / cloud hosting sector. Four of the six colocation / cloud hosting projects were very large, accounting for 95 percent of the colocation / cloud hosting sector savings and 68 percent of total program savings. While

Data Center Program services are utilized by a variety of different business sectors, Navigant notes most projects, and project savings, are sourced from just two economic sectors.

The Tracking Database records key dates of program activity including dates of application and pre-application submittal; project site visits, enrollment, completion, and incentive paid. Navigant's analysis of the Tracking Database dates provided the following findings:

- On average, Incentive Payment Date is one hundred thirty-nine days (4.8 months) following Project Complete date. Elapsed time ranges from twenty to three hundred thirty days. One project was recorded as incentive paid before the project was complete. Actual incentive payment time is significantly longer than the four to six weeks advertised to customers in the "AEP Ohio Data Center Brochure 2015-16" document.
- The database indicates only 4 of the 40 completed project applications were submitted prior to the date of project completion; 1 project application was submitted on the date of project completion. There are 4 projects in the database with no project application submittal date. This is a significant change from 2015 when 74 percent of project applications were submitted before project completion.
- While there are project outliers, most project applications were submitted to AEP Ohio within 90 days from project completion. There is confusion about when applications must be submitted: program staff indicates within 180 days of project completion. The "AEP Ohio Data Center Brochure 2015-16" document indicates customers may apply at any time within a current calendar year: "Project applications must be submitted within 180 days of project completion from a previous calendar year or within the same calendar year of its completion". This same brochure also has a contradictory instruction: "The final application should be submitted within 30 days of the project completion". Actual elapsed time between Project Completion and Application Submitted as reported in the tracking database:
 - Four projects submitted before project completion
 - Twenty-eight projects submitted within 90 days of completion
 - Three projects submitted between 90 and 180 days after project completion
 - One project submitted >180 days after project completion
 - Four projects had no Application Submitted date entered

Of those projects submitted after the completion date, most were submitted within approximately one month of project completion. The original program eligibility criteria indicated that applications must be submitted within six months of project completion; one project exceeded this with an application submitted 253 days after the project completion date.

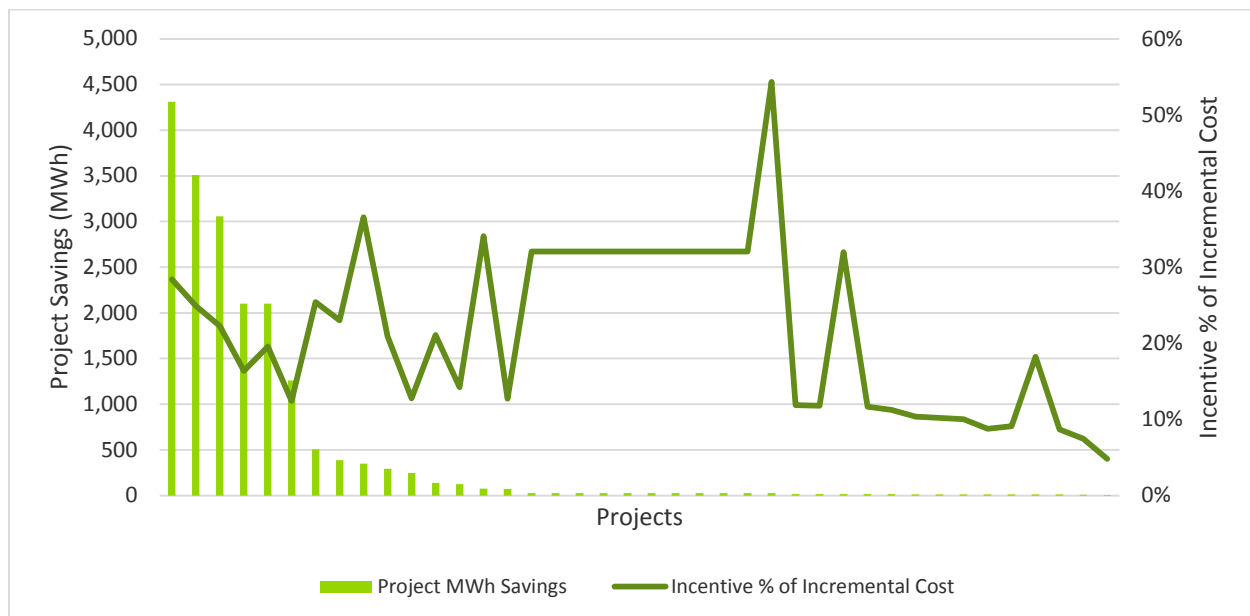
- Customers are informed of their estimated project incentive through an incentive reservation letter, sent when an application or pre-application is received. Only sixteen out of forty project records (40%) include a pre-application received date, indicating most program participants implemented their projects without knowing how much of an incentive they would receive. Best practices would include a goal to provide customers with an incentive commitment letter within 10 business days of receiving their pre-application to support and encourage project completion.

The findings listed above support the following program recommendations:

- Amend the program terms and conditions to require program application prior to the purchase of equipment. This change would help to ensure the program can influence customers; that customers are aware of, and receive the complete set of program benefits; and allow AEP Ohio to leverage program resources invested in a single project to realize additional savings.
- Use a binary value for entries where a value is not recorded because it was not needed, to clarify the difference between inputs which are missing (and requiring resolution from the implementation team), and inputs that are unnecessary for a measure or project. For example, “NPA” could be used to indicate “no pre-application” was received for this project.

Incentives ranged from five to 54 percent of reported Project Incremental Cost. While there is some correlation between a project’s energy savings and the incentive amount as a percent of customer total cost, the incentive structure is not responsive to the financial constraints of individual projects. Figure 3-4 illustrates a comparison of project kWh savings with incentives as a percent of project incremental cost. This analysis of project incentive results demonstrates the challenges faced by customers to estimate how the project incentive will affect their financial investment, in advance of receiving a reservation letter from AEP Ohio. If a customer is unaware of how their incentive will affect the project return on investment, the degree to which incentives affect customer project decisions is uncertain.

Figure 3-4. Project kWh Savings and Incentives as a Percent of Incremental Cost



The tracking database contains both Project Cost and Total Cost fields. Identical values are shown in both fields, except for five projects with no Project Cost entry. The Incremental Cost field is only shown in the measure file; it is not reported in the Project database file. Navigant recommends rolling up incremental costs at the project level to assess the financial impacts of energy efficiency projects on AEP Ohio’s customers.

Measures completed under the program were divided into two broad categories, measures related to HVAC (Heating, Ventilation and Cooling) and IT and Power Equipment (UPS, Virtualization or Equipment/

Storage). Within each category, measures were further subdivided into the specific measure types shown in Table 3-4. In 2016, 12 different Data Center Measure Types were installed. This is a sharp contrast with the 26 measures available to the program, and marketed to customers in the “AEP Ohio Data Center Brochure 2015-16” document.

As Table 3-4 shows, 88 percent of measures and fully 95 percent of total *ex ante* savings came from HVAC-related measures, while the balance came from measures related to IT and power equipment. The largest share of HVAC savings came from new construction comprehensive cooling system measures, with other major HVAC measures being new CRAH units and conversion from an air-cooled system to a water-cooled system. The IT equipment savings came from storage, server and equipment virtualization. Figure 3-5 illustrates the distribution of installed measures.

The 2016 program performance in terms of measure end use, project comprehensiveness, and savings distribution stands in contrast with AEP Ohio’s website, which disaggregates Data Center energy use as over 50 percent from “IT Load”, and 47 percent from “HVAC Load”. Program marketing materials list twenty-six different Data Center measure types.

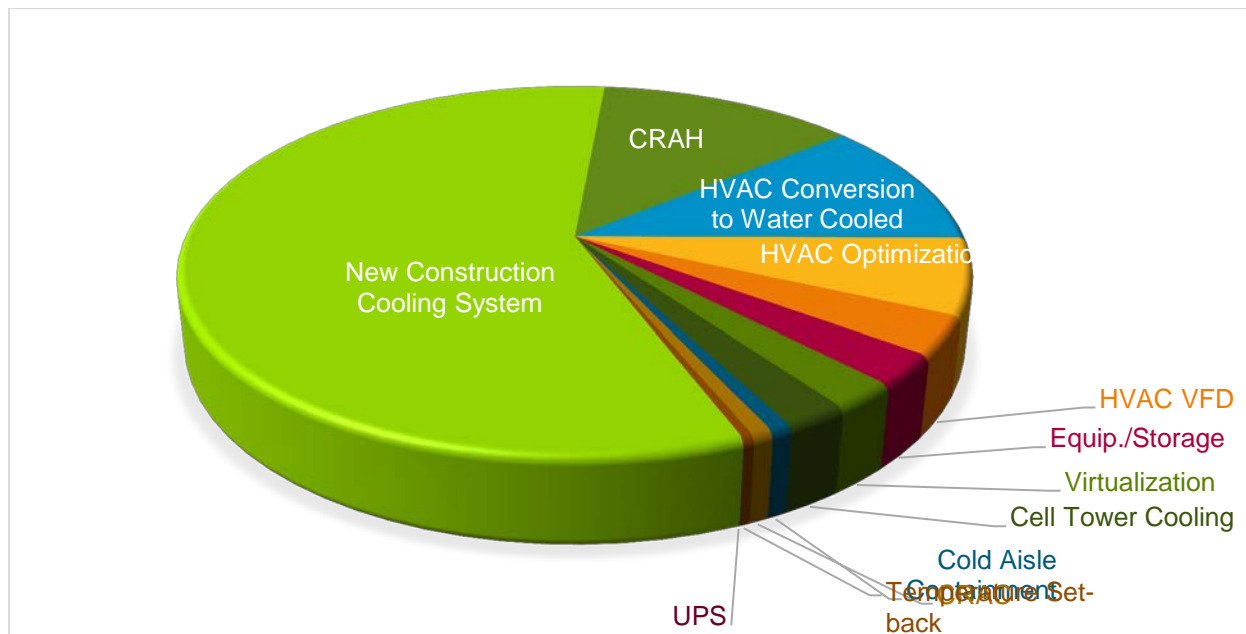
Table 3-4. 2016 Measures by Category

Measure Types	No. of Measures	Ex Ante Savings		Measure Cost
		kWh	kW	
HVAC Equipment Measures				
Cell Tower Cooling	23	424,415	31.6	\$170,616
Cold Aisle Containment	1	139,713	15.9	\$46,413
Computer Room Air Conditioner (CRAC)	3	136,812	15.6	\$66,137
Computer Room Air Handler (CRAH)	2	2,391,880	273.0	\$779,846
HVAC Conversion to Water Cooled	1	2,101,344	414.8	\$816,000
HVAC Optimization	1	1,260,082	121.6	\$709,999
HVAC VFD	2	631,955	90.4	\$252,083
New Construction Cooling System	3	10,879,140	1,347.6	\$2,227,076
Temperature Set-back	1	72,741	8.3	\$40,035
Subtotal HVAC Equipment Measures	37	18,038,082	2,318.8	\$5,108,205
IT and Power Equipment Measures				
UPS	1	1,458	0.2	\$292
Virtualization	3	445,007	53.6	\$71,622
Equipment/Storage	1	505,737	57.7	\$139,200
Subtotal IT and Power Equipment Measures	5	952,202	111.5	\$211,114
Total	42	18,990,284	2430.3	\$5,319,318

Formalizing and prioritizing a Solution Provider initiative that educates and rewards participating contractors can help to diversify the types of measures in the program and increase project

comprehensiveness. Solution Providers are in a unique position to identify opportunities and refer their customers to the Data Center Program. While the direct sales approach has been successful for AEP Ohio to meet its energy savings goals, Navigant continues to recommend it be supplemented with a broader outreach and communications campaign, to build awareness of both the program and opportunities to reduce energy use in Data Center operations.

Figure 3-5. Measures Implemented in Data Center Program by Energy Savings (kWh)



3.2 Impact Evaluation Findings

This section includes a summary and discussion of the evaluation-calculated energy and demand savings for the 2016 Data Center Program. Annual electricity savings were calculated using the data collected through document reviews and field visits for the sample of sites.

With a few exceptions, the project details and savings calculation approach was well documented by the implementation contractor. Data center projects are complex, and clear and concise documentation is necessary for effective evaluation. Navigant appreciates the level of detail provided by the implementation contractor in the project files.

3.2.1 Summary of Impact Findings

The *ex post* energy and summer coincident demand savings for 2016 are 21,399 MWh/year and 2.73 MW, respectively. The *ex post* savings is almost double the savings from either the 2014 or 2015 program year and demonstrates strong savings growth. The realization rate for energy savings is 1.13 and the demand savings realization rate 1.12, which is the highest realization rate achieved by the program to date. These results are shown in Table 3-5. Both energy and demand reductions exceeded the goal of 90 percent confidence at 10 percent precision.

Table 3-5. Impact Savings, Realization Rate and Precision of Sample

Metric	2016 Program Goals ¹ (a)	<i>Ex Ante</i> (b)	<i>Ex Post</i> (c)	Realization Rate RR = (c) / (b)	Overall Relative Precision at 90% Confidence	Percent of Goal = (c) / (a)
Annual Energy Savings (MWh)	7,979	18,990	21,399	1.13	4.85%	268%
Coincident Peak Reduction (MW)	0.99	2.43	2.73	1.12	4.66%	276%

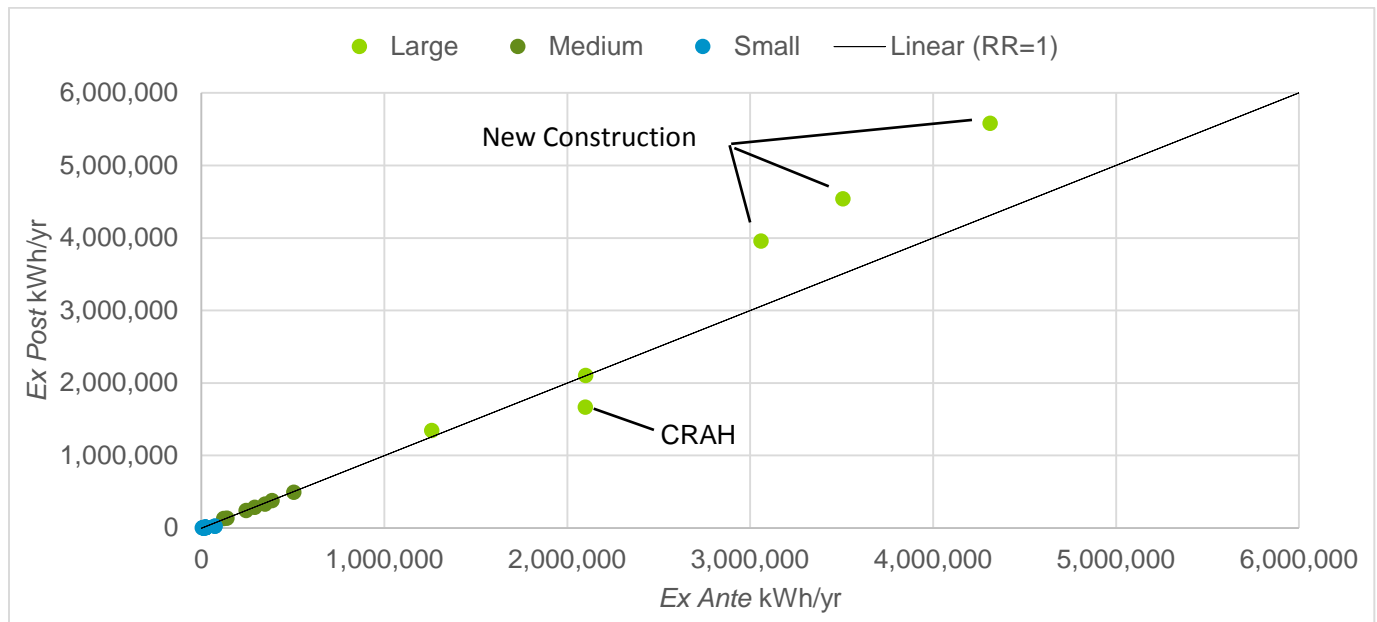
Source: ¹AEP Ohio VOLUME 1: 2012 TO 2014 Energy efficiency/Peak Demand Reduction (EE/PDR) Action Plan, November 29, 2011, data for 2014; Evaluation Data Collection and Analysis.

3.2.2 Driving Factors of Realization Rate

Data analysis revealed certain factors are driving the realization rate between claimed savings and verified savings. Energy savings and demand savings will be discussed simultaneously since most measures have a flat savings profile regardless of time or season.

Nine projects were sampled as part of the impact study. The diversity of the measures sampled is similar to the measure mix in the entire population. Three of the sampled projects are identical large new construction data centers with a comprehensive approach to the data center cooling system; two of the projects are CRAC or CRAH replacements; one project is an HVAC optimization project with the addition of air-side economizers, hot aisle containment, and VFDs added to the UPS CRAC units; one project is converting from an air-cooled system with CRACs to a new chilled water plant; one project is a cell tower cooling system retrofit; and one sampled project is a server virtualization project.

Figure 3-6 is a graphical representation of the project level *ex ante* versus *ex post* energy savings grouped by sample strata and program approach. The diagonal line represents the goal of a realization rate of one. Points above and to the left of the RR=1 line represent projects with energy realization rates above one, while those points below and to the right are projects with realization rates less than one.

Figure 3-6. *Ex Ante* vs. *Ex Post* Energy Savings


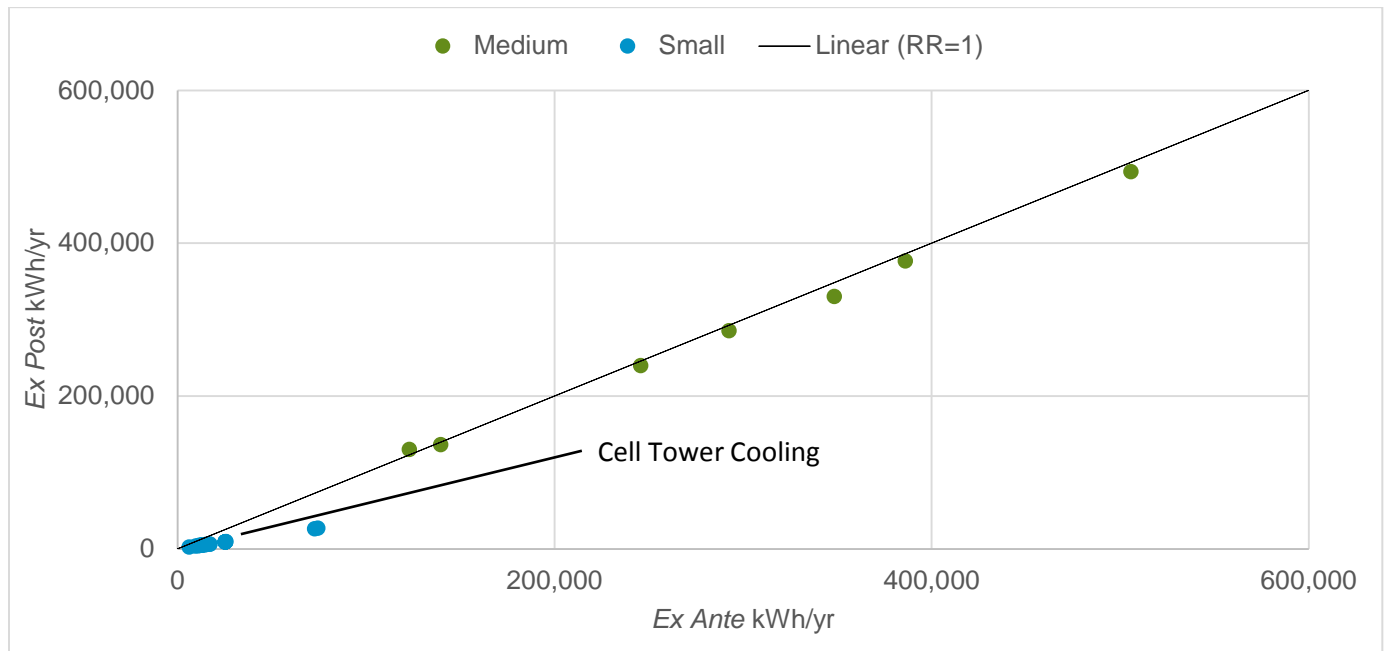
A company providing cloud hosting built three identical new data centers depicted in Figure 3-6 as “New Construction”. These projects represent phase one of the build out, with seven more phases to be built in the future. Phase one consists of 4MW of IT load at each data center. The data centers incorporate several advanced energy efficiency measures, including the elimination of mechanical cooling, very high supply air temperatures coupled with direct outside air economization, and evaporative cooling to extend the economization window to the full year. The same system is used to support the UPS electrical rooms. Efficiency savings is also claimed for the new UPS units. *Ex ante* calculations compare measured energy consumption to the baseline given by CA Baseline document for new data centers. The implementation contractor provided a detailed analysis model to calculate savings. Navigant found only a few small errors in the analysis, such as a small data entry error of minimal consequence. The primary driver of the realization rate adjustment is that Navigant was able to collect more operational data with the data center at a higher IT load, which affected both the baseline and actual energy profiles. Overall, the project has a realization rate of 1.29 for both energy and demand reduction. The *ex ante* project lifetime is 15 years, but given the nature of the overall system design, Navigant adjusted the lifetime to 20 years. Combining the increased first year energy savings and the increased project lifetime resulted in a lifetime realization rate of 1.73. However, one area of concern remains regarding the project economics, which is discussed in Section 3.2.3 Incremental Cost Findings.

The CRAH project is a data center that underwent a replacement of 28 CRAH units with 25 new Liebert CW106D units with electrically-commutated fan motors and iCom controls. Since the existing CRAH units were over 20 years old and beyond useful service life, the baseline for this project is 25 new CRAH units based on ASHRAE 90.1 guidelines. However, the *ex ante* calculation assumed the existing manual controls would apply to the baseline condition of new constant speed CRAH units. Navigant asserts

automatic controls are industry standard and should be applied to the baseline condition. Adjusting the baseline controls resulted in the realization rate of 0.79⁶ for both energy and demand reduction.

Figure 3-7 presents the same information as in Figure 3-6, but with the large projects removed so detailed results can be demonstrated for medium and small projects.

Figure 3-7. Ex Ante vs. Ex Post Energy Savings Without the Large Stratum



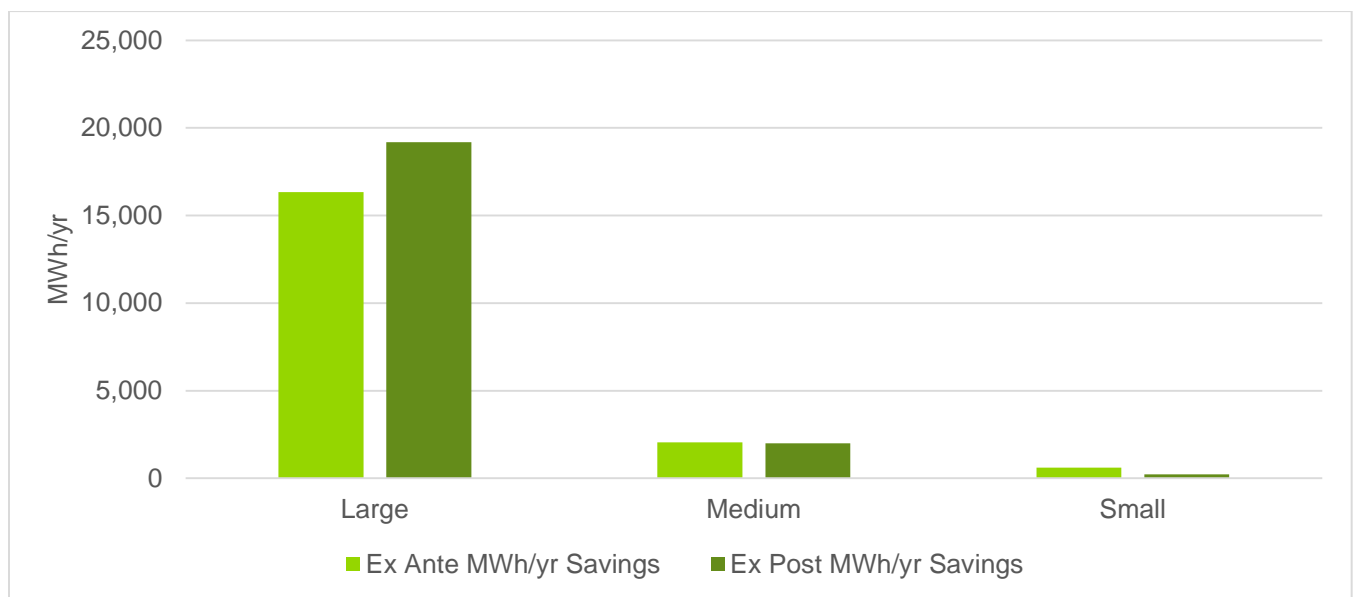
Only one project was in the verification sample from the small stratum since the small stratum collectively consisted of only 3.2 percent of the *ex ante* program savings. The randomly selected project was a cell tower cooling system retrofit, which happened to be one of ten identical projects conducted by the same participant, all with the same *ex ante* savings. The verification effort examined all ten cell tower projects. Then, the result was divided by ten to find the average savings for each project, which was applied to the one sampled project. This approach of looking at the set of identical projects eliminated variance in savings from site to site. Each tower replaced two wall-mounted packaged cooling units with two wall-mounted Marvair DC Free Air HVAC units including economizer. The original units did not include an economizer. The *ex ante* savings calculation relied on a baseline provided by ASHRAE 90.1. However, the ASHRAE 90.1 baseline is for space comfort cooling, not a specialized application like cell tower cooling. Navigant applied an *ex post* baseline of equivalent efficiency to the existing units and was therefore able to employ a billing analysis. The billing analysis was extended to all ten cell tower projects for this participant and on-site visits with metering were conducted at three of the sites. Results were weather adjusted as the post retrofit year was considerably warmer than the prior baseline year. The billing analysis coupled with the metering shows *ex ante* savings are overstated, in fact *ex ante* savings estimates exceed the entire *ex post* cooling load. Additionally, it was found through on-site interviews and

⁶ Navigant also calculated project savings relative to an as-found baseline. Had the as-found baseline been used the realization rate would have been 0.68 instead of 0.79.

the billing analysis that one of the sites claimed did not actually conduct the retrofit. Overall, the project realization rate is 0.36 for energy and 0.38 for demand reduction. This realization rate was applied to the entire small stratum.

Figure 3-8 provides the *ex ante* and the *ex post* energy savings for each verification sample stratum. The realization rates for the large, medium and small strata are 1.17, 0.98 and 0.36, respectively. This trend of increasing realization rate as the project size gets larger is an indication the implementation contractor is appropriately spending more evaluation time with larger projects and making sure the saving claim is well vetted on the largest projects.

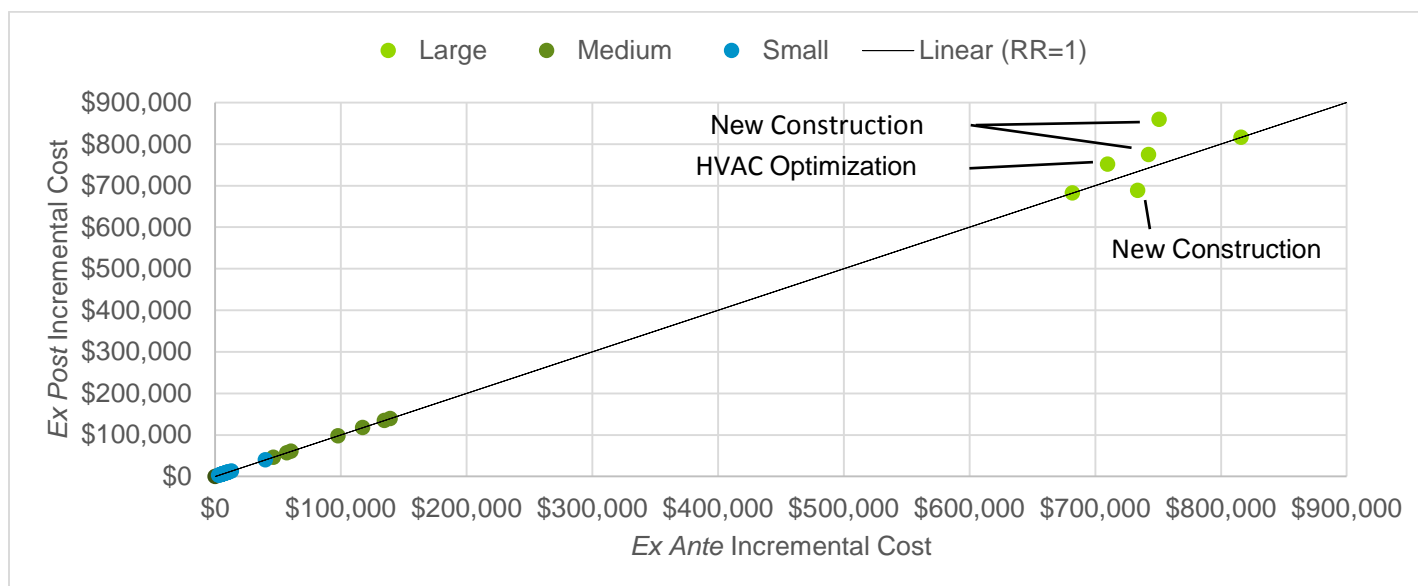
Figure 3-8. Energy Savings Stratum Comparison - Ex Ante vs. Ex Post



3.2.3 Incremental Cost Findings

The project incremental cost is an important parameter in the benefit/cost analysis. The incremental cost is defined as the difference between the cost of the proposed energy efficient equipment and the cost of retrofitting the data center to meet baseline conditions in lieu of the energy efficient option. In cases where the existing equipment has significant remaining useful life, the baseline cost is zero; but, in the case where the affected equipment is near the end of life, the baseline cost is the least expensive equipment that meets the commercial energy code, is commercially available, and will meet performance requirements. Incremental cost is recorded in the measures tracking data.

Like Figure 3-6, Figure 3-9 is a graphical representation of the project level *ex ante* versus *ex post* project incremental cost grouped by sample strata and program approach. The diagonal line represents the goal of a realization rate of one. Points above and to the left of the RR=1 line represent projects with cost realization rates above one, while those points below and to the right are projects with realization rates less than one.

Figure 3-9. *Ex Ante* vs. *Ex Post* Incremental Cost


Since there were adjustments to the first-year savings, the measure lifetime energy savings were adjusted and the blended project level lifetimes were adjusted.

A project which consisted of new CRAC units used an ASHRAE 90.1 fan power baseline rather than the CA Baseline document. Navigant informed the implementation contractor in June, 2016 that projects completing in the second half of the program year should be using the CA Baseline document and ASHRAE 90.1 baselines would no longer be accepted. The project was completed in August, inspected in October, and the incentive was paid in December. Additionally, the compressor savings calculation used the sensible coefficient of performance (SCOP) in the baseline, but used a measured power for the efficient case. The SCOP is based on standardized conditions and would not match the measured condition. Navigant adjusted the compressor savings to be based on SCOP in both the baseline and efficient case. Project realization rate is 1.06 for both energy and demand reduction.

A server virtualization project estimates baseline power by referencing APCs server power database⁸. The efficient case was represented by a hard-coded number in the project file which is labeled as a server rack measurement. Given the nature of the measurement, it is assumed to be a spot measurement. The spot measurement may not be consistent over a longer time horizon. Navigant adjusted the efficient case analysis method to match the baseline analysis, i.e., using APCs server power database to estimate power. The virtualized server power is small compared to the baseline and therefore had a minimal effect on the project savings. Project realization rate is 0.95 for both energy and demand reduction.

A project which involved a conversion from an air-cooled system to a water-cooled system used the wrong coincident peak period. Adjusting to the correct peak hours resulted in a demand reduction realization rate of 0.98.

3.3 Process Evaluation Findings

The process evaluation review found the program has been successful in meeting its 2016 energy savings goals. There is evidence the program is broadening the range of participating customers, and in meeting the ancillary goal of making the program available to data centers of different sizes.

However, the evaluation also found the number of Solution Providers, completed projects, measures, and unique customers has decreased in comparison to the 2015 program year. In comparison with the 2014 program year, some of these metrics increased slightly, while others decreased as illustrated in Table 3-6.

⁸ APC's server power database can be found at

http://www.apc.com/template/country_selection.cfm?ref_url=/tools/ups_selector/index.cfm?args=us/en

Table 3-6. Historical Participation Metrics

Metric	2014	2015	2016
Projects	36	46	40
Unique Customers	23	32	15
Measures	53	62	42
Solution Providers	7	27	12

The evaluation finds the Data Center Program goal of 7.98 GWh in energy savings and 0.99 MW of demand savings was achieved through the contribution of just three very large projects from a common participant, totaling 10.88 GWh and 1.35 MW savings (*ex ante*). Additionally, the quantity of completed 2016 measures is significantly less than the measures available to program participants. Through adjustments in program outreach and service offerings, AEP Ohio can increase the project comprehensiveness and the quantity of customers benefiting from program services. Recommendations for continued program improvement are found in each of the following subsections.

The remainder of this section presents these findings in more detail, including:

- Marketing Efforts and Program Awareness
- Customer Enrollment Process
- Incentive Payment Process
- Review of Program Tracking Data
- Verification and Due Diligence

3.3.1 Marketing Efforts

Historically, both AEP Ohio and implementation contractor staff have stressed the importance of having a specific program to serve the unique needs of data centers, and their specialized data center staff. Thus, the Data Center Program has been developed, intending to access this market segment with a specific marketing approach and program technical staff devoted to identifying project opportunities and overcoming customer barriers to improving data center energy efficiency.

The data center market is complicated in that some companies utilize a third-party to administer their data center. This means, in some instances, the organization responsible for the data center at a customer site is not actually an AEP Ohio customer.

Outreach in 2016 has been largely focused on direct contact activities conducted by AEP Ohio Account Representatives. Indeed, the tracking data suggest most customers learned about the program directly through their AEP Ohio Account Representative; only two projects were referred from a customers' contractor. In the past, marketing efforts have also included cold calls to customers known to have data centers, meetings with Solution Providers, targeted outreach to segments identified as having potential (such as schools and hospitals); and an e-mail blitz to potential participants to communicate the availability of the program and generate leads. Navigant received an inconclusive answer from the implementation contractor regarding if a reallocation of budget between incentive spending and marketing

spending would increase program participation and savings. Navigant plans to research this topic further during the next participant survey.

2016 saw a decrease in the number of projects, measures, unique customers, and Solution Providers as compared with 2015. In comparison with the 2014 program year, some of these metrics increased slightly, while others decreased as illustrated in Table 3-6. The Data Center implementation contractor indicated their only direct Solution Provider activity in 2016 was the annual meeting, where high performers were recognized. Additional Solution Provider communications and outreach were delivered through a supporting vendor, including newsletters, certificates and alerts. These are excellent methods to engage Solution Providers should be viewed as single tactics within a larger strategy of Solution Provider engagement and management.

Many customers rely on third-party contractors to manage their data centers; AEP Ohio should prioritize its relationships with these contractors to identify energy efficiency opportunities, develop comprehensive projects, and promote the Data Center Program. The program can achieve improved participation and comprehensiveness through additional Solution Provider management tactics, including delivering a clear value proposition illustrating contractor participation benefits, ongoing technical and program trainings, routine Solution Provider engagement, and management of individual projects.

The decrease in 2016 program participation (quantity of projects, unique customers, measures, and Solution Providers) contrasts with recent program results. Some of this decrease in participation activity may be the result of the program's focus on serving three very large projects. AEP Ohio should balance large scale project implementation with developing and managing Solution Provider relationships to build a pipeline of comprehensive projects.

The comparative increase in 2015 Solution Provider activity indicates the strategy of reaching out to this sector to build program awareness and encourage participation had been successful. The 2015 Interviews with Solution Providers indicated they learned of the program through contact with the program implementer or AEP Ohio staff; several commented on working with implementation staff in completing their projects and applications. The Solution Providers interviewed in 2015 had each enrolled at least one project in the program, indicated an interest in learning more about the program and increasing their involvement. In some instances, the Solution Provider had completed multiple projects in the Ohio market but had not always enrolled these in the program.

Solution Providers are in a unique position to identify opportunities and refer their customers to the Data Center Program. While the direct sales approach has been successful, Navigant continues to recommend this be supplemented with a broader outreach and communications campaign, to build awareness of both the program and of opportunities to reduce energy use in Data Center operations. We note the program has developed case studies and other communications materials which are now available on the program website to aid in this process.

3.3.2 Customer Enrollment Process

The customer enrollment process was reviewed, including the application forms, processes followed by the implementation contractor in reviewing and approving applications, time required for review and approval of applications, and approval review processes. As noted in prior evaluations, the listing of "*Steps for Submitting Your Application*" and the "*Check list*" included in the application form are helpful in ensuring all the required elements are included in applications.

There were three very large data center projects in 2016 which should have been included in the New Construction Program, but were not. As such, there are missed opportunities for the customer to gain additional energy efficiencies and incentives in their project, and missed opportunities for the New Construction Program to claim additional savings⁹. Program and implementation staff of both programs report that communication is open and ongoing between the programs. AEP Ohio should commit to prioritizing a comprehensive approach not only to data center projects, but also through referrals to complementary program services.

Navigant recommends Data Center floor space be tracked rather than building area. In many cases, a data center is not the core use of a building. Identifying the floor area devoted to Data Center activity as compared to other business activities will put the Data Center activity in context for each business served.

Other than the square footage clarification, Navigant found no significant issues with respect to the enrollment and approval process. In part, this reflects the fact that program staff provides considerable support to participants in completing program applications and supporting documentation.

3.3.3 Incentive Payment Process

The average elapsed time between the project inspection and issuing the incentive is 139 days, or five months. This time seems quite long, however, there is no indication in the tracking database of when the program received the complete set of project information required to pay the incentive. The elapsed time is significantly more than the suggested four to six weeks listed on the program documentation between project completion and incentive payment.

Navigant recommends new data fields be added to the database recording when the application and all required information is complete, as well as when the project is approved for payment, so the actual processing time can be properly tracked and monitored. The goal of this recommendation is to identify specific issues (either with obtaining customer data or internal processing) contributing to project completion delays and develop processes to improve the customer experience and project work flow.

3.3.4 Program Tracking Data Review

Program tracking data is maintained by the implementation contractor and shared securely with AEP Ohio via email. Navigant reviewed the tracking data and found it to be reasonably comprehensive and complete. However, the evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

The following recommendations are offered to further improve the value of the tracking data:

- To the extent possible, the economic sectors of all businesses should be recorded to best describe the business's primary activity. While the 2016 data showed an improvement over previous years, there are some projects with the "Business Type" as "Data Center". Given all eligible applications to this program are for a data center, this designation provides little insight into the nature of the businesses served.

⁹ New Construction program measure opportunities include: lighting power density, lighting controls, and thermal envelope.

- The administrative project review should include a requirement to obtain missing information, or note why it has not been included in the database. In past reviews, Navigant has noted several fields in the tracking base were found to be incomplete. Several fields in 2016 have been identified with either missing data or no explanation with respect to why the data is missing. Use of inspection date fields is inconsistent and difficult for the evaluation team to assess the efficiency and effectiveness of program management.

Program implementers should clarify the data field definitions, and when project managers should use these different date fields. Finally, Navigant recommends developing data inputs to designate binary values for fields where no input is currently required for a measure or project. These recommendations will support implementation staff and the evaluation team to determine which measures and projects require additional action, and which have been successfully completed.

The review of 2016 tracking data finds:

- **Incremental Cost** is only included in the Measure data file; it is not rolled up at the project level file
- **Project Cost and Total Project Cost** fields in the project data file should be clearly defined. There is no obvious difference between the two fields, other than Total Project Cost had all the data fields completed where the project cost is missing from 5 projects.
- **Post-Inspection Date:** missing from 27 projects (consider developing a null value to acknowledge when the field is unnecessary, such as “NI” for Not Inspected, rather than leaving blank)
- **Enrollment Date:** missing from 4 projects
- **Pre-Application** and **Pre-Estimated Project Complete Dates:** both missing from 24 projects
- **Pre-Project Cost:** Missing from 27 projects
- **Application Submitted Date:** Missing from 4 projects
- **Pre-Inspection Passed** date: missing from 37 projects
- **Post-Inspection Passed** date: missing from 27 projects
- **Actual Site Visit Date:** While all forty projects listed this date, its use conflicts with program staff description, who indicated some of the smaller replicated projects for the same customer did not receive site visits
- In the measures file, there was one project in 2016 with multiple measures. There was a data entry error in the total cost and incentive paid fields, where the total project values were entered into each measure, effectively triple counting the results.
- Thirty-nine of the 40 projects completed were listed in the measures file as a single measure, even though many of them did indeed incorporate multiple measures. For example, the HVAC Optimization project consisted of hot aisle containment, the addition of two air side economizers, and variable frequency drive upgrades to the four UPS room CRAC units, but in the measures file, these were reported as a single measure.
- Adding or modifying a few tracked fields would enhance the data available to support program management, adjustments to program design, and the evaluation process:
 - Add the field “Data Center Floor Area Affected” to clarify the objective of recording square footage as that limited to data center activity. If a site visit is performed, verify the data center floor area affected by the project and update the tracking data.

- Track two fields for demand reduction: 1) demand reduction coincident with the Ohio peak period, and 2) demand coincident with the PJM system peak.
- Add or otherwise clarify three fields: (1) the date on which the final application with all supporting documentation was submitted, (2) the date when the final inspection was completed, and (3) the date of application approval. As discussed above, the tracking data does not include a field to indicate when all the project information required to approve the application has been received.
- Add a definition worksheet which documents the intent of database fields and provides an explanation of column headers, acronyms, and any protocols with respect to how the data is input and reported. Several acronyms and abbreviations are used in the tracking database without explanation.

Navigant understands that the implementation contractor also tracks other metrics to monitor program performance, such as engineering review time, accuracy of data entry and customer satisfaction.

3.3.5 Verification and Due Diligence

Navigant reviewed verification, due diligence and quality control issues with respect to both program data and the engineering review of energy savings carried out as part of the program. While administrative procedures are in place to ensure information submitted to the program is processed and recorded in the project tracking database, there are some missing data points. It is conceivable these are due to routine program implementation procedures, however, in absence of database field definitions and use protocols, the evaluation team views these as erroneously missing data points.

Application forms are reviewed to ensure project eligibility is satisfied, the form is complete, and all required documentation has been provided. Program management reported all projects are subject to an administrative review after being entered into the program tracking database and before being uploaded to a SharePoint site for review by AEP Ohio. AEP Ohio then reviews all program application data provided by the implementation contractor.

All applications are subject to an engineering review to ensure the savings for the project are calculated correctly and result in the appropriate level of incentive for the customer. The program implementer develops a measurement and verification (M&V) plan for each project to determine how energy savings will be measured or estimated. The baseline used in estimating the potential incentive is determined by equipment age and whether it is being replaced or is at end-of-life. In most instances, a site inspection is carried out as part of this process. The implementation contractor stressed it works to ensure its process for estimating energy savings is transparent and that it maintains communications with the customer throughout the process, using in-person meeting, phone and e-mail contact to ensure the implementer is in touch with projects monthly.

The engineering review process differs depending on the type and size of the project. The nature of each project is quite varied, resulting in different verification requirements. Depending on the nature of the efficiency measure, verification may be based on engineering calculations and equipment specifications, use of metering data available within the data center, or the installation of metering by the program administrator. The implementation contractor has indicated in the past that post installation metering is carried out for about half of the projects.

The engineering analyses typically rely on custom spreadsheets developed by the implementation contractor, modified as required for the program. Modeling is generally done within these spreadsheets rather than using building simulation models. The implementation contractor has previously expressed some concerns with how effectively building simulation models handle HVAC systems for data centers.

From past discussions with the implementation contractor, we understand there are several challenges involved in verifying project savings. One issue is many of the data centers involved in the program are constantly in a state of flux. Projects such as server virtualization may take place over an extended period. This issue makes it particularly challenging to isolate and identify those aspects of the data centers' operation related to the energy efficiency program, with obvious implications for verification efforts. The second challenge relates to the program goal of including a variety of customers, and, therefore, project sizes. This concern has led the implementation contractor to streamline its verification process so it could evaluate a small initiative at the same cost per kWh as a large project. To make programs cost effective from an administrative perspective, it is common for implementation contractors to take this streamlined approach with smaller projects. While Navigant supports this approach, as the evaluation contractor, Navigant will sample the smaller project strata so a program level savings can be achieved within the required confidence and precision.

3.4 Cost Effectiveness Review

This section addresses the cost effectiveness of the Data Center Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-7 summarizes the unique inputs used in the TRC test.

Table 3-7. Inputs to Cost-Effectiveness Model for Data Center Program

Item	
Measure Life	18
Projects	40
<i>Ex post</i> Annual Energy Savings (kWh)	21,399,475
<i>Ex post</i> Coincident Peak Savings (kW)	2,731
Third Party Implementation Costs	\$679,460
Utility Administration Costs	\$180,666
Utility Incentive Costs	\$1,079,969
Participant Cost	\$5,319,318

Based on these inputs, the TRC ratio is 2.9 and 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 Cost Test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-8. Cost Effectiveness Results for the Data Center Program

Test	Benefit/Cost Ratio
Total Resource Cost	2.9
Participant Cost Test	3.9
Ratepayer Impact Measure	0.8
Utility Cost Test	9.3

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. KEY FINDINGS AND RECOMMENDATIONS

This section presents the key findings and recommendations from the 2016 Data Center Program impact and process evaluations.

4.1 Key Impact Findings and Recommendations

These recommendations are specific to increasing realization rates and streamlining the impact verification.

1. A CRAC unit replacement project used a savings analysis method that was deemed obsolete in the 2015 evaluation report. The project used an ASHRAE 90.1 baseline calculation method for fan energy, rather than the California (CA) Baseline document.¹⁰

Impact Recommendation 1a: Create a document that provides acceptable savings calculation methodologies for common measures. Update the methodology document annually after the evaluation report is released.

Impact Recommendation 1b: Acceptable baselines will change for the 2017 evaluation period due to state law requiring an as-found baseline. The implementation contractor should meet with AEP Ohio and Navigant to ensure clarity on the new requirements.

2. Two sampled projects were found to incorrectly use a different method of calculating the baseline energy consumption and the post-retrofit energy consumption. A CRAC unit replacement project used SCOP for the baseline consumption and measured energy for the post-retrofit case. A server virtualization project used APC's server power database to estimate baseline server power, but used spot measurements to estimate the post-retrofit energy.

Impact Recommendation 2: Use the same methodology to calculate both baseline and post-retrofit energy profiles where possible. If there is robust measurement data available, calibrate both the baseline and post-retrofit calculations to the measured data. In the two examples given, the CRAC unit replacement project had sufficient data to calibrate, but the server virtualization project did not.

3. A sampled cell tower project used an inappropriate baseline based on ASHRAE 90.1 for the cooling system. Billing analysis and site metering found the *ex ante* calculations to be inflated nearly three times the actual amount.

Impact Recommendation 3a: Always check that *ex ante* savings estimates pass a sanity test relative to the utility billing data. Have project reviewers check savings relative to billing data.

Impact Recommendation 3b: Revise cell tower projects to use an as-found baseline.

4. On participant received incentives for ten identical cell tower projects. During verification, it was found through on-site interviews and the billing analysis that one of the sites claimed did not actually conduct the retrofit.

¹⁰ The California Energy Efficiency Baselines for Data Centers can be found at:

http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/hightech/data_center_baseline.pdf

Impact Recommendation 4: Improve quality control procedures to make sure there is sufficient proof of project completion even on small projects. If a physical inspection cannot be conducted, invoices need to be acquired.

5. A CRAH unit replacement project that was identified as a replace on burnout project correctly used a new CRAH for the baseline calculation, but failed to update CRAH controls to industry standards.

Impact Recommendation 5: Starting in 2017, an as-found basis will be used for the baseline. In the CRAH replacement project that would have allowed the existing controls in the baseline, but would have also required the existing CRAH unit efficiency.

6. Three identical new construction data center projects underestimated savings. The projects' *ex ante* calculations relied on the CA Baseline document to determine the baseline and metered data to determine the as-built case. The actual IT load relative to IT capacity affects both the baseline and as-built energy analysis when using this method. The *ex ante* loading was determined early in the data center ramp-up process, while the *ex post* calculations had the benefit of data once the data center was more fully operational and loaded.

Impact Recommendation 6a: Starting in program year 2018, switch the baseline basis to ASHRAE 90.4 Energy Standard for Data Centers, which does not depend on actual loading, but instead relies on facility design and equipment specifications.

Impact Recommendation 6b: If ASHRAE 90.4 cannot be used, require the data center to be more fully loaded before the project is completed. At least 25 percent IT load is recommended.

7. A project which involved a conversion from an air-cooled system to a water-cooled system used the wrong coincident peak period.

Impact Recommendation 7: Ensure all projects which use an hourly bin analysis use the correct AEP Ohio coincident peak period, which is June, July and August between the hours of 3-6 PM on non-holiday weekdays.

8. Three identical new construction projects have *ex ante* incremental cost that precisely matches 10 percent of the measure cost and does not match the project files incremental cost. Getting the correct incremental cost is vital for cost effectiveness calculations and for determining incentive eligibility.

Impact Recommendation 8: Ensure all fields in the project files match the tracking data including incremental cost.

9. Three identical new construction projects have *ex ante* baseline costs that are well documented, but the actual project cost was a figure provided by the participant without any supporting materials. Invoices were not provided, nor was there any detail regarding how the figure was determined or what equipment was included. Data Center Program terms and conditions require invoices be submitted and the invoices be itemized sufficiently to separate the incremental project cost from the costs of other services not related to the energy efficiency project.

Impact Recommendation 9: Incentives should not be provided until extensive supporting materials are submitted that detail how incremental cost is determined. This may include supporting materials provided by the participant or its Solution Provider establishing the baseline cost.

10. An HVAC Optimization project has an *ex ante* incremental cost based on the invoiced amount submitted, not the purchase order amount. A small portion of the purchase order had not been invoiced yet and, therefore, the incremental cost was understated by six percent.

Impact Recommendation 10: Where possible collect all purchase orders and change orders and compare to the invoiced amount. Obtain explanations from the participant or Solution Provider for any differences and document in the project file the reason for those differences.

4.2 Key Process Findings and Recommendations

The process review found the program has been successful in meeting its participation and energy savings goals. The program processes appear to be reasonable, easy for customers to access, and well accepted by participants. The program continues to have a broad range of participating customers and is available to data centers of different sizes.

The following process recommendations are offered to help improve program effectiveness and efficiency and further improve participant's experience of the program.

1. 2016 saw a decrease in the number of projects, unique customers, and Solution Providers as compared with 2015. The program is overly reliant on a few very large projects to meet energy savings goals. The only formal Data Center Program promotional activity for Solution Providers in 2016 was the annual meeting, where high performers were recognized. Many customers rely on third-party contractors to manage their data centers; these contractors can identify energy efficiency opportunities and promote the AEP Ohio Data Center Program, including IT load efficiencies, which are currently underrepresented.

Process Recommendation 1a: Expand efforts to establish a network of Solution Providers for the program. AEP Ohio should reward contractors who promote the program, encourage early program involvement, identify savings opportunities for their trusted clients; and close projects for AEP Ohio.

Process Recommendation 1b: Train implementation contractors and Solution Providers to leverage customer project activity by evaluating IT rooms for additional opportunities that are not currently under consideration.

2. Both the staff interviews and tracking database analysis reinforce the fact program communications have been focused on personal sales efforts and direct contact through AEP Ohio Account Representatives. While this direct sales approach has been successful and new support materials, such as case studies, have improved the quality of program information, more can be done to communicate the benefits and opportunities for improved energy efficiency in Data Centers.

Process Recommendation 2: Supplement direct sales efforts with a broader outreach and communications campaign, to build awareness of both the program and of opportunities to reduce energy use. Outreach and communications should be targeted at underserved populations such as medium-sized Data Center operations.

3. Per the database, only four of the 40 completed project applications were submitted prior to the date of project completion; one project application was submitted on the date of project completion. There are four projects in the database with no project application submittal date. One project application was received 253 days after project completion. The eligibility criteria for the program indicate applications must be submitted within six months of project completion.

Process Recommendation 3a: Clarify application submittal date language to be consistent to program staff and across customer-facing documentation (including the "AEP Ohio Data Center Brochure 2015-16" document).

Process Recommendation 3b: Consider the eligibility of projects with an application date more than six months after the completion date to determine if this is a data entry issue or if these projects

should not have been eligible. Projects over six months old may be served through the Self Direct Program if the project meets that program's requirements.

Process Recommendation 3c: Develop quality control procedures to ensure data transferred from customer applications and analysis documents into program database is correct and meets program eligibility criteria.

4. Based on the Data Center Program's custom project analysis and procedures, customers are only informed of their incentive amount through a reservation letter. Reservation letters are issued upon receipt of project application or pre-project application. Since only four projects are recorded as submitting a pre-project application, most customers completed their projects in absence of program information about their project-specific incentive amount. Project pre-applications would allow the implementation contractor an opportunity to review the proposed project and suggest enhancements or additions, thus maximizing comprehensiveness and savings.

Process Recommendation 4a: Encourage early involvement in the program by requiring participants to submit a pre-application prior to project completion to be eligible for the program. Ensure data entry is accurate for pre-application dates

Process Recommendation 4b: Provide customers an incentive commitment letter within 10 days of receiving the pre-application.

5. The program application requires the incentive not exceed "50% of the total project cost"¹¹. The program application also states "Incentive Threshold: 50% incremental cost."¹² Project cost is defined as the material cost of installed equipment. However, implementation protocols and project files have limited incentives to 50% of incremental cost (as previously recommended by Navigant). One project slightly exceeded 50% of incremental cost.

Process Recommendation 5a: Amend the program application form to consistently reflect an incentive cap based on 50 percent of the incremental cost of efficiency upgrades (retrofit minus baseline cost), per program implementation protocols.

Process Recommendation 5b: Institute an administrative process to confirm project incentives do not exceed 50% of incremental cost as part of the administrative review.

6. There were three very large data center projects in 2016 which should have been included in the New Construction Program. As such, there are missed opportunities for the customer to gain additional energy efficiencies and incentives in their project, and missed opportunities for the New Construction Program to claim additional savings.

Process Recommendation 6: Prioritize providing customers with a comprehensive project approach not only to data center projects but also through referrals to complementary services.

4.3 Key Tracking System Findings and Recommendations

Program tracking data is maintained by the implementation contractor and shared with AEP Ohio via a SharePoint site. Navigant reviewed the tracking data and found it to be reasonably comprehensive and complete. The evaluator did not address whether the tracking system is adequate for regulatory prudence

¹¹ AEP Ohio Data Center Application, Page 6: "AEP Ohio will pay the lesser of 1) the calculated incentive as approved by AEP Ohio or 2) 50% of the total project cost (not including labor)".

¹² AEP Ohio Data Center Application, Page 8: Data Centers Program Incentive table.

reviews or corporate requirements. The following recommendations are offered to further improve the value of the tracking data:

1. The average elapsed time between the project inspection and issuing the incentive is 139 days, or five months. This time seems quite long, however, there is no indication in the tracking database of when the program received all the project information required to complete the project and pay the incentive. The elapsed time is significantly more than the advertised four to six weeks listed on the program documentation between project completion and incentive payment.

Tracking Data Recommendation 1: Add new fields to the database recording when the application and all required information is complete, as well as when the project is approved for payment, so the actual project processing time can be properly tracked and monitored. The goal of this recommendation is to identify specific issues contributing to project incentive delays, and develop processes that improve the customer experience and project work flow.

2. Business descriptions in the database do not accurately describe business activity. While the 2016 data showed an improvement over previous years, there are some projects with the “Business Type” as “Data Center”. Given all eligible applications to this program are for a data center, this designation provides little insight into the nature of the businesses served

Tracking Data Recommendation 2: Record descriptive economic sectors for all businesses.

3. In past reviews, Navigant has noted several fields in the tracking base were found to be incomplete. In 2016, several fields were identified with either missing data or no explanation with respect to why the data is missing. Currently, it is not clear if a blank field indicates information was not required, has not yet been entered, or if it is missing on the actual application.

Tracking Data Recommendation 3a: Institute an administrative process to obtain missing information, or note why it has not been included in the database.

Tracking Data Recommendation 3b: All date fields should be clearly defined as binary fields for consistency; a code should be used to explicitly indicate if a field does not apply to a measure or project. This designation will help make it clear where staff follow-up may be required to complete a task (i.e. an inspection) or obtain data (i.e. if the inspection has been completed but not recorded). Examples include:

- c. **NPA:** No Pre-Application
- d. **NI:** Not Inspected

4. In the measures file, there was one project in 2016 with multiple measures. There was a data entry error in the total cost and incentive paid fields, which erroneously input the project total values into each of three measures, effectively triple counting those values.

Tracking Data Recommendation 4: Institute an administrative process to confirm measure level data reflects measure level costs, savings, and incentives.

5. Thirty-nine of the 40 projects completed were listed in the measures file as a single measure, even though many of them did indeed incorporate multiple measures. For example, the HVAC Optimization project consisted of hot aisle containment, the addition of two air-side economizers, and variable frequency drive upgrades to the four UPS room CRAC units, but in the measures file, these were reported as a single measure.

Tracking Data Recommendation 5: Allocate project activities across individual measures to track measure participation and project comprehensiveness. In the case where savings are calculated at the project level, include (at a minimum) an estimate of energy savings and incremental costs for each measure.

6. Adding or modifying a few tracked fields would enhance the data available to program managers and evaluators in support of identifying and implementing adjustments to the program design and evaluation process.

Tracking Data Recommendation 6a: Relative to square footage, add the field “Data Center Floor Area Affected” to the application.

Tracking Data Recommendation 6b: Use two fields to track demand reduction: 1) demand reduction coincident with the Ohio peak period, and 2) demand coincident with the PJM system peak.

Tracking Data Recommendation 6c: Add or otherwise clarify three fields: (1) the date on which the final application with all supporting documentation was submitted, (2) the date when the final inspection was completed, and (3) the date of application approval. As discussed above, the tracking data does not include a field to indicate when all the information required to approve the application was received.

Tracking Data Recommendation 6d: Roll up incremental cost from the measure level to the project level to demonstrate the financial investment implications for an entire project.

Tracking Data Recommendation 6e: Add “Repeat Customer” as a field entry option for ‘how did you learn about the program.’ With this addition, AEP Ohio staff and evaluators will be able to more accurately assess how customers learn of and engage with the program.

7. Several acronyms and abbreviations are used in the tracking database without explanation.

Tracking Data Recommendation 7: Add a definition worksheet to document the intent of database fields and provide an explanation of column headers and acronyms. Additionally, the definition worksheet should contain explanations of any data entry protocols.

8. Discrepancies were identified in the Contractor field between the measure tracking database and the project tracking database. (Eleven were listed in the project data; twelve in the measure data).

Tracking Data Recommendation 8: Institute an administrative process to verify all fields have consistent values in both the measure and project reporting systems.

APPENDIX A. INTERVIEW GUIDE

January, 2017

AEP Ohio

Evaluation of Data Center Programs

Program Manager (internal to AEP Ohio) and Contractor (Willdan) Interview Guide

Interview Date:

Time/Duration:

Interview Context:

Interviews will be conducted with AEP Ohio staff responsible for administering the Data Center Program as well as key staff at the program administration firm. If the individual was interviewed in prior year, the questions below will focus on activities or changes since prior year interview.

INTRODUCTION

1. Has your role in the program changed in the past year? Please describe.

PROGRAM HISTORY/BACKGROUND

2. What program changes have occurred since the 2015 Evaluation?
3. Has the involvement of Solution Providers (trade allies) in the program changed in the last year?
4. Describe a typical first engagement with a new participant?
 - a. How is a connection typically made?
 - b. Who is engaged from the participant side?
 - c. How is the program introduced to someone not wholly familiar?
 - d. What technical assistance is offered?
5. Who conducts the facility survey in advance of the incentives offer? How often does this survey identify energy efficiency measures not already under consideration? Are those recommendations ever put in writing? What would trigger metering efforts?
6. How many people (in terms of FTE's) in your organization are working on the Data Center Program?

PROGRAM PROCESS

7. Please describe any changes in the **key steps or processes** in the program process.
8. Please describe any changes in the **key players** involved in the program and their roles? (i.e., Willdan and AEP Ohio).

9. Describe the **key goals** of the program?
 - a. Have goals been set for future years?
 - b. What was the basis for setting goals? (i.e., *energy or demand savings targets, participation rates, etc.* – *any transformational, capacity goals?*)
 - c. Does the program want to grow participation/savings or stay status-quo?
10. Please describe any change in the performance metrics you use to measure the performance of the program?
11. Any changes to how the program verifies participant savings estimates?
 - a. Who conducts post installation savings verifications?
 - b. Have issues arisen with differences in savings estimates by customer and the program?
 - c. How were these resolved?
12. Have you seen any change in the value placed on significance of “*non-energy*” benefits to program participants? Please describe.

OUTREACH AND MARKETING

13. What are the key motivations and interests for potential participants? How have these been addressed in external communications?
14. Please describe customer recruitment/marketing strategy used in the last year.
 - a. Have you targeted specific market segments?
 - b. How have you identified potential participants?
 - c. What outreach and marketing activities have you conducted in the past year?
 - d. Do you have a plan to reach larger data centers that have not previously participated?
15. Has coordination between the Data Center Program and AEP Ohio's “*Qualified Data Center Site Program*” continued in the past year? Could you explain examples of how the programs have worked together?
16. What marketing/outreach activities worked well? Which didn't work as well as expected?
17. How do you ensure that you cover the entire AEP Ohio service territory?
18. (*If not previously addressed*) - - - Have you conducted outreach / recruitment / education / marketing activities for Solution Providers (trade allies)? Have you considered creating a qualified SP network?
19. Does the program provide any recognition or acknowledgement (i.e. a certificate or plaque) to program participants or Solution Providers? If yes, please describe.
20. Does the program check-in with past participants (whom they may not have contacted in a year or more) to see if other opportunities exist for new projects?

21. Based on your experience, do you believe an increase in the level of resources available for marketing and outreach could increase program participation and savings?
- IF YES – ASK - Would that hold true if the resources were made available by reducing the level of incentives available?*

APPLICATION, INTAKE, PROCESSING, AND INCENTIVE PAYMENT

22. Has your program application process changed since last year? Have you considered using a pre-application as suggested in the 2015 process recommendations?
23. How do you verify customer and equipment eligibility?
- How do you determine whether equipment being replaced is functional, being replaced on burn-out, obsolescence or need for new capacity? (*To determine baseline and calculate savings eligible for incentive*).
24. At what points do you communicate with the customer? Describe typical communications process.
25. When do you advise the participant of incentive amounts available?
26. What are the follow-up procedures with “stale” applications?
- How are projects reviewed to see if they are stalled? What options are available to move them forward?
 - How does Willdan track “drop outs” (*participants who have chosen not to proceed under the program*)?
 - What proportion of customers “drop out”?
 - What causes customers to drop out?
27. How do you ensure program data (e.g. customer, application) is complete and accurate? What quality control procedures are in place?

INTERACTION WITH PARTICIPANTS:

28. Who do you feel are the key decision-makers/influencers in the project process – specifically with respect to energy efficiency decisions?
29. Please describe your interactions with:
- Program participants.
 - Solution Providers involved in the program.
30. For each:
- Any issues that have been identified?
 - Areas for improvement?

31. What opportunities do program staff have to discuss projects with participants prior to project implementation?
 - a. How do program staff suggest more efficiency measures to participants, where appropriate?
32. How often and at what points do you visit participant project sites in person, including any final inspection or verification?
 - a. How are sites selected?
 - b. Who is responsible for conducting verification?
 - c. How are the results documented?
 - d. What is the process, and who is responsible for resolving disparities?
33. Have customers indicated any issues with, or are confused by, any program requirements or documentation?
34. Have some customers who could be eligible for the program declined to participate? If so, why?
35. Are there any program requirements that have caused projects to be ineligible or unfeasible?
36. What proportion of projects proceed with essentially the initial level of energy efficiency as submitted to the program?

PROGRAM DATABASE

37. Have there been any changes to the structure of or processes for updating the project database?
38. Has any documentation been developed in the past year for the tracking database?

PROGRAM PARTICIPATION

39. What have been the key challenges in implementing the program in the past year? What steps have you taken to overcome these challenges?
40. From the customer's perspective, what are the perceived barriers to participation?
41. Are there changes to the program that you feel could be made to boost program activity or improve the program? Describe.

PROGRAM REQUIREMENTS

42. When must participants apply for the program in order to be eligible? (i.e., for new projects or projects which are contemplating efficiency projects).
43. How are projects managed that apply after the eligibility period?
44. Do you find that early enrollment allows for greater opportunities in improving the efficiency project (more efficient equipment, broader scope)? How does the program encourage early application?

45. Have you encountered any projects where it was unclear whether the project was eligible?

CLOSING

46. Is there anything else you think we should know?

If we have any additional questions is it best to follow up with you by phone or by e-mail?

Thank you very much for your time in assisting us with this evaluation.

REQUEST:

1. *RECOMMENDATIONS for EE measures not already under consideration (q5)*
2. *Outreach and Marketing documents*
3. *Final inspection and verification results documentation*
4. *Any other program management documentation.*

APPENDIX P



Continuous Energy Improvement Program

2016 Evaluation Report

Prepared for:

AEP Ohio



A unit of American Electric Power

May 4, 2017

Submitted by:

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

312.583.5700
navigant.com

Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

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

Contact:

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

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

Prepared by:

Dustin Bailey, Senior Consultant
360.828.4006
dustin.bailey@navigant.com

Jean Rokke, Consultant
312.583.3769
jean.rokke@navigant.com

David Bluestein, Managing Consultant
360.828.4005
david.bluestien@navigant.com

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Executive Summary

This report presents the results of the 2016 evaluation of the AEP Ohio Continuous Energy Improvement (CEI) program. The Executive Summary provides a high-level description of the program, key impact and process findings, and recommendations for future program improvements. Detailed methodology and findings are contained in the body of the report, with supplemental data included in the accompanying appendices.

ES.1 Program Summary

The CEI Program provides training for commercial and industrial customers on how to view the energy consumption at their facilities in a holistic manner, and identify no cost/low cost opportunities to reduce energy use. Through this training, participants learn to apply behavioral principles of continuous energy improvement and to implement strategic energy management practices. These practices can reduce energy use at an individual site anywhere from three to fifteen percent with little or no financial investment from the customer.

The program includes several cohorts, or groups of participants, who began the program in roughly the same calendar year. The first set of cohorts (cohorts 1 through 4) began the program in 2013 and completed it in 2016. The second set of cohorts (cohorts 5 through 8) began the CEI Program in either late 2014 or 2015 and completed their first year in mid-2016.¹ Therefore, this evaluation covers the third and final program year of cohorts 1 through 4, and the first year of cohorts 5 through 8.

In 2015, AEP Ohio adjusted the CEI Program from a three-year to a one-year program structure. At the time of the 2015 program design, the Ohio Public Utilities Commission only had approved the CEI Program through 2016. AEP Ohio therefore allowed cohorts 5 through 8 to participate anywhere between 13 to 18 months ending in mid-2016, and paid the \$0.02 incentive per kWh saved for the entire participation time period. The differences in evaluation activities between the two sets of cohorts prompted Navigant to treat the cohorts separately in the structure of the report.

ES.2 Evaluation Results

This section provides separate evaluation results for cohorts 1 through 4 and cohorts 5 through 8.

ES.2.1 Results for Cohorts 1 through 4

Cohorts 1 through 4 completed their third and final year in the CEI Program in 2016. The current evaluation focused on the persistence of savings continuing over the three-year program to understand how well CEI motivated participants to adhere to the program training received in Year 1. Navigant conducted two activities to evaluate this cohort group, 1) a quantified analysis of the savings identified in

¹ Cohorts 5 through 8 participated in the program anywhere between 13 and 18 calendar months, but the evaluation and this report refers to that time frame as the first program year.

the participant energy models; and 2) a qualified analysis of the quantified results using self-reported participant interviews.

Quantified Persistent Savings Results

Navigant used the facility specific energy models to quantify two key results for cohorts 1 through 4, persistent savings and measure life.

Persistent savings estimates include any energy savings persisting over the three-year program period for this group of cohorts. Navigant used input variables from the facility specific energy models to inform a program level regression model, and used this regression model to estimate the persistent savings shown in Table ES-1. A small number of sites in cohort four had issues accounting for large process changes and equipment issues occurring in Program Year 1 resulting in the significant change in savings from Year 1 to Year 2. Several sites in cohort three had data issues that Navigant staff were unable to account for resulting in the small number of participants being included in the analysis.

Table ES-1. Average Annual Savings of Each Participant Included in the Persistence Analysis

Cohort	Program Enrollment Date	Total Number of Participants	Number of Participants in Analysis*	Year 1 Energy Savings (kWh)	Year 2 Energy Savings (kWh)	Year 3 Energy Savings (kWh)
1	1/1/2013	18	14	1,513,124	1,598,277	1,091,746
2	5/1/2013	6	4	680,099	1,279,311	619,404
3	9/1/2013	7	1	964,957	258,658	400,591
4	10/1/2013	8	5	1,309,476	7,251,495	5,971,331

Source: Navigant Analysis

* = not all participants provided appropriate data for the persistent analysis.

Measure life refers to the amount of time it takes for the site savings to drop to 50% of its maximum realized value. This number is then used to represent the EUL of the measure installed. Since the program is a mix of behavior changes and low cost equipment upgrades, Navigant was unable to determine the measure life of each individual activity and instead estimated measure life based on total program savings of each cohort.

Navigant collected model data for cohorts one through four and analyzed the information to calculate the average savings of each site for each of the three years. Navigant estimated the program had a measure life of approximately 3.3 years after the first year of intense training was completed. Results show nearly the same number of sites had an increase in savings between Years 2 and 3 as had decreases in savings over that time period. However, it was the amount of the energy usage at the larger sites that shifted the overall cohort savings in either direction. Table ES-2 shows the resulting measure life estimates.

Table ES-2. Calculated Measure Life for Cohorts 1 through 4

Cohort*	Number of Participants	Measure Life (years)
1	15	3
2	4	2
4	5	5
Weighted Average		3.3**

Source: Navigant Analysis

* = only one participant provided sufficient data from cohort 3, so Navigant removed this cohort from the measure life calculation.

**This is 3.3 years after the 12-month training is completed at the sites resulting in a true effective useful life of 4.3 year.

Qualified Persistent Savings Results

Self-reported participant interviews provided insight into the reasons behind the site-level quantified persistence savings. These interviews determined many of the sites reporting negative savings mentioned this situation was due to issues with model accuracy, not lack of motivation. If these models had more accurately reflected the savings due to CEI activities, it is likely measure life would have been longer.

ES.2.2 Results for Cohorts 5 through 8

Cohorts 5 through 8 completed the CEI Program in mid-2016. Navigant conducted a full impact and process evaluation for this group to understand the specific energy consumption changes these participants undertook, review the reported energy savings from these changes, and understand how well this group embraced the CEI Program. AEP Ohio also expanded the participant eligibility for this group of cohorts to include large commercial buildings, and received participation from several hospitals and universities.

Impact Evaluation Results

Navigant compared the *ex ante* and *ex post* savings for all participants in the 2016 CEI program. The results of the cohorts 5 through 8 year 1 savings and the cohort 1 through 4 incremental savings were combined to arrive at an overall realization rate for this group. Table ES-3 provides a summary of these analyses.

Table ES-3. CEI Program *Ex Ante* and *Ex Post* Savings for CEI 2016

	2016 Program Goals* (a)	<i>Ex Ante</i> Incremental Savings (b)	<i>Ex Post</i> Incremental Savings** (c)	Realization Rate = (c / b)	Percent of Goal = (c / a)
Energy Savings (MWh)	20,000	55,949	42,768	76%	214%
Demand Savings (MW)	2.46	1.75	1.84	105%	75%

Source: Navigant Analysis

* 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 March 9, 2016.

The demand savings methodology was under review during this program year, so only a small number of sites claimed demand savings for this year. This site realized a *ex post* demand savings of 1838.4 kW. Although the program did not reach its demand savings goals this year, it is expected the program will reach its demand savings goals in the future. Table ES.4 provides the *ex ante* and *ex post* savings and realization rates by cohort, as well as the percentage of site savings each cohort achieved on average.

Table ES-4. CEI Program for Cohorts 5 through 8

Cohort	Number of Sites	Year 1 <i>Ex Ante</i> Energy Savings (MWh)	Year 1 <i>Post</i> Energy Savings (MWh)	Realization Rate	Savings as a Percent of Site Usage (Average)
Cohort 5	12	10,434	8,330	80%	3.5%
Cohort 6	18	7,561	6,128	81%	2.2%
Cohort 7	16	11,629	8,558	74%	4.3%
Cohort 8	11	26,086	20,466	78%	5.3%
Total or Weighted Average	57	55,710	43,482	78%	3.9%

Source: Navigant Analysis

Note: Totals may not sum due to rounding.

ES.2.3 Demand Savings Review

AEP Ohio asked Navigant to review potential methodologies for calculating demand saving for the CEI Program. As a part of this review, AEP Ohio provided Navigant with engineering calculations for estimating the demand savings for the 2016 CEI Program. The sites chosen for review were from all cohorts and did affect the final claimed *ex ante* demand savings. Navigant reviewed the calculation

methodology and made several changes meant to strengthen the defensibility of the calculations, as described in Section 2.3. This methodology will likely be used in the future to claim demand savings for this program. Table ES-5 provides the demand savings results using these adjustments to the calculation methodology.

Table ES-5. Peak Demand Savings Evaluation Results

Customer	<i>Ex Ante</i> Demand Savings (kW)	<i>Ex Post</i> Demand Savings (kW)	Project Realization Rate
A*	236.2	236.2	100%
B	755.2	740.4	98%
C	565.0	503.6	89%
D	191.0	358.2	188%

**Detailed calculations were not provided for this site as savings were calculated using a simpler equipment reduction methodology.*

ES.3 Key Findings and Recommendations from the 2016 Evaluation

Impact Evaluation Findings and Recommendations

1. Cohorts 1 through 4 showed a net decrease in persistent savings between Program Years 2 and 3. Three of the four cohorts used in the persistence savings analysis showed a decrease in energy savings over the last two years of the CEI Program. The primary reasons for this decrease was the lack of model updates to reflect major changes in facility energy use or energy champions leaving.

Impact Recommendation 1a: Continue to provide energy modeling support after the program period has ended. The model is a key component of a site's persistent energy savings. The implementer did work with all the sites to update these models throughout Year 3, but several sites had issues with the models properly reflecting their energy use and thus could have used more support.

Impact Recommendation 1b: Allow a facility to rejoin the CEI training workshops if there is a major change in the Energy Team. Navigant found several sites lost their Energy Champion and lost motivation with the CEI Program. AEP Ohio should reach out to customers who go through such a change and offer to re-train a new Energy Champion.

2. Navigant's estimate of a 4.3 effective useful life is the best estimate for the persistence of CEI Program savings given the data that was available, but the Navigant team identified two issues with the data provided for the persistence and measure life analysis. The first issue was that modeling data was not maintained and updated by the facilities or did not account for changes occurring at the facilities. Several sites did not maintain the collection of variables identified in the baseline models or properly adjust the model based on large facility wide changes. The second issue was the limitation in analysis years. For participants who provided sufficient energy consumption and updated modeling data, the Navigant team only had three years of program data to use for the regression model's measure life analysis. This is a very limited number of data points and leads to lower confidence in the results.

Impact Recommendation 2a: The implementer and utility should encourage sites to continue to collect variable data for all variables identified in the baseline even after completing the 12 months of training, so the models can accurately reflect the energy savings achieved at these facilities. Also, as noted above in finding 1a, the implementer should support sites in model updates if site characteristics change greatly from the baseline period.

Impact Recommendation 2b: If AEP Ohio is especially interested in persistence of savings for these programs, Navigant recommends continuing to gather data beyond the three-year program period to refine analysis.

Process Evaluation Findings and Recommendations

1. Commercial buildings encountered unique issues with the CEI Program. The recent program expansion to include large commercial buildings brought about some program design issues that AEP Ohio must consider as they recruit more commercial customers. Some of these issues included, generating less savings overall than industrial customers, not having the time or staff to devote to an Energy Team, requiring more focused training from the workshops, varying degrees of technical knowledge, and needing to focus on different low cost/no cost measures than those applicable in the industrial sector. Interviewed participants also reported that having their peers at the training workshops was a valuable aspect of the CEI Program.

Process Recommendation 1a: Navigant recommends that the training for new cohorts recognizes the differences between the industrial and commercial sectors and present topics differently for each participant group. These include differences in the major energy-consuming end-uses between the sectors, where commercial buildings tend to upgrade lighting and HVAC equipment, while industries tend to focus on process-related upgrades and air compressors. This may require separate training sessions with the various audiences, perhaps forming cohorts only including sites of a given sector.

Process Recommendation 1b: Provide two tiers of training based on participating company's levels of expertise and technical knowledge. Navigant identified this split most obviously between commercial and industrial respondents but differences could also exist within businesses of the same sector.

Process Recommendation 1c: Be sure to have adequate representation from each business type to allow for networking. AEP Ohio should be aware of the business representation at these workshops as they group commercial customers into cohorts.

1. INTRODUCTION

This section provides a description of the AEP Ohio Continuous Energy Improvement (CEI) program, as well as the objectives of the 2016 evaluation.

1.1 Program Description

The role of the CEI Program is to train commercial and industrial customers how to implement strategic energy management, and apply the principles and practices of continuous energy improvement. The goal of this training is to reduce the participant's site level energy use by three to fifteen percent with little or no financial investment. The CEI Program provides the tools, coaching, training structure, and resources necessary to achieve these energy savings. AEP Ohio staff collaborates with the implementation contractor (CLEAResult) to deliver the CEI Program across AEP Ohio's service territory.

Specifically, the CEI Program includes the following features:

- Coaching assistance, tools, and templates to support customer employees to meet plant and corporate cost savings targets
- Custom statistical models for each customer to measure and manage energy intensity
- An Energy Coach and technical resources to help customers identify and implement energy saving opportunities
- A structured support group of local companies that share best practices and provide team support, encouragement, and accountability

1.1.1 Adjustments to Program Facility Size

The original CEI Program, designed in January of 2013, supported AEP Ohio's largest industrial customers (e.g., those that consumed greater than 10 GWh annually). In May of 2013, AEP Ohio expanded the program to include customers using greater than three GWh. This change impacted all cohorts beyond cohort 1.²

Facility type adjustments. In 2015, AEP Ohio expanded the CEI Program offering to other large customers beyond the industrial sector. Cohorts 5 through 8 now includes hospitals and universities.

Program structure adjustments. AEP Ohio changed the incentive structure and length of the CEI Program. Cohorts 1 through 4 signed contracts to participate in a three-year CEI Program that paid out \$0.02 per saved kWh over the three-year period. Under this structure, the participants would receive training identifying how to reduce energy use, and strategies for improving energy consumption over the first 12-18 months of the program. After this training period, AEP Ohio would incentivize participants for another two years to drive facilities to search for even more energy savings through a continued energy

² Navigant uses the term "cohort" here and throughout this report to mean a group of participants who began participating in the CEI Program at about the same point in each calendar year. Each cohort is comprised of multiple participants of varying counts.

improvement process. During this two-year period, the implementer provided support to the sites to update and maintain the energy models at these sites.

At the time of the 2015 program design, the PUCO had only approved the CEI Program through 2016, so AEP Ohio shifted the program to a one-year structure and allowed cohorts 5 through 8 to end participation in mid-2016, but still offered the \$0.02 per kWh savings.

1.2 Evaluation Objectives

This section presents the objectives of the 2016 CEI Program evaluation effort. The Navigant team developed a set of evaluation approaches informed through previous work with AEP Ohio and tailored to meet the Ohio evaluation requirements. Table 1-1 presents the energy (MWh) and demand (MW) savings goals for the 2016 program year.

Table 1-1. 2016 CEI Program Budget and Estimated Savings

Metric	Value	Percent of Business Sector
Estimated Budget	\$4,000,000	8.0%
Estimated Energy Savings (at Meter)	20,000 MWh	5.2%
Estimated Demand Savings (at Meter)	2.46 MW	3.5%

Source: VOLUME 1: 2012 TO 2014 ENERGY EFFICIENCY/PEAK DEMAND REDUCTION (EE/PDR) ACTION PLAN AEP Ohio EE-PDR, November 29, 2011, data for 2014.

1.2.1 Evaluation Objectives for Cohorts 1 through 4

For 2016, the primary evaluation objective of cohorts 1 through 4 was to understand the quantity and quality of savings *persisting* from Program Year 2 to Program Year 3. One of the goals of the original CEI Program designed in 2013 was to capture savings over a three-year engagement period by incentivizing participants to continue to generate savings after Year 1. Table 1-2 shows the enrollment date and participant count for cohorts 1 through 4.

Table 1-2. Enrollment Date and Participant Count for Cohorts 1 through 4

Cohort	Program Enrollment Date	Number of Participants
1	2013-Jan	18
2	2013-May	6
3	2013-Sept	7
4	2013-Oct	8

Source: Navigant Analysis

The training, energy improvement measures, and incentive structure put in place during the first 12-18 months should generate persistent savings over the rest of the three-year timeframe. Participants in cohorts 1 through 4 completed this third program year in 2016, allowing Navigant to evaluate persistent

savings using two evaluation activities, 1) a *quantified* analysis of savings from the CEI models at each site, and 2) a *qualified* analysis of self-reported interview results with participants. Using the interview results from the qualified analysis, Navigant and AEP Ohio can determine the reasons why sites may or may not be generating persistent savings. Section 2.1 provides a detailed account of the methods used to complete these two evaluation activities.

1.2.2 Objectives for Cohorts 5 through 8

Cohorts 5 through 8 completed 13-18 months of the CEI Program in 2016. Table 1-3 shows the start date and number of participants that had completed energy models provided to Navigant for each cohort.

Table 1-3. Enrollment Date and Participant Count for Cohorts 5 through 8

Cohort	Program Enrollment Date	Number of Participants
5	2014-Dec	12
6	2015-Feb	18
7	2015-Apr	16
8	2015-June	11

Source: Navigant Analysis

1.2.2.1 Impact Evaluation Objectives

The 2016 impact evaluation sought to quantify the actual energy generated by the CEI Program for cohorts 5 through 8. This group of cohorts completed their first full year of the program and reported the resulting savings estimates to AEP Ohio. Navigant reviewed and verified these savings estimates to calculate a realization rate for each participating site. A full description of the impact evaluation methodology appears in Section 2.2.

1.2.2.2 Process Evaluation Objectives

Navigant conducted a process evaluation for the 2016 study and asked participants in cohorts 5 through 8 a battery of questions regarding their experience with the CEI Program. The team also interviewed the implementation contractor and AEP Ohio staff to understand what possible improvements the utility could make to the CEI Program in future program years. Section 2.2 provides the detailed methodology for the 2016 process evaluation.

The objectives of the process evaluation were to specifically understand issues such as:

- Which program activities were key to achieving the reported energy savings?
- What portions of the continuous energy improvement training were most beneficial?
- What steps AEP Ohio could take to improve the CEI Program?
- If any barriers exist that caused sites to be cautious about participating in the program, and how AEP Ohio can overcome these barriers.

2. METHODOLOGY

The 2016 evaluation included three distinct evaluation activities, covering the two cohort groups. For the first cohort group, cohorts 1 through 4, Navigant evaluated the program's ability to generate persistent savings from Year 2 to Year 3 of the program. Section 2.1 describes the methods used for analyzing this persistence. For the second cohort group, cohorts 5 through 8, Navigant conducted both impact and process evaluation activities detailed in Section 2.2.

2.1 Persistent Savings Evaluation for Cohorts 1 through 4

Participants in cohorts 1 through 4 began the CEI Program throughout the 2013 calendar year. When these customers joined the program, the incentive structure was \$0.02 per kWh saved for three years to motivate customers to continue their energy-saving behaviors beyond the first-year training period.

2.1.1 Quantifying Persistence

Navigant sought to quantify the amount of energy savings persisting over the three-year program for cohorts 1 through 4. To do this, the team employed a linear regression model to estimate average program savings for each customer. The team defined the average energy consumption per customer as a function of enrollment date, customer-specific production, temperature, plant-specific scheduling and a random error term. Using data 12 months prior to the first program year as the "reference year," the team estimated savings across the three years for cohorts 1 through 4.

The team also took differences between industrial participants into consideration and created a separate linear regression equation for each participant. Equation 1 provides an example of this equation.

Equation 1. Estimating Energy Savings

$$kWh_{t,i} = \alpha_o + \alpha_1 Post_{t,i} + \sum_{\varphi} \alpha_{2\varphi} X_{t,i} + \varepsilon_{t,i}$$

Where:

i = customer

t = time (daily, weekly or monthly)

Independent Variables:

$kWh_{t,i}$ = average energy consumption for customer i at time t

$Post_{t,i}$ = an indicator variable that takes the value 1 on and after the program enrollment date and takes the value 0 before the program enrollment date.

$X_{t,i}$ = other control variables (i.e., production, temperature, plant shut-down)

$\varepsilon_{t,i}$ = random error term for customer i at time t

Estimated Coefficients:

α_o = intercept

α_1 = average savings for customer i

$\alpha_{2,\varphi}$ = impact of other control variables on energy consumption for customer i

2.1.1.1 Calculating Measure Life

Navigant calculated an average measure life for each cohort using the program degradation rate (% degradation), which is the difference between the average savings in Year 2 and Year 3 divided by the maximum average savings of all three years of the study. Equation 2 presents this calculation.

Equation 2. Calculation of Measure Life

$$ML = \frac{\log(0.5)}{\log(1 - \%degradation)}$$

Where

$$\%degradation = \frac{\text{Savings Year 2} - \text{Savings Year 3}}{\text{Max}(\text{Savings})}$$

$\log(0.5)$ = after 50% of the savings are degraded

2.1.1.2 Data Sources for Persistence

Navigant obtained energy consumption and CEI Program model data for each participant in cohorts 1 through 4 to use in the regression modeling effort.³ However, not all participants provided sufficient pre-program reference year data, so Navigant excluded these sites from the regression model. Table 2-1 provides the total counts of participants in each cohort (column 3), as well as the number of participants included in the regression analysis (column 4).

Table 2-1. Summary of Participants Included in the Persistence Analysis

Cohort	Program Enrollment Date	Total Number of Participants	Number of Participants Included in Analysis
1	2013-Jan	18	14
2	2013-May	6	4
3	2013-Sept	7	1
4	2013-Oct	8	5

Source: Navigant Analysis

2.1.1.3 Data Limitations

The participants excluded from the persistence analysis either did not provide reference year data, or the data provided had formatting issues, such as insufficient granularity. However, the Navigant team identified two larger issues with the data required for proper persistence and measure life analysis.

- **Outdated modeling data.** The possibility exists that participants did not maintain and update their energy models as facility energy consumptions changed. For example, if a facility

³ The regression model Navigant used to calculate persistence and measure life required inputs from the energy models provided to each participant in the CEI Program.

implemented energy use strategies to reduce consumption, but did not properly update the model with this information, the model would not reflect accurate savings.

- **Limited analysis years.** Even for participants who provided sufficient energy consumption and updated modeling data, the Navigant team only had three years of program data to use for the regression model's measure life analysis. This is a very limited number of data points and leads to lower confidence in the results.

Despite these data limitations, Navigant believes the estimate of a 4.3-year effective useful life is the best estimate for persistence for this program and should be used until better data is available.

2.1.1.4 Tracking Data Review

Navigant conducted a review of the tracking data for cohorts 1 through 4 to ensure the project reviews matched the data in AEP Ohio's tracking database. The team conducted this review as a separate task outside of the persistence savings impact evaluation. Section 3.1.4 provides the results of this review. The evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

2.1.2 Qualifying Persistence

Navigant's means of qualifying persistence for cohorts 1 through 4 followed similar steps for any process evaluation by using self-reported data from program participants. This activity allowed the team to ask participants how well they thought savings persisted over the three-year program period, and whether any behavioral changes implemented in training year 1 continued over the remaining program years. Navigant interviewed 10 participants in cohorts 1 through 4 to collect this self-reported data. Questions included the following:

- If savings changed from Year 2 to Year 3, what factors could have influenced these changes?
- Are the behavioral changes implemented in the year 1 training period still in place?
- Were there any changes or additions to the behavior changes in Years 2 or 3?
- Did the site install or remove any other energy-consuming equipment?

Navigant probed participants to discuss factors of energy savings increases or decreases over the three-year program period and asked whether AEP Ohio or the implementer could have influenced these variations in any way. In addition to program participants, Navigant also interviewed the Program Coordinator and Business Sector Manager at AEP Ohio, and the implementation contractor to understand their perspectives on savings persistence. Section 3.1.2 discusses the results of both the participant and program staff interviews.

2.2 Impact and Process Evaluation of Cohorts 5 through 8

Navigant conducted a detailed impact and process evaluation using the first full year of program data collected in 2015 for cohorts 5 through 8. This data covered a 13 to 18-month timeframe depending on when the cohort began the CEI Program. This section provides the methods and activities employed for

this evaluation. Table 2-2 provides an overview of the data sources used for the 2016 impact and process evaluation.

Table 2-2. Data Collection Activities for the 2016 Evaluation for Cohorts 5 through 8

Data Collection	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis	CEI Program projects approved for payment for 2016	AEP Ohio Tracking Database	-	All	Jan 2017 to March 2017
In-depth Interviews	AEP Ohio Program Staff	Contact from AEP Ohio	Business Programs Manager and CEI Program Coordinator	1	March 2017
	CEI Program Implementers	Contact from AEP Ohio	CLEAResult Implementation Staff	1	
Facility Interviews	CEI Program Participants	Tracking Database	10% Precision and 90% Confidence	N=52 Targeted=20 Completed=10	Feb 2017 to March 2017
Application File Review	Tracking Database	Stratified Random Sample by Site-Level kWh	Stratified Random Sample by Site-Level kWh	20	Jan 2017 to March 2017

Source: Evaluation activities conducted from January 2017 through March 2017

2.2.1 Impact Evaluation Methods

The impact evaluation of cohorts 5 to 8 was the primary research tool used to estimate the energy savings from the CEI Program. Navigant conducted a site-specific impact evaluation using engineering models and analysis, including:

1. Adopting the International Performance Measurement and Verification Protocol (IPMVP) option C—billing/metered data regression as the main method of site-level impact evaluation, since the CEI Program contains primarily behavioral-based changes.
2. Updating participant's energy models using collected data, including program tracking data and supporting documentation (project specifications, invoices, etc.), utility billing and interval data, and telephone conversations with onsite staff.
3. Confirming energy model results meet industry-standard statistical criteria for robustness, uncertainty, and fit for the program year. For models not meeting these criteria, or if there is significant degradation in statistical robustness since the baseline period, Navigant recommends model adjustments based on collected data prior to evaluation.
4. Compiling the results and findings from the 2016 evaluation of all participants in cohorts 5 to 8, and using the aggregate results to inform any recommendations for structuring models for future cohorts.

Navigant was provided energy models to all sites participating in the CEI Program. The team used data from these models, as well as other site-specific information, to identify operating characteristics of the facility both pre- and post-program implementation. Participants must adjust the energy models to reflect any changes to the site's processes impacting energy consumption due to CEI Program activities to ensure proper savings estimates. The changes that could affect model savings include:

- Changes in hours of operation
- Changes in number of employees
- Changes in production
- Any capital measures installed at the site implemented through other energy efficiency programs offered by AEP Ohio, or from other outside parties

The Navigant team reviewed and updated the engineering models for each site, following this general process:

1. Recreating the energy models to ensure these aligned with the provided data
2. Confirming the model saving calculations accounted for all capital projects
3. Identifying and accounting for any short-term effects occurring outside of the influence of the CEI Program influence, with confirmation of these changes from telephone interviews with facility staff
4. Making any additional changes to the model as needed, such as excluding certain data points or including additional variables

2.2.1.1 Verifying Reported Savings

Navigant attempted to verify the savings reported by AEP Ohio (*ex ante* savings) and adjust these savings in the CEI Program tracking system using a multitude of evaluation activities:

- **Tracking System Savings Review**, to identify potential adjustments to *ex ante* reported savings for measures, due to outliers, missing information, or tracking system data entry or calculation errors. Navigant adjusted all measures in the population identified through the Tracking System Savings Review, where applicable.
- **Application Documentation Technical Review**, to identify potential adjustments to *ex ante* reported savings for measures based on the review of documentation, assumptions, and engineering analysis for a sample of projects. Section 2.2.1.3 discusses sampling.
- **Data collection through telephone interviews with the Energy Champion**, to account for any major changes made at the facility during or after the program. The Energy Champion was the onsite contact identified by the CEI Program to lead activities and attend the training.
- **Other Adjustments to Savings**, including statistical or baseline adjustments to *ex ante* savings.

Reported savings for the CEI Program are from project-specific calculations. AEP Ohio bases its calculations on energy models created from pre-project data and collected post-project energy usage. Typically, these models use two years of energy usage data, along with production data, weather data, or other factors that could affect site energy usage. Navigant then compared the model to site usage after the beginning of the CEI Program. Savings results from any differences in energy usage.

2.2.1.2 Regression Model

The implementation contractor provided an Energy Model for every facility participating in the CEI Program. AEP Ohio, the implementer, and the customer all use this regression model to estimate site energy consumption and track energy savings. The implementer follows a series of steps to develop the model, including:

- **Collect necessary facility data.** The model requires a variety of inputs, including, among others, weather and production data.
- **Build an energy model prototype for each customer.** AEP Ohio, the implementer, and the customer test the prototype over the first month of the program, and review the model results to verify accuracy.
- **Finalize energy model for each customer.** After testing the prototype and making the necessary adjustments, the implementer provides the final version of the energy model to the customer and AEP Ohio.
- **Provide modeling support.** The implementer provides ongoing modeling support throughout the first training year of the CEI Program, and helps make any adjustments to the model based on facility adjustments in energy use for the full three-year duration of the program.

A model prototype can go through multiple revisions before being ready to track energy savings at a facility. When the model is final and calibrated to the facility's specific energy consumption patterns, it is a valuable tool for predicting energy savings from changes in production, employee behavior, equipment upgrades, and a multitude of other strategic energy management activities.

2.2.1.3 Tracking System Data

Navigant conducted a review of the tracking data for cohorts 5 through 8 to ensure the project reviews matched the data in AEP Ohio's tracking database. The team conducted this review as part of the overall impact evaluation. Section 3.2.1.3 provides the results of this review.

2.2.1.4 Impact Evaluation Sampling Plan

Navigant designed the impact evaluation sampling plan to achieve at least 90% confidence with +/- 10% relative precision of participating sites in cohorts 5 through 8. In the 2015 evaluation, Navigant was able to achieve 90% confidence with 13% relative precision with 20 of the 52 sites. For the 2016 evaluation, Navigant sampled a similar number of sites from cohorts 5 to 8.

The team stratified the sites in these cohorts by size, using kWh energy use, and sorted the sites from largest to smallest. Stratum 1 includes projects with the largest energy use (greater than 30 GWh); Stratum 2 includes medium-sized sites (15 to 30 GWh); and Stratum 3 contains the smallest sites, using less than 15 GWh annually. This approach resulted in a total sample of 20 projects for application documentation and engineering review. Navigant sampled 46 percent of the reported program energy savings. Table 2-3 provides a profile of the impact measurement and verification (M&V) sample compared with the populations within each stratum.

Table 2-3. Profile of the Impact M&V Sample by Strata

Sampling Strata	Population Summary		Sample		
	Number of Projects (n)	Ex Ante Energy Savings (MWh)	Number of Projects (n)	Ex Ante Energy Savings (MWh)	Sampled Percent of Population
Strata 1 – large	13	33,591	8	13,110	39%
Strata 2 – medium	11	14,399	8	10,720	80%
Strata 3 – small	24	7,720	5	1,971	23%
Total or Overall Value	48	55,710	21	25,801	46%

Source: Navigant impact evaluation analysis of program tracking data.

2.2.1.5 Documentation and Technical Review

Navigant conducted file reviews for the stratified sample of CEI projects to calculate the realization rate of the program overall. For each selected project, Navigant's in-depth review of project documentation included assessing the engineering methods, parameters and assumptions used to generate the *ex ante* reported savings. For each sampled CEI site, Navigant estimated *ex post* savings based on the review of project documentation and engineering analysis. Navigant made *ex post* adjustments to *ex ante* savings based on building-specific information, additional billing history, and major changes reported during the Energy Champion interviews.

Reasons for changes to *ex ante* reported savings could include the following:

- Change in production, operating hours, or number of employees between the pre-and post-period
- Misalignment of reported energy usage and provided billing data
- Not properly annualizing the energy savings of a given site
- Other short-term changes not properly accounted for in the reported savings

2.2.1.6 Verification Results

After Navigant developed the *ex post* impacts for each project in the sample, an experienced engineer familiar with the evaluation reviewed the results at the project level. Using *ex post* savings results, Navigant estimated an *ex post* realization rate (the ratio of the *ex post* savings to *ex ante* reported

savings) for each stratum. Navigant then applied the stratum-level realization rates to the population of *ex ante* reported savings by strata. The result is an *ex post* estimate of savings for the program.

2.2.2 Process Evaluation Methods

The purpose of the process evaluation is to assess the effect of the program structure and program implementation on program performance and customer satisfaction. The Navigant team's process efforts provide insights and recommendations to support the ongoing development of the CEI Program.

Navigant's approach to the process evaluation for the CEI Program included self-reporting interviews and review of relevant program tracking databases, documents, and other materials to understand how the program has evolved from the previous year. The interviews involved program managers, program implementers, and the Energy Champion at each facility to understand customers' satisfaction and perceptions related to the program. Table 2-4 shows the counts of interviews Navigant conducted for the 2016 process evaluation of cohorts 5 through 8.

Table 2-4. In-Depth Interviews Sample for Cohorts 5 through 8

What	Who	How Many
In-depth interview	Program Manager	1
In-depth interview	Implementation Contractor	1
In-depth interview	Facility Energy Champion	10*
Total		12

Source: Navigant Analysis

* = Navigant planned to interview 20 participants, but customers were much less responsive for this group of cohorts, so 10 interviews were completed. Although the process analysis was only for 10 sites, the impact analysis included all 20 sites.

Navigant developed interview guides to be open-ended and allow for a free-flowing discussion between interviewer and respondent, and real-time interviewing flexibility. The interview guides highlighted key issues and allowed respondents to provide detailed knowledge and experience of the program. The accompanying appendices to this report include all interview guides used for the 2016 process evaluation.

2.3 Demand Savings Methodology

During the 2015 evaluation, Navigant recommended AEP Ohio review peak demand savings. Evaluations of the CEI Program show significant kWh savings; however, the claimed coincident peak demand savings have been limited to equipment either removed or permanently disabled. AEP Ohio has expressed interest in understanding the demand savings that can be attributable to the program and requested the implementer address coincident peak demand savings in more detail. AEP Ohio tasked Navigant with reviewing the implementer's process for calculating demand savings to assess where improvements to that process, if any, might be worthwhile.

The goal of Navigant's review of the demand savings was to provide insights to the implementer to understand how the CEI Program impacts peak demand. These insights will help guide future program designs and evaluation efforts. Navigant reviewed the implementer's current methodology for calculating demand savings, which compares the Average Demand with Interval Data, and detailed the process in the following steps:

1. Determine the time frame of interest (e.g., weekday afternoon hours during summer months)
2. Calculate average kW over the time frame, using the Baseline period versus the Performance period, and determine the difference between these two periods
3. Normalize and adjust demand usage on weather and production data from each site's energy model
4. Adjust for any added equipment (additional kW)
5. Net out previously claimed kW from capital projects (subtracted kW)

The implementer collected a sample of sites with favorable operation schedules for calculating demand savings. These sites had fairly stable year-over-year production, and provided variable information at short enough frequencies to aid in the estimation of demand usage. Examples of variable information collected include:

- Weather data
- Production data
- Shutdown / operational data
- Interval power data
- Effects of projects and equipment outside of the CEI Program
- Other site-specific key operational indicators

AEP Ohio provided Navigant with engineering calculations for estimating the demand savings for three sites participating in the 2015 CEI Program. Navigant reviewed the calculation methodology and made two major changes meant to strengthen the defensibility of the calculations. These changes included:

1. Navigant noted AEP Ohio made proportional savings adjustments to the final calculated savings, and not to the pre-or post-period models. This caused the model to underestimate the effect of a given change at the site. For example, if production drops from 100 units to 50 units (half) the team would expect kW to go from 150 to 75 kW (half). However, the provided calculation methodology applied this 50 percent drop to the savings and not the post model resulting in the following calculation:

$$150kW - 75kW = 75kW \quad 75kW * (50 \text{ units} / 100 \text{ units}) = 38 \text{ kW}$$

Navigant recommends adjusting the calculation methodology and applying the adjustments to the post period demand usage. This results in the following calculation:

$$150 \text{ kW} - 75 \text{ kW} (100 \text{ units} / 50 \text{ units}) = 0 \text{ kW}$$

The original calculation methodology caused the models to both over and underestimate savings depending whether a given variable increased or decreased from the pre-period to the post period.

2. Navigant also made adjustments to how AEP Ohio calculated the proportional factors in the models. AEP Ohio independently determined and applied the proportion adjustments for each variable directly to the post period energy usage. For example, if the average temperature increased by ten percent from the pre-period to the post period, the post period kW demand usage would likewise be adjusted ten percent to reflect this change. The issue here is it is unlikely each variable would have a directly proportional impact on the demand savings. To calculate the relative impact of each variable, Navigant used the provided kWh energy models for each site to understand the relative impact each variable had on the kWh energy use at the site. If a ten percent increase in temperature only changed the estimated energy usage by two percent, Navigant used the same relative impact to calculate demand.

These two changes resulted in what Navigant believes is a more robust and defensible model, without greatly increasing the effort required to calculate the demand savings for these sites. Section 3.3 provides the results of Navigant's demand savings review under this new methodology.

3. EVALUATION RESULTS

This section presents the results from the 2016 CEI evaluation, including persistence savings estimates for cohorts 1 through 4, and impact and process results for cohorts 5 through 8.

3.1 Persistence Savings Evaluation Results from Cohorts 1 through 4

Cohorts 1 through 4 completed their third and final year in the CEI Program in 2016. This section provides the results of the persistence savings analysis completed for this group of cohorts.

3.1.1 Quantified Persistence Results

This section summarizes Navigant's analysis of quantifying the persistence of energy savings for the CEI Program, and attempts to calculate the measure life for SEM measures. Persistence of energy savings was defined in terms of a measure savings half-life. This is the time it takes for the program average savings to drop to 50% of the maximum program savings. Navigant collected model data for cohorts one through four and analyzed the information to calculate the average savings for each site, for each of the three years. Navigant estimated the persistence of the savings by creating linear regression models similar to the models provided by the implementer for cohorts 1 through 4 for each of the three program years and presents the results in Table 3-1.

A small number of sites in cohort 4 had issues accounting for large process changes and equipment issues occurring in Program Year 1, resulting in the significant change in savings from Year 1 to Year 2. Several sites in cohort 3 had data issues that Navigant staff were unable to account for, resulting in the small number of participants being included in the analysis.

Table 3-1. Average Annual Savings of each Participant Included in the Persistence Analysis

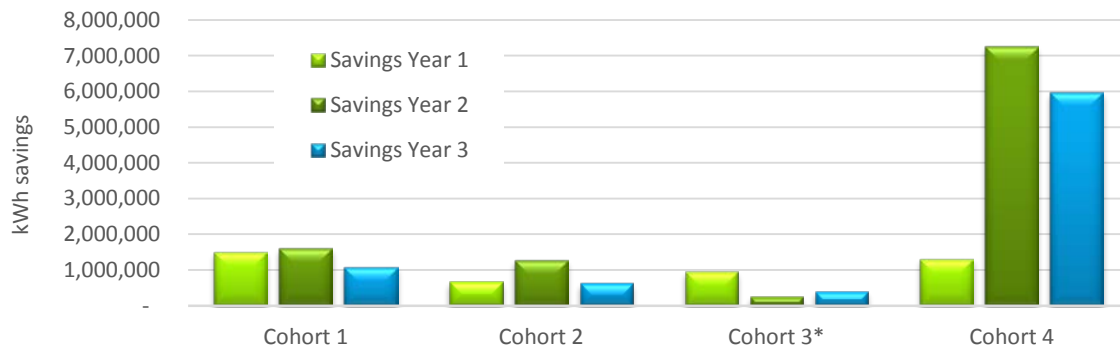
Cohort	Program Enrollment Date	Total Number of Participants	Number of Participants in Analysis*	Year 1 Energy Savings (kWh)	Year 2 Energy Savings (kWh)	Year 3 Energy Savings (kWh)
1	2013-Jan	18	14	1,513,124	1,598,277	1,091,746
2	2013-May	6	4	680,099	1,279,311	619,404
3	2013-Sept	4	1	964,957	258,658	400,591
4	2013-Oct	7	5	1,309,476	7,251,495	5,971,331

Source: Navigant Analysis

* = cohort 3 only provided sufficient modeling data for one participant.

Figure 3-1 presents the data differently, showing a year-over-year kWh savings comparison for each cohort.⁴

Figure 3-1. Year-over-year Energy Savings by Cohort



Source: Navigant Analysis

* = cohort 3 had a limited number of data points included in the analysis.

Cohort 4 includes several very large industrial customers who are able to implement CEI changes that generate large amounts of savings. For context, the average savings as a percentage of site usage in Year 3 was: cohort 1 = five percent, cohort 2 = three percent, cohort 3 = three percent, and cohort 4 = four percent based on ex post savings results.

Navigant also used the persistence analysis results to calculate a measure life for the CEI Program. The team calculated the weighted average of the measure lives for cohorts 1, 2, and 4 (summarized in Table 3-2) to arrive at this result.

Table 3-2. Calculated Measure Life for the Measure

Cohort*	Number of Participants	Measure Life (years)
1	15	3
2	4	2
4	5	5
Weighted Average		3.3

Note: Navigant excluded cohort 3 from the measure life calculation due to the limited amount of data provided for this cohort.

⁴ Navigant's 2015 evaluation discussed the significant jump in savings for cohort 4 between Year 1 and Year 2. The main reason for this was a major equipment malfunction at large industrial site that caused the artificially low savings results in Year 1. See the 2015 Evaluation Report for more information.

3.1.2 Qualified Persistence Results

Navigant conducted 10 interviews with participants in cohorts 1 through 4 to get self-reported data regarding persistent savings. The team compared these interview results with the data extracted from these sites' energy models in the quantified analysis. The results of the self-reported interviews provided insight into the reasons behind the site-level quantified persistence savings. Results show nearly the same number of sites had an increase in savings between years 2 and 3 that had decreases in savings over that time. However, it was the amount of the energy usage at these sites that shifted the overall cohort savings in either direction. Details from each cohort follow.

- Cohort 1 showed a reduction in savings due to the loss of the Energy Champion at one of the larger sites in the cohort. The interviewee at this facility said the site lost motivation to pursue energy efficiency when the Energy Champion left.
- Cohort 2 showed a reduction in savings due primarily to modeling issues. Two large sites reported significant facility changes, including a significant change to production processes, and a major facility upgrade. Neither of the energy models accurately reflected these changes and therefore estimated inaccurate savings.
- Cohort 3 showed a slight increase in overall savings from year 2 to year 3 based on analysis of a single data point. Navigant was unable to analyze a significant number of sites for cohort 3 due to insufficient data provided by the participants.
- Cohort 4 showed an overall reduction in savings because one of the largest facilities in the cohort left the program. However, many of the smaller facilities in this cohort had an increase in savings from year 2 to year 3. Interviews with these participants revealed the increases were due to employee and corporate buy-in resulting in a constant stream of ideas and activities that the site later implemented in year 3. In addition, one of the sites interviewed reported making CEI a part of its corporate goals and presented the results of CEI activities on a weekly basis. Lastly, one site reported increased energy savings due to proper calibration of the building energy management controls.

Overall findings from the persistence analysis interviews identified the following trends.

Goal Setting

Similar to the 2015 evaluation, the key to the successful persistence of savings from year 2 to year 3 was goal setting. Interviewed participants mentioned having concrete goals for saving and conserving energy motivated the entire facility to strive to meet these goals. These goals acted as a form of accountability and encouraged sites to continue to seek opportunities year after year.

Employee Engagement

Sites reporting persistent savings from Year 2 to Year 3 mentioned continuing to engage and empower their employees to both follow the energy-saving procedures put in place in the training Year 1, and to look for opportunities to save energy in their everyday activities. This held true at every level of the business, from the executive level supporting the business decisions to pursue energy efficiency, to the energy team leading energy improvements throughout the company.

Program Support of the Energy Model

One of the underlying themes of the current evaluation of cohorts 1 through 4 was the mention of the importance of the energy models. Participants reported the energy model received during the first year was one of the most beneficial aspects of participating in the CEI Program. As the program continued into year 2 and year 3, participants claimed the importance of the energy models evolved as well. These interviewees said they specifically used the model to identify the major energy end uses of the facility, monitor the impact of the changes, and plan for future projects.

Navigant recommends AEP Ohio makes a concerted effort to support these models throughout the life of the program, whether that is a three-year period or only a one-year period, and ensure these represent the site's energy use as accurately as possible. Many of the persistence savings issues identified in this evaluation were the direct effect of inaccurate and out-of-date energy models.

Furthermore, Navigant recommends AEP Ohio consider a process to continue to support the energy models after the program officially ends. Having a support line for facilities to use as they continue to understand and enhance their energy model will help to generate future energy savings across AEP Ohio's service territory.

Measure Implementation

Sites continued to implement several low-cost or no-cost measures to help with persistent energy savings in Program Year 3. Installing these types of measures, including equipment shut down controls, compressed air equipment optimization, low cost lighting improvements, and optimizing building controls, removes the choice of employees to maintain energy efficient behaviors and ensures facilities consume less energy on a regular basis.

3.1.3 Tracking Data Review Results for Cohorts 1 through 4

Along with the persistence analysis, Navigant reviewed the tracking data for cohorts 1 through 4 by extracting key program participation data from AEP Ohio's tracking database. The database extract spreadsheet included a project level dataset with project total impacts, application submittal and status data, and internal approval information. Savings calculations were on a site-by-site basis (although the technical documentation provided by AEP Ohio sometimes grouped sites together for a single company). Navigant noted small differences in the tracking data compared to the provided site reports. The differences between the report and tracking data were due to the inclusion of capital projects late in the reporting period. The capital project changes mostly affected year 2 and year 3 of cohorts 1 through 4, as shown in Table 3-3.

3.2 Impact and Process Evaluation Results for Cohorts 5 through 8

Navigant conducted an impact and process evaluation of cohorts 5 through 8 after their first full year in the CEI Program.

3.2.1 Impact Evaluation Results

This section provides the results of the impact evaluation of cohorts 5 through 8 and incremental for cohorts 1 through 4. Overall, the 48 projects completed by these participants met their 2016 kWh goals, saving on average 4 percent of site energy use calculated with *ex post* savings results. Nineteen of the 20

reviewed sites calculated *ex ante* savings for more than a 12-month period, resulting in a realization rate of 77 percent. Participants in these cohorts ran the program for 13-18 months and reported the cumulative sum of energy saving across the entire period. Navigant normalized these savings for only a 12-month period, resulting in the lower *ex post* savings. Table 3-4 shows the high-level impact results for cohorts 5 through 8.

Table 3-3. Savings Estimates for 2016 CEI Program

	2016 Program Goals* (a)	<i>Ex Ante</i> Incremental Savings (b)	<i>Ex Post</i> Incremental Savings** (c)	Realization Rate = (c / b)	Percent of Goal = (c / a)
Energy Savings (MWh)	20,000	55,949	42,768	76%	214%
Demand Savings (MW)***	2.46	1.75	1.84	105%	75%

Source: Navigant Analysis

* 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 March 9, 2016.

The demand savings methodology was under review during this program year, so only a small number of sites claimed demand savings for this year. This site realized a *ex post* demand savings of 1838.4 kW. Although the program did not reach its demand savings goals this year, it is expected the program will reach its demand savings goals in the future. Table ES.4 provides the *ex ante* and *ex post* savings and realization rates by cohort, as well as the percentage of site savings each cohort achieved on average.

Table ES-1. CEI Program for Cohorts 5 through 8

Cohort	Number of Sites	Year 1 <i>Ex Ante</i> Energy Savings (MWh)	Year 1 <i>Post</i> Energy Savings (MWh)	Realization Rate	Savings as a Percent of Site Usage (Average)
Cohort 5	12	10,434	8,330	80%	3.5%
Cohort 6	18	7,561	6,128	81%	2.2%
Cohort 7	16	11,629	8,558	74%	4.3%
Cohort 8	11	26,086	20,466	78%	5.3%
Total or Weighted Average	57	55,710	43,482	78%	3.9%

Source: Navigant Analysis

Note: Totals may not sum due to rounding.

3.2.1.1 Site Level Results

For each site, Navigant reviewed and updated the provided engineering models. Navigant staff generally followed the process below for this review:

Step 1. Navigant recreated the provided energy models to ensure these aligned with the provided data.

Step 2. Navigant confirmed the model savings calculations accounted for all capital projects.

Step 3. Navigant identified and accounted for any short-term effects not a result of CEI Program influence. The team used information from telephone interviews with site staff to confirm the changes.

Step 4. Navigant made additional adjustments to the provided model as needed, such as accommodating outliers and ensuring savings reflected the correct number of time periods.

While the majority of sites achieved realization rates of 75 percent or higher, several sites had realization rates well below or well above 100 percent. Variable realization rates for program cohorts were a result of:

- Site operation changes during the measurement period requiring the removal of some data points due to outlier variables. Variables were considered outliers if these were 110 percent and above the maximum, or 90 percent and below the minimum of the baseline range for a given variable.
- Site operation changes during the measurement period that required the removal of some data points due to short term or long term changes occurring at the site. The team identified these changes on a site-by-site basis, but included shutdown of major equipment, long-term equipment malfunction, or short-term production changes that affected the overall energy usage.
- *Ex ante* calculations that included time periods outside of the 12-month measurement period.

Table 3-6 presents the site level results for the sample of participants used in the impact evaluation.

Table 3-4. Site Level Results and Realization Rates for the 2016 Participant Sample

Site	Ex Ante Energy Savings (kWh)	Ex Post Energy Savings (KWh)	Site Level Realization Rate
A	-	-	-
B	639,758	330,569	52%
C	2,838,586	1,652,579	58%
D	24,485	15,530	63%
E	1,910,087	1,267,882	66%
F	2,649,924	1,766,616	67%
G	5,095,436	3,411,593	67%
H	580,248	432,988	75%
I	348,883	275,843	79%
J	145,889	115,962	79%
K	468,916	375,133	80%
L	462,993	370,395	80%
M	296,401	237,121	80%
N	2,594,898	2,093,285	81%
O	524,795	423,609	81%
P	1,885,431	1,713,269	91%
Q	642,864	597,727	93%
R	809,683	773,144	95%
S	1,893,750	1,811,809	96%
T	534,882	523,667	98%
U	276,408	326,333	118%
V	1,178,308	1,421,210	121%
Total or Weighted Average	25,802,625	19,936,264	77%

Source: Navigant impact evaluation and program tracking database

Site A

During the 12-month measurement period, Site A did not report additional energy usage from the installation of new machinery. Since information on the energy consumption of the new equipment was unavailable, Navigant was not able to separate the impact of the new machinery from the impact of CEI activities. While this site began to show savings from CEI activities in the last three months of the measurement period, there were not enough data points to establish a trend to extrapolate over the 12-month measurement period.

Sites B, C, F, J, K, L, and M

These sites reported *ex ante* savings with a measurement period beyond twelve months, and had significant savings in the post-12-month period. Subsequently, the reported *ex ante* savings were significantly larger than the *ex post* savings, which only measured twelve months of data. To calculate *ex post* savings reflective of the savings achieved by these sites, for sites showing relatively stable savings during the entire measurement period, Navigant found an average across the entire period to calculate annual savings for these sites. For sites with little savings in the earlier months of the program, Navigant calculated savings based on the last 12 months of the measurement period.

Sites B and C also included outliers for certain model variables in the post-12-month time period. Navigant removed these outliers in the *ex post* adjustment, slightly reducing the benefit of the adjustment. The realization rates remained low for sites B and C, at 52 and 58 percent, respectively.

Site E

This site achieved significant savings for the majority of the 12-month measurement period, but savings tapered off around month nine due to lack of available staff to conduct CEI activities. Navigant annualized savings from these months to calculate the site's *ex post* savings, excluding months with irregular operations. Additionally, reported *ex ante* savings calculations included savings for time periods outside of the 12-month measurement period. These factors resulted in a lower realization rate for this site.

Site G

This site temporarily discontinued one production line between months four and ten of the 12-month measurement period, resulting in perceived savings, which were not due to any CEI activities. Further, removing the impact of this discontinued line from the *ex post* savings was difficult because information on the energy consumption of the production line was unavailable. To factor the impact of the discontinued production line in the *ex post* savings, Navigant created another regression model including a binary variable for the discontinued line. Navigant used the value of this variable's coefficient to reduce the *ex post* savings for each time period the production line was not used. Navigant determined the total impact of the discontinued production line was approximately 1.1 million kWh. The remaining delta between *ex ante* and *ex post* savings for this site is explained by an extra time period included in the reported *ex ante* savings.

Site U

This site achieved moderate but steady savings throughout the measurement period as a result of CEI activities. However, the site reported *ex ante* savings with time periods outside of the 12-month measurement period, leading to the realization rate of 118 percent. These extra time periods included a significant drop in *ex ante* savings. Properly annualized results show a higher *ex post* savings than the claimed *ex ante* savings.

Site V

This site achieved strong savings during periods of normal operation, but had two extended periods of irregular operation. During both periods, damaged equipment caused efficiency losses before staff could make repairs. Because both instances were unrelated to CEI activities and unreflective of typical operations, Navigant removed these time periods from the *ex post* calculation by annualizing savings from periods of regular operation. Reported *ex ante* savings for this site included these periods of irregular operation as well as reduced savings from outside of the 12-month measurement period. As a result of the *ex post* savings adjustment within the 12-month time period, *ex post* savings were considerably higher than *ex ante* savings, despite the additional included time periods.

3.2.1.2 Tracking Data Review Results

The CEI Program evaluation team was able to extract key program participation data from AEP Ohio's tracking database. The database extract spreadsheet includes a project level dataset with project total impacts, application submittal and status data, and internal approval information. Savings calculations were on a site-by-site basis (although the technical documentation provided by AEP Ohio sometimes grouped sites together when these were under the same company). Navigant did not find any discrepancies in the tracking data for cohorts 5 through 8. The evaluator did not address whether the tracking system is adequate for regulatory prudence reviews or corporate requirements.

3.2.1.3 Demand Savings Results

AEP Ohio asked Navigant to review potential methodologies for calculating demand saving for the CEI Program. As a part of this review, AEP Ohio provided Navigant with engineering calculations for estimating the demand savings for the 2016 CEI Program. The sites chosen for review were from all cohorts and did not affect the final claimed *ex ante* demand savings. Navigant reviewed the calculation methodology and made several changes meant to strengthen the defensibility of the calculations, as described in Section 2.3. This methodology will likely be used in the future to claim demand savings for this program. Table ES-5 provides the demand-savings results using these adjustments to the calculation methodology.

Table 3-5. Peak Demand Savings Evaluation Results

Customer	<i>Ex Ante</i> Demand Savings (kW)	<i>Ex Post</i> Demand Savings (kW)	Realization Rate
A*	236.2	236.2	100%
B	755.2	740.4	98%
C	565.0	503.6	89%
D	191.0	358.2	188%

**Detailed calculations were not provided for this site as savings was calculated using a simpler equipment reduction methodology.*

3.2.2 Process Evaluation Results

Navigant conducted a full process evaluation of cohorts 5 through 8 in 2016 to understand how the CEI Program worked for this new group of participants. The team used self-reported interview data from utility staff and participating Energy Champions to provide insight into the program design and delivery, as well as reasons behind the energy savings achieved in year 1.

3.2.2.1 Self-Reported Reasons for Energy Savings

Interviewed participants from cohorts 5 through 8 provided several reasons for why their facility saved energy through the CEI Program in year 1. The top responses included:

- **The energy model.** Participants commented on how powerful the energy model tool was and how it benefited them as they were considering making facility upgrades. Participants valued the modeling support provided and requested a mechanism for continued support going forward. Navigant recommends exploring ways AEP Ohio can support facilities and their energy model updates after participation in the CEI Program officially ends.
- **Training workshops.** Interviewees mentioned the CEI training workshops as a critical component of the program. Cohorts 5 through 8 received 12 workshops in total, four with the Energy Champions from all the participating facilities, and another eight meetings face-to-face or on the phone with the implementer. These meetings focused on how the whole facility uses energy, and how the employees of the facility view energy consumption.
- **Formation of Energy Teams.** Requiring participants to form Energy Teams provided a formal structure companies turned to for energy efficiency activities. Interviewees mentioned getting the Energy Teams to participate in the energy assessment conducted by the program implementer was significant for the key decision-makers in understanding the importance of energy efficiency.
- **Collaboration and meetings with other companies participating in CEI.** Customers saw significant value in meeting with peers facing similar challenges in implementing continuous energy improvement projects. Several customers mentioned they would like to have a follow-up meeting with these peers after the first twelve months of training is complete. The Energy Champions were interested in hearing about the additional measures other companies implemented, and ideas about how others are keeping energy reduction as a continuous goal. Navigant understands AEP Ohio formed an Alumni group for 2017 and looks forward to seeing the results of this cohort.
- **Shift in business sustainability practices.** Some customers said they are expanding their conservation focus to include the sustainability and environmental impact of their business actions. One participant reported:

“My role has even expanded to include the management of other utility resources such as water, sewage, electricity, gas, and emissions as our company continues to try and improve business practices from a sustainability standpoint.” Cohort 5 through 8 participant

3.2.2.2 Program Issues and Barriers

This section describes some of the issues Navigant found during the 2016 evaluation. AEP Ohio should consider these items when planning for future CEI Program years.

- **Commercial facilities require more attention than industrial facilities.** One of the main findings with cohorts 5 through 8 was commercial participants needed more support from AEP Ohio and the implementer than their industrial counterparts. Not all commercial participants had these issues, but in general, the following examples apply to the commercial sector:
 - Interviews with commercial facilities showed they generally had less knowledge about their overall energy use and what sorts of systems accounted for their site’s energy consumption. Industrial customers are much more aware of these issues and are able to apply the principles of the CEI Program more readily.
 - Commercial customers need more training specific to their sector during the workshop sessions. This detailed training helps commercial Energy Champions learn about energy

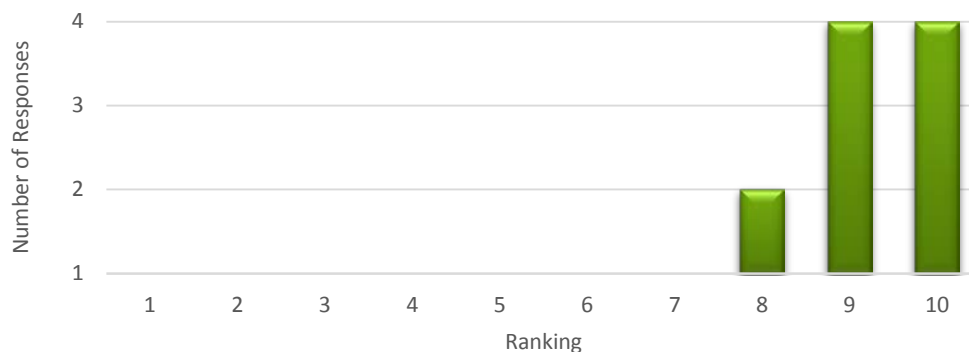
efficiency and where to look for it in their facilities. The larger industrial customers, however, do not need as detailed training and may lose interest if they have to sit through the same training session as the commercial participants.

- Most commercial Energy Champions have less time to devote to energy efficiency than their industrial counterparts. Many of the commercial sites reported their facility managers had many other responsibilities than just managing the facility, and therefore could not focus all their attention on energy efficiency activities identified in the CEI training workshops. Support from AEP Ohio for this group of participants is key for them to continue to realize savings from this program.
- Commercial buildings focus on HVAC and lighting system controls to achieve energy savings, while industrial sites see savings in process equipment upgrades and air compressor optimization. AEP Ohio should focus the CEI training workshops on these different end uses to engage the targeted audiences more directly.
- **Time commitments are still a barrier to participation for all customers.** Interviews with AEP Ohio staff revealed many customers do not have the time to commit to the CEI Program, regardless whether they are a commercial or industrial sector business.

3.2.2.3 Participant Satisfaction

Navigant asked participants about their satisfaction with the CEI Program. Using a scale of 1 to 10, with 1 being completely dissatisfied and 10 being completely satisfied, all respondents gave a rating of 8 or higher, as shown in Figure 3-2. Participants appreciated the savings achieved by making a minimal investment in time and money. Participants felt the workshop presentations provided valuable information they could apply to their own facilities.

Figure 3-2. Customer Overall Satisfaction (n=10)

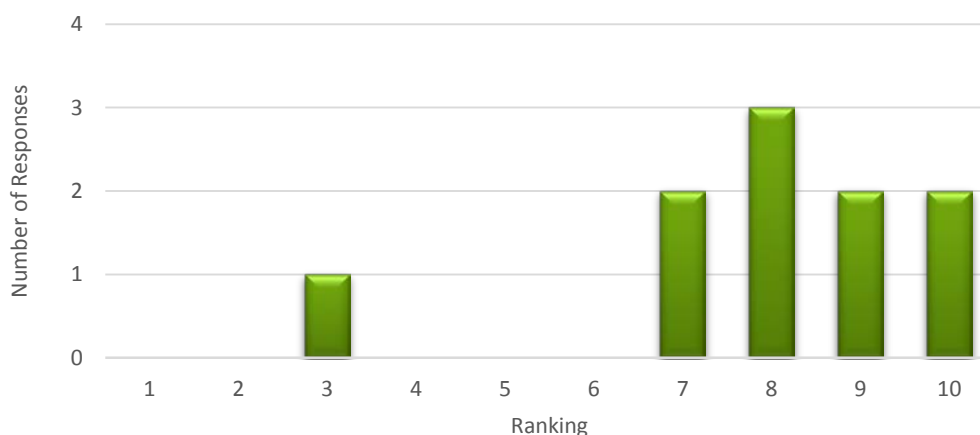


Source: Navigant Analysis

The team also asked about satisfaction with various components of the program, such as the training workshops, with the result presented in Figure 3-3. Even though interviewees mentioned the training workshops as a critical component to the CEI Program, satisfaction in the workshops dipped slightly compared to previous years. As mentioned earlier, the knowledge level regarding conservation and sustainability for some of the participants is very high; as a result, these customers would like the training

workshops to be more specific to their business. A participant noted that, as a university, hearing about measures to save energy at an industrial site was not helpful.

Figure 3-3. How satisfied were you with the content of these workshops? (n=10)



Source: Navigant Analysis

3.2.2.4 Marketing and Site Recruitment

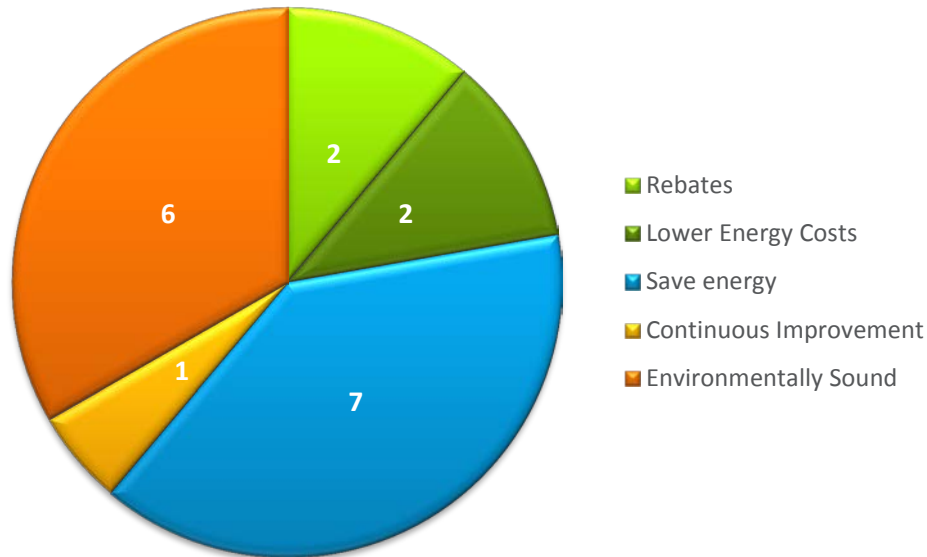
AEP Ohio markets the CEI Program to customers consuming three GWh or more annually.⁵ Customer Service Engineers review the list of customers meeting this criterion, identify those with sufficient staff and resources, and personally reach out to them to solicit participation in the CEI Program. The strong relationship between AEP Ohio Customer Service Engineers and the large energy customers, coupled with the one-on-one invitation to participate in the program, worked well as a recruit process. For cohorts 5 through 8, AEP Ohio expanded the list of possible participants to include large commercial customers and successfully recruited several hospitals and universities under the 2015 program year.

Navigant completed 10 interviews with participants in cohorts 5 through 8 and revealed several reasons the sites decided to participate in the CEI Program. Figure 3-4 provides a distribution of the results.⁶ The reason cited most often was the desire to save energy.

⁵ AEP Ohio may consider customers consuming less than three GWh annually if they perceive a high potential level of savings.

⁶ While ten interviews were conducted, respondents could provide multiple responses, leading to response count of more than 10.

Figure 3-4. Participant Reasons for Participating in CEI (n=10)



Source: Navigant Analysis

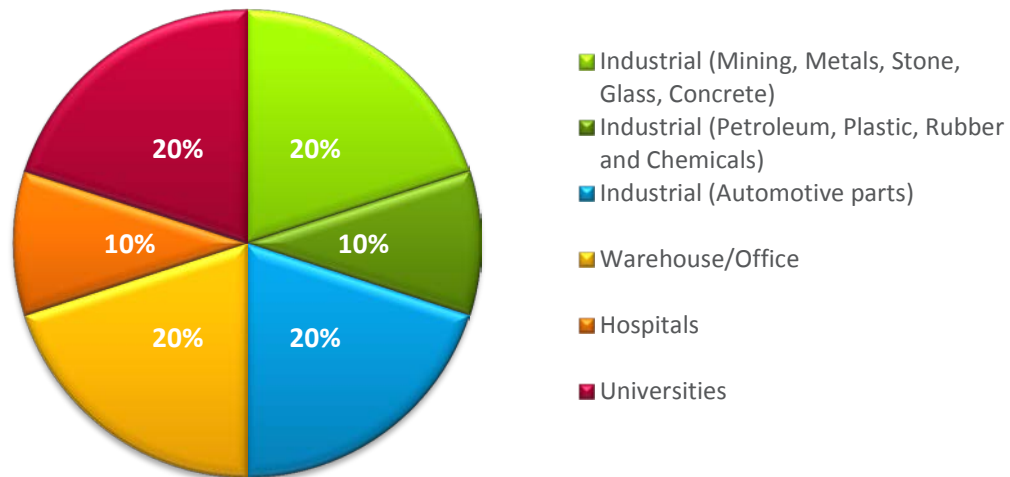
Six of the 10 interviewees mentioned wanting their facility to be Environmentally Sound as a reason to participate in the CEI Program. Navigant probed further to reveal more and more sites are making energy decisions based on their environmental impact and continued environmental sustainability. Universities also mentioned being environmentally aware helps to meet students' expectations.

3.2.2.5 Participant Demographics

Results from the 10 completed participant interviews include demographic and other facility-specific information for cohorts 5 through 8. The average age of the facilities is 41 years old, with a range of 15 to 68 years. The average facility size is 687,960 square feet. Navigant grouped responses into three groups based on the number of employees per facility: 500 or less, between 500 and 1,000, and over 1,000. Half of respondents reported a workforce of 500 employees or less, 20 percent employed between 500 and 1,000 employees, with 30 percent employing over 1,000 employees.

Participant facilities covered a range of industrial and large commercial activities. Figure 3-5 shows the distribution of business activities for cohorts 5 through 8, including the newly expanded commercial activities of hospitals and universities.

Figure 3-5. CEI Participant Business Sectors for Cohorts 5 through 8



Source: Navigant Analysis

The 2016 participant profile includes large commercial buildings, such as hospitals and universities. Section 3.2.2.2 provides a discussion on the differences between the new commercial participants and their industrial counterparts.

3.2.3 Cost Effectiveness Review

This section addresses the cost effectiveness of the 2016 CEI Program. Navigant and AEP Ohio used the Total Resource Cost (TRC) test to assess the Cost Effectiveness of the program. Table 3-8 summarizes the unique inputs used in the TRC test.

Table 3-6. Inputs to Cost-Effectiveness Model for AEP Ohio CEI Program

Item	2016
Measure Life	4
Participants	48
Ex Post Annual Energy Savings (kWh)	42,676,784
Ex Post Coincident Peak Savings (kW)	1,838
Third Party Implementation Costs	\$1,249,263
Utility Administration Costs	\$366,522
Utility Incremental Incentive Costs	\$2,751,228
Participant Contribution to Incremental Measure Costs	\$2,483,054

Source: Navigant Analysis

The impact evaluation *ex post* savings results are the basis of the cost effectiveness analysis. The team did not analyze the Participant Cost Test (PCT), as the implementation contractor did not supply any data for “Participant Contribution to Incremental Measure Costs.”

Based on these inputs, the TRC ratio is 2.3 and the program passes the TRC test for the program in its entirety. Table 3-9 summarizes the results of the cost effectiveness tests.

Table 3-7. CEI Program Cost-Effectiveness Results

Test Results for CEI Program	Benefit/Cost Ratio
Total Resource Cost	2.3
Participant Cost Test	5.7
Ratepayer Impact Measure	0.6
Utility Cost Test	2.1

Source: Navigant Analysis.

At this time, the calculation of the TRC does not include the reduction of greenhouse gas emissions. These additional benefits would increase the given TRC benefit/cost ratio.

4. EVALUATION FINDINGS AND RECOMMENDATIONS

This section presents the key findings and recommendations from the 2016 CEI Program impact and process evaluations.

4.1 Key Impact Findings and Recommendations

These recommendations are specific to increasing realization rate and streamlining the impact verification.

1. Cohorts 1 through 4 showed a net decrease in persistent savings between Program Years 2 and 3. Three of the four cohorts used in the persistence savings analysis showed a decrease in energy savings over the last two years of the CEI Program. The primary reasons for this decrease was the lack of model updates to reflect major changes in facility energy use or Energy Champions leaving.

Impact Recommendation 1a: Continue to provide energy modeling support after the program period has ended. The model is a key component of a site's persistent energy savings. Although the implementer did work with the sites to update these models throughout Year 3, several sites seemed to have issues with the models properly reflecting their energy use in Year 3 and could have used more support.

Impact Recommendation 1b: Allow a facility to rejoin the CEI training workshops if there is a major change in the Energy Team. Navigant found several sites that lost their Energy Champion and lost motivation with the CEI Program. AEP Ohio should reach out to customers who go through such a change and offer to re-train a new Energy Champion.

2. Navigant's estimate of a 4.3 effective useful life is the best estimate for the persistence of CEI Program savings given the data that was available but the Navigant team identified two issues with the data provided for the persistence and measure life analysis. The first issue was that modeling data was not maintained and updated by the facilities or did not account for changes occurring at the facilities. Several sites did not maintain the collection of variables identified in the baseline models or properly adjust the model based on large facility wide changes. The second issue was the limitation in analysis years. For participants who provided sufficient energy consumption and updated modeling data, the Navigant team only had three years of program data to use for the regression model's measure life analysis. This is a very limited number of data points and leads to lower confidence in the results.

Impact Recommendation 2a: The implementer and utility should encourage sites to continue to collect variable data for all variables identified in the baseline even after completing the 12 months of training so that the models can accurately reflect the energy savings achieved at these facilities. Also, as noted above in finding 1a, the implementer should support sites to update models if site characteristics change greatly from the baseline period.

Impact Recommendation 2b: If the utility is especially interested in persistence of savings for these programs, Navigant recommends continuing to gather data beyond the three-year program period to refine analysis.

3. Reported *ex ante* savings included several months beyond the 12-month time frame used in the *ex post* analysis. Participants in cohorts 5 through 8 participated in the CEI Program for between 13-18

calendar months, and included savings over this entire time span in the reported *ex ante* estimates. Navigant's impact evaluation only reviewed an annualized 12 months of savings in the *ex post* verification analysis, resulting in an overall realization rate of 77 percent for this group of cohorts.

Impact Recommendation 3: Due to the unique timing issues around estimating savings for this program, the implementer should always take care to calculate savings for an annualized period even if the program participation goes beyond 12 months.

4. Modeling issues continue to be a hindrance to accurately estimating savings. Modeling issues for cohorts 5 through 8 included the addition of capital equipment that the implementer did not accurately account for, invalid data points, and irregular site operation schedules that the models did not capture.

Impact Recommendation 4a: Once all post data is collected, the implementer should review the post period data to look for invalid data points, irregular site operation and other unaccounted for site changes.

Impact Recommendation 4b: For data points that are not valid in the post period (either above 110 percent of the maximum or below 90 percent of the minimum) the implementer should consider removing these points and calculating annualized savings based on an average of valid data points. If there is a significant number of invalid data points, the implementer should provide clear reasons why data points should be included in the post period.

Impact Recommendation 4c: If a site experienced a short-term change in production or operation that is not reflective of "normal operation," the implementer should either, remove these points and calculate annualized savings based on an average normal operation, or estimate the impact of this short-term change using engineering calculations and remove it from the model.

Impact Recommendation 4d: If a site installs additional equipment or changes operations for a long period of time, the implementer should calculate the impact of these changes and remove them from the model. Estimating impacts of this kind can be done through engineering calculations, onsite measurements, or through a variety of techniques using the energy models for these sites. Post period multi-regression models can be created that include variables to account for these effects and, if they are statistically significant, can be removed with a high level of confidence.

5. One of the facilities with the largest energy savings had a facility change that greatly affected the program's overall realization rate. During the review of this facility, Navigant noted a process line shutdown occurred as a result of the CEI Program. During the follow-up interview with this facility, Navigant found that although CEI did encourage the site to shut down the line early, the facility had planned to shut the line down due to financial reasons and not because of the CEI Program.

Impact Recommendation 5: The implementer should carefully review all changes to ensure proper allocation of savings to the CEI Program or to other factors. In addition, the implementer should carefully review all measures and ensure each measure is eligible for the program, and remove savings from the model for those measures deemed ineligible.

Navigant reviewed the demand savings methodology for the CEI Program provided by the implementer. During the review of the methodology, Navigant identified two major changes to strengthen the defensibility of the calculations. 1) Navigant noted AEP Ohio made proportional savings adjustments to the final calculated savings, and not to the pre-or post-period models. This caused the model to underestimate the effect of a given change at the site; 2) Navigant noted the models did not account for relative effects of changes in production, weather, or other factors. A 10

percent increase in production could have a much greater effect on the demand usage than a 10 percent increase in temperature, but the provided models treated all changes as linear and equal.

Impact Recommendation 6a: Navigant recommends adjusting the calculation methodology and applying the adjustments to the post-period demand usage and not to the final demand savings.

Impact Recommendation 6b: To calculate the relative impact of each variable in the demand calculation, Navigant recommends using the provided kWh energy models for each site to understand the relative impact each variable had on the kWh energy use at the site.

4.2 Key Process Findings and Recommendations

The following process recommendations are offered to help improve program effectiveness and efficiency and further improve participant's experience of the program.

1. Commercial buildings encountered unique issues with the CEI Program. The recent program expansion to include large commercial buildings brought about some program design issues that AEP Ohio must consider as they recruit more commercial customers. Some of these issues included generating less savings overall than industrial customers, not having the time or staff to devote to an Energy Team, requiring more focused training from the workshops, varying degrees of technical knowledge, and needing to focus on different low cost/no cost measures than those applicable in the industrial sector. Interviewed participants also reported that having their peers at the training workshops was a valuable aspect of the CEI Program.

Process Recommendation 1a: Navigant recommends that the training for new cohorts recognizes the differences between the industrial and commercial sectors and present topics differently for each participant group. These include differences in the major energy-consuming end-uses between the sectors, where commercial buildings tend to upgrade lighting and HVAC equipment, while industries tend to focus on process-related upgrades and air compressors. This may require separate training sessions with the various audiences.

Process Recommendation 1b: Provide two tiers of training based on participating companies' levels of expertise and technical knowledge. Navigant identified this split most obviously between commercial and industrial respondents, but differences could also exist within businesses of the same sector.

Process Recommendation 1c: Be sure to have adequate representation from each business type to allow for networking. AEP Ohio should be aware of the business representation at these workshops as they group commercial customers into cohorts.

2. Interviewed participants from cohorts 1 through 4 who reported increased savings over the three years reported goal setting and employee buy-in as the key to their long-term success.

Process Recommendation 2: These key behaviors should be encouraged through training and possible incentives for completing certain tasks such as long term goal setting.

3. Interviewed participants from cohorts 5 through 8 provided reasons why their facility saved energy through the CEI Program in year 1, including mentioning how powerful a tool the energy model was and how it benefited them as they were considering making facility upgrades. Interviewees also mentioned the CEI training workshops as a critical component of the program, and enjoyed the opportunity to work with their peers who faced similar challenges in implementing continuous energy improvement projects.

Process Recommendation 3: The program should continue to create high quality models and provide focused and relevant training that brings participants together to form collaborative teams pursuing similar efficiency goals for their businesses. In addition, once the program is complete, determine ways AEP Ohio can continue to support the customer's modeling efforts; having an accurate understanding of its facilities usage will help the customer maintain and improve upon their savings. This will also help AEP Ohio to have a higher persistency in the program.

4. Customers reported high satisfaction with the program, regardless of the amount of savings a customer received. Customers were very pleased with the training workshops and interaction with the implementation contractor. Customers were especially appreciative of the site-level attention received from the implementation contractor, including the walk-through assessments and expert advice on their processes.

Process Recommendation 4: Navigant recommends that the program continue to focus on site-level issues through walk-throughs and process-focused expert advice.

APPENDIX A. PARTICIPANT, AEP OHIO STAFF, AND IMPLEMENTATION STAFF INTERVIEW GUIDES

A.1 AEP Ohio CEI Program: AEP Ohio Staff Interview Guide

Section A: Introduction

We are interested in asking you questions about cohorts 5 through 8 so we can understand the nuances of any new program elements and identify program successes; and for cohorts 1 through 4, address any persistence issues from your perspective.

1. Before we get started, has your role and scope of responsibilities with respect to AEP Ohio's CEI Program changed since 2015?

Section B: Program Goals/Status

1. How did the program do in terms of meeting your annual goals?
 - A. Are there any other quantitative goals AEP Ohio keeps track of, including non-energy goals (e.g., recycling, emissions)?
2. Is participation sufficient to meet current and future program goals?
3. Do you anticipate a change in the goals for program year 2017-2018?

Section C: Site Support

1. The demographics of your participants have changed in Cohorts 5 through 8. What was the best project (can be either viewed by savings, or creativity of measure) implemented by this group?
2. What interaction have you had with the cohorts 1 through 4 sites since the end of the training?
3. Have any of the sites been more active in AEP Ohio's other programs since the end of their training?
4. If yes, what percent of the CEI participants have increased their activity in other programs?

Section D: Marketing and Outreach Activities

1. Does AEP Ohio continue to be involved in the choosing of sites for your program?
 - A. How have the criteria for recruiting changed since the beginning of the program?
 - B. What messages about the program are customers most responsive to in your recruiting?

- C. Which customers are included or excluded?
 - D. Is the majority of the participation from internal recruiting or outside interest?
- 2. Of the customers that were recruited:
 - A. Did any of the different business industries not have the proper data available to participate?
 - B. Did any of the different business industries not have the proper technical expertise to participate?
 - C. Why do you think the participants did not seek this kind of training elsewhere? Were they unaware of the benefits of this kind of training?
- 3. How are you planning to recruit moving forward?
- 4. Have you made any changes in how you implement the program since the first year of cohorts 1 through 4?

Section D: Program Tracking and Reporting

- 1. Have there been any changes to how the implementer provides the savings data and reports to you?

Section E: Program Strengths and Areas for Improvement

- 1. Reflecting over the past three years, what unexpected things happened that affected the program's operation or ability to reach its goals?
- 2. Is there anything you would like to change about this program moving forward?
- 3. Concerning the cohort meetings/training, how satisfied are you with the content of these workshops?
- 4. In your opinion, what can AEP Ohio and/or CLEAResult do to improve these workshops?

Section F: Closing

- 1. Do you have any other comments, concerns or suggestions about the program that we did not discuss that you would like to make sure I know about?

Thank you very much for taking the time in assisting us with this evaluation.

A.2 AEP Ohio CEI Program: Implementation Staff Interview Guide

Section A: Introduction

We are interested in asking you some questions about this program so that we can understand the new program elements and get a sense of program successes and challenges, from your perspective.

1. Before we get started, has the implementers role and scope of responsibilities with respect to AEP Ohio's CEI Program changed over the past three years?
 - a. In regards to training
 - b. In regards to the on-site assessment
 - c. To the Utility

Section B: Program Design

Next, we would like to discuss a little more about how the program is **currently** structured. (Comparing questions 2 – 7 to responses from 2015)

1. What interaction have you had with the cohorts 5 through 8 sites since the end of the training?
2. Besides the monthly training, how did you provide support to your facilities?
3. Besides the energy coach, did you bring in additional specialist staff to provide support to these sites? What support do they provide?
4. What do you feel could be changed in the program design, either by you or AEP Ohio?
5. Ask any additional follow-up questions based on interviews with participants
6. How are the clients using the energy model?
 - A. Have clients used it internally to help cost justify projects?
7. Has there been any changes in how you report the results to the client and AEP Ohio?
 - A. Did you have any issues with these reports including timing, or the information that you had to provide to both AEP Ohio and the customer?
8. How was the program different for cohort 6 (hospitals and universities) compared to the other cohorts?

- A. What could be done to improve the experience for these types of clients?
- 9. The CEI Program recommends that clients form Energy Teams at their facilities.
 - A. Did you form teams in different ways for different business types?
 - B. Do you think there are ways to improve these team designs?
- 10. How do you encourage engineers to break the “follow protocol” model and look at things from a different angle?

Section C: Marketing and Outreach Activities

- 1. Were you involved in how sites are chosen for the cohorts 5 through 8?
 - A. What are the criteria for recruiting?
 - B. How are the sites chosen and targeted? If needed: What’s the relationship between you and AEP Ohio in recruiting and choosing sites?
 - C. Which customers are included or excluded?
 - D. Is the majority of the participation from internal recruiting or outside interest?

Section D: Site Support

- 1. What interaction have you had with the cohorts 1 through 4 sites since the end of the training?
- 2. Of the customers from cohorts 1 through 4:
 - A. Do you have insight into why certain customers were able to maintain or increase their savings throughout Program Year 2 and 3 and why others showed a drop in savings in year 2 and 3?
 - B. What steps do you think could be taken (by you or AEP) to increase persistence of CEI savings?
- 3. Were there changes at the sites that may have affected the accuracy of the model over the last three years?
- 4. How do you handle when an Energy Champion rolls off the project due to various reasons?

- A. How can the program do better at keeping the Energy Champion engaged?
- 5. In terms of the energy models for sites 1-4:
 - A. Certain sites had significant changes occur (such as production changes or large new equipment). Do you think there could be adjustments to the models to claim savings at these sites?
 - B. Do you think there are any constraints within the model that would limit how long the clients will use it?
- 6. How many members of cohorts 1 through 4 are still using the model?

Section E: Improvement on Training Workshops

- 1. Regarding the cohort meetings/training:
 - A. Did you attend these meetings? (If so, how many per month?)
 - B. How satisfied are you with the frequency of these workshops?
 - C. How satisfied are you with the content of these workshops? Do you feel that you were limited by what you could present and do you plan to make changes moving forward?
- 2. Reflecting over the past three years, do you feel that the training workshops could be improved? If so, how?
- 3. How was the training different for cohort 6 (hospitals and universities) compared to the industrial sites?
- 4. Do you feel that the current number of workshops conducted is sufficient, or would you like to increase or decrease the number of workshops?
- 5. Do you think doing a follow-up/check-in training six months from the last training session would be valuable?
 - A. How should a follow-up process work?
 - B. What goals or metrics should be included?
 - C. How often would you do this kind of checkup after the first year?

Section F: Closing

1. Do you have any other comments, concerns or suggestions about the program that we did not discuss that you would like to make sure I know about?

Thank you very much for taking the time in assisting us with this evaluation.

This guide is to be used to interview implementation staff for the AEP Ohio Continuous Energy Improvement (CEI) Program during the 2016 program year. These questions will not necessarily be asked verbatim, but rather serve as a roadmap during conversation.

A.3 AEP Ohio CEI Program: Cohorts 1 through 4 Participant Facility Manager Interview Guide

Section A: Introduction

We are interested in documenting your thoughts regarding the program to gain a sense of which aspects of the program worked well and where to make improvements.

1. [For the new participants being interviewed] Before we get started I have a couple general questions, can you take a moment and explain your job title or role?

Section B: Program structure

1. Has the Energy Champion changed over the last three years?
 - A. If so, how was the transfer of knowledge and training from the CEI Program handled?
2. What were the three-year goals you set up at the beginning of this program? [If available, prefill this question with previous year's responses].
 - A. Were there internal goals at your site to achieve energy savings from this program? (Perhaps corporate goals or departmental goals established.)
 - B. Were there any internal incentives to encourage these reductions?
3. After three years, what stands out as the most important thing you received or learned from the CEI Program?
 - A. [If needed, ask about things learned in training or on-site assessments]
 - B. [If needed, what could AEP Ohio have done to be more helpful?]

Section C: Changes to Program Processes

1. In reviewing your final CEI report, there were significant changes [Insert the change in over the past three years] in your annual savings and we are trying to determine what could have caused this.
 - A. What new behavioral changes have you implemented since year 1 or 2 of the program?
 - B. Has there been a change in site operation (hours, production, and employees)?

- C. Any major new equipment installed since the training. If so, what?
- D. Which of the behavior changes made during the CEI training (years 1 or 2) are still in place?
- 2. [If the savings went down over the past three years] What could AEP Ohio have done differently to help you maintain or increase your energy savings?
- 3. [If the savings increased significantly over the three years] Did actions by AEP Ohio help maintain your energy savings?
- 4. In the first year, what were the behavioral changes your facility made because of the CEI Program?
- 5. In the second year, what were the behavioral changes your facility made because of the CEI Program?
- 6. In the third year, what were the behavioral changes your facility made because of the CEI Program?

Section E: Training Workshops

- 1. How frequently did you attend the CEI Program training workshops?
 - A. What did you think of the number of workshops – too many, too few?
- 2. In hindsight, what were the major benefits you learned from the training workshops?
- 3. Were there aspects of the training that were not helpful?
- 4. In your opinion, what can AEP Ohio do to improve these workshops?
 - A. [If needed probe for topics in training, onsite assessment.]

Section F: Participant Satisfaction

- 1. On a scale of 1-10, where one is not at all satisfied and 10 is very satisfied, how satisfied are you with the program, overall?
- 2. Is there anything AEP Ohio could do to increase your satisfaction with the program, overall?

Section H: Closing

1. Regarding your behavioral changes, what are your plans moving forward?
2. Have your energy efficiency and conservation goals for the next five to ten years changed?
3. Do you have any other comments, concerns or suggestions about the program that we did not discuss that you would like to make sure I know about?

Thank you very much for taking the time in assisting us with this evaluation.

A.4 AEP Ohio CEI Program: Cohorts 5 through 8 Participant Facility Manager Interview Guide

Section A: Introduction

We are interested in asking you questions about the program so we can document your understanding of the new program elements and get a sense of program successes and challenges, from your perspective.

1. Before we get started I have a couple general questions, are you on the Energy team currently?
2. Can you take a moment and explain your job title or role?
3. About how many fulltime equivalent employees work at the facility?

Number of Full Time Equivalent Employees	
1	Less than 10
2	11 to 25
3	26 to 40
4	41 to 75
5	76 to 100
6	More than 100
88	Refused
99	Don't Know

4. What is the total square footage of the portion of the facility that you occupy at this location?
5. When was the majority of the facility built (that you occupy)?

6. What is the principal activity type of your facility?

Principal Activity Type	
1	Office
2	Retail (non-food)
3	College/university
4	School
5	Grocery store
6	Convenience store
7	Restaurant
8	Health care/hospital
9	Hotel or motel
10	Warehouse
11	Personal Service
12	Community Service/ Church/ Temple/Municipality
13	Industrial Electronic & Machinery
14	Industrial Mining, Metals, Stone, Glass, Concrete
15	Industrial Petroleum, Plastic, Rubber and Chemicals
16	Other Industrial
17	Agricultural
18	Condo Association / Apartment Management
77	Miscellaneous [RECORD VERBATIM]
88	Refused
99	Don't Know

7. Is this Site (respondent's location) the headquarters, one of several locations, or your company's only site?

- A. How many of these sites are in AEP Ohio's service area?
- B. Have you implemented AEP Ohio's CEI Program at any of your other sites?

a. What was their experience with the program?

Section B: Program structure

1. How were the "energy champion", "energy team" and "Executive sponsor" chosen for your facility?

- A. Who was your “energy coach”?
2. What are the main reasons your facility originally chose to participate in the CEI Program? (guide if needed to fit in categories below)

Participation Reasons	
1	Rebate/ Incentive
2	Lower Utility Bill
3	Help to justify investment
4	Able to make improvements sooner
5	Energy Savings
6	Training for your staff
7	ID Opportunities
8	Other

3. As a company, have your energy efficiency and conservation goals for the next 5 to 10 years changed?
4. Regarding to your interaction with AEP Ohio:
- A. Besides the monthly training, how did AEP Ohio provide support to your facility? (Meters, send resources, exercises, future thinking, etc.)
- B. On a scale of 1-10, where 1 is not at all helpful and 10 is very helpful, how helpful were these activities in helping your facility to achieve your primary goal?
- C. What do you think AEP Ohio could do to be more helpful?

Section C: Facility’s Goals/Program Status

1. How did you first hear about the CEI Program? Who told you about the program and its potential benefits?

Section D: Changes to Program Processes

1. What behavioral changes has your facility implemented because of the CEI Program?
- A. Did the CEI Program training workshops influence your facility's decision to install these measures? If so, what sections?

2. What capital measures have you installed at your facility during your participation in the CEI Program?
 - A. In what ways did the CEI Program influence your facility's decision to install these measures?
 - B. Did you explore other AEP Ohio business energy efficiency programs when installing these measures?
 - C. Did you receive a rebate for these measures?
3. Has your facility completed any demand savings-focused measures as a part of the CEI Program?
4. Since you began participating in this program, has your facility had any significant change in hours of operation or production?
 - A. Did the CEI Program influence these changes?
5. Has your facility installed any significant pieces of equipment that would affect your energy use other than those you installed through the CEI Program?

Section E: Training Workshops

1. How frequently do you attend the CEI Program training workshops?
 - A. What did you think of the number of workshops – too many, too few?
2. How many people from your organization regularly attended the CEI Program training workshops?
3. On a scale of 1-10, where 1 is not at all satisfied and 10 is very satisfied, how satisfied are you with the frequency of these workshops?
 - A. [If <6] What are the reasons that you are less than satisfied with the frequency of these workshops?
4. On a scale of 1-10, where 1 is not at all satisfied and 10 is very satisfied, how satisfied are you with the content of these workshops?
 - A. [If <6] What are the reasons that you are less than satisfied with the content of these workshops?

5. Which training/interaction while participating in the CEI Program do you feel was most beneficial to your site?
6. In particular, what major benefits have you gotten from the workshops?
7. In your opinion, what can AEP Ohio do to improve these workshops?

Section F: Participant Satisfaction

1. On a scale of 1-10, where 1 is not at all satisfied and 10 is very satisfied, how satisfied are you with the program, overall?
2. Is there anything AEP Ohio could do to increase your satisfaction with the program, overall?

Section G: Closing

1. Do you have any other comments, concerns or suggestions about the program that we didn't discuss that you would like to make sure I know about?

Thank you very much for taking the time in assisting us with this evaluation.

APPENDIX Q



TRANSMISSION AND DISTRIBUTION AND INTERNAL SYSTEM EFFICIENCY IMPROVEMENTS Program

2016 Evaluation Report

Prepared for:

AEP Ohio



A unit of American Electric Power

May 1, 2017

Submitted by:

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

312.583.5700
navigant.com



Submitted to:

AEP Ohio
700 Morrison Rd.
Gahanna, Ohio 43230

Presented by:

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

Contact:

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

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

Prepared by:

Eugene Shlatz, Director
802.233.1890
eugene.shlatz@navigant.com

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1. PROGRAM DESCRIPTION

AEP Ohio's Transmission and Distribution and Internal System Efficiency Improvements Program (load loss reduction program) is targeted to transmission and distribution (T&D) facilities that are candidates for efficiency improvements, typically in concert with other benefits, such as increased capacity or reliability performance. For most of these projects, T&D savings are achieved when lines and equipment are replaced with similar facilities that produce lower line and equipment losses. For example, replacing smaller, high resistance wire with larger wire that has lower resistance is commonly referred to as reconductoring. Physical losses accrue in the form of heat losses. When heating losses are high due to loading equipment above normal ratings for extended periods of time, equipment can be damaged or experience premature loss of life.

Loss reduction also is achieved when new lines are added and existing lines reconfigured, lines are converted to operate at a higher voltage (resulting in lower current needed to supply the same amount of load); feeder power factor is improved, and low loss devices are installed, such as highly-efficient transformers. T&D efficiency benefits accrue via lower peak demand and reduced energy losses. Because losses are proportional to the square of the load served, the percent reduction in peak demand losses are higher than the percent reduction in energy losses.

AEP Ohio's T&D loss reduction program for projects placed in service during 2016 focuses on several of the following measures listed (not all are necessarily implemented in any given year). The methodology AEP Ohio employed to derive demand and energy loss savings is presented in the sections that follow. Table 3-1 lists the Ohio TRM evaluation protocols¹ AEP Ohio applies to each of the categories.

- » Line reconductoring (distribution, subtransmission and transmission)
- » New substations and circuits (distribution, subtransmission and transmission)
- » Voltage conversion
- » Power factor improvement (via capacitor banks, regulators & load-tap changers)
- » Feeder reconfiguration
- » Load transfers and phase balancing

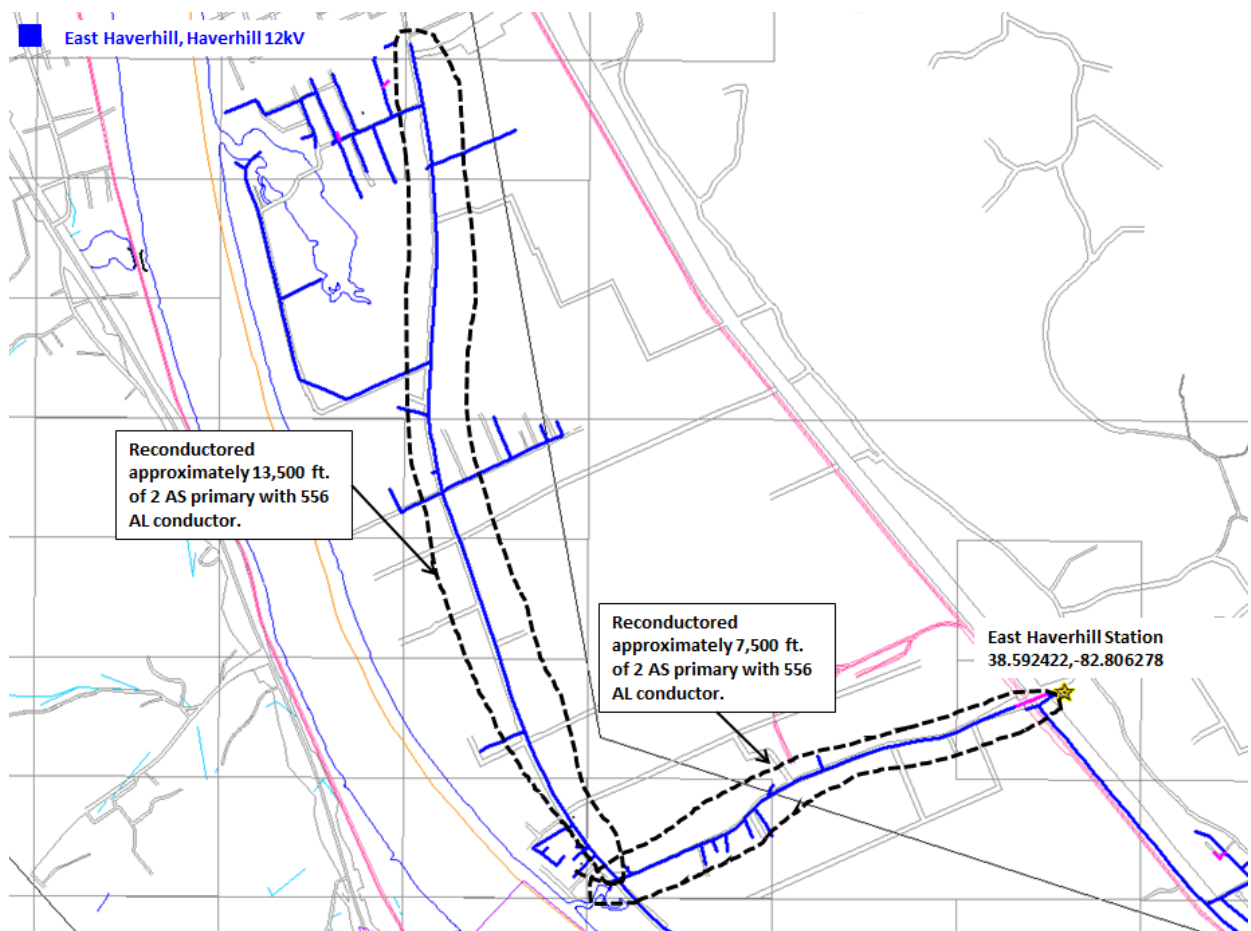
The items previously listed commonly are referred to as loss reduction programs, and include both load and no load losses. Some electrical equipment, such as transformers, produces load and no-load losses. Load losses are those that vary as the amount of current increases or decreases. No-load losses are independent of load, and occur during all hours the device is in service. No-load losses typically occur only on equipment that requires inductive current (magnetizing current) to operate, such as transformers and motors. Loss reduction programs sometimes may include the replacement of equipment with high no-load losses with devices with lower no-load losses. The load reduction savings AEP Ohio has estimated for the aforementioned programs do not appear to include any projects focusing mostly on reduction of no-load losses, which is common among utilities.

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

2. METHODOLOGY

AEP Ohio estimated load loss reduction amounts using tools and methods that are commonly employed to accurately predict peak and energy savings. These include use of a comprehensive and detailed distribution feeder load flow simulation model (CYMDist) and network transmission load flow models (PSS/E) to estimate loss savings at the time of the feeder peak. The CYMDist and PSS/E models are commonly used by power industry professionals and each applies a level of rigor that is sufficient to accurately predict losses for transmission and distribution facilities.² The accuracy of the model results is highly dependent on model inputs and assumptions. AEP Ohio provided Navigant distribution model loss output tables and electrical diagrams illustrating the upgrades and changes made for each feeder, with before and after loss summaries, thereby ensuring loss estimates are based on net loss savings. A typical line segment of a representative feeder targeted for loss savings is illustrated in Figure 2-1.

Figure 2-1. Example Project Diagram: East Haverhill Station, Franklin Furnace-Haverhill Circuit – Reconductor 21,000 ft. of Primary Distribution



² The loss reduction projects cited by AEP Ohio include distribution lines, typically 15 kV class and below. These also include higher rated distribution and transmission lines rated 23 kV, 34.5 kV, 69 kV, 138 kV and 345 kV. Lines rated 34.5 kV, 69 kV and 138 kV often operate radially, but may be configured in a network arrangement, particularly 138 kV. Lines rated 345 kV are almost always operated in a network configuration.

In this example, major sections of the circuit were reconductored from #2 AS to 556 AL, a significant increase in conductor size. The reconductoring reduced net peak loss savings from 263 kW to 104 kW, a 60 percent decrease (several other projects achieved similar percent decreases in line losses).

Peak demand losses are derived by conducting load flow studies with and without the upgrade, with the difference in losses between the two cases equal to the net loss savings. AEP Ohio provided copies of model output and feeder maps that confirm AEP Ohio's distribution planning personnel included a high level of detail in the CYMDist feeder model for each of the loss reduction programs previously listed. The peak load loss savings AEP Ohio derived for each of the projects listed are consistent with the percent savings Navigant has determined in its own studies of similar upgrades for utility distribution systems, as well as results we have reviewed from projects developed by other utilities.

To derive energy loss savings, AEP Ohio employs the following formula, which Navigant supports as a reasonable and accurate approach (the resulting value of the calculation within the bracket is defined as the Loss Factor). This equation has been vetted and accepted within the utility industry for decades.

$$\text{Energy Loss Savings} = \text{Peak Loss Savings} * (C_1 * LF + C_2 * LF^2) * 8760$$

Where LF is the feeder load factor, and C1 and C2 are coefficients derived using methods outlined in published industry literature. C1 and C2 for AEP Ohio are 0.1 and 0.9, respectively.³

The loss factor for the preceding formula typically is between 0.30 and 0.50. The loss factor AEP Ohio used to derive 2016 energy loss savings is 42.02 percent. The results of AEP Ohio's loss reduction program are presented in subsequent sections of this report.

³ The Energy Loss Savings formula and values used by AEP Ohio were obtained from an internal report titled "AEP Ohio Power Company 2015 Analysis of System Losses", revised 10/2016. This report compiled the results of system loss investigations conducted during 2011 by Management Applications Consulting, Inc. for CSPCO and OPCO. This study also included derivation of the C1 and C2 coefficients. The load factor for AEP Ohio Power Company is 63% obtained from the 2015 Analysis of System Losses and subsequently updated in 2016.

3. DETAILED FINDINGS

Table 3-1 summarizes the peak demand and energy reductions for AEP Ohio in 2016. Results are presented separately for distribution and transmission assets. Similar to prior years, 2016 reported loss savings are higher for transmission facilities. Table A-2 (Appendix) presents reported demand and energy loss savings for specific T&D projects that AEP Ohio placed in service during 2016.

Table 3-1. Peak Demand and Energy Reductions

	Number of Projects	Peak (kW)	Energy (kWh)
Distribution	13	500	1,840,360
Transmission	7	1,900	7,012,970
TOTAL	20	2,400	8,853,330

3.1 Distribution Loss Savings

Navigant's review confirmed AEP Ohio's composite peak demand savings of approximately 500 kW for distribution is reasonable and consistent with the level of savings associated with the 13 projects summarized above and listed individually in Table A-2 (Appendix). This conclusion is supported by the type of projects included in the AEP Ohio loss reduction program and the methods AEP Ohio employed to derive these savings. Navigant notes the amount of savings decreased by about 1,400 kW from those reported in 2015 (about 74 percent decrease). A similar decrease occurred for energy savings, with about 4,650 MWh less savings than 2015 (about 70 percent). The average demand and energy savings per project in 2016 also decreased by about 50 percent compared to projects completed in 2015. AEP Ohio reports the decrease in 2016 was due to smaller reconductoring projects versus several larger conversion and reconductoring projects completed in 2014 and 2015. (In 2016, one of the 13 distribution projects was classified as a voltage conversion, which typically achieve very high line loss reductions,)

Navigant's review confirms the peak demand and energy reductions are reasonable given the scope of each upgrade. Further, similar to most electric utilities, most distribution projects are implemented to address capacity shortages or improve reliability or operating flexibility, with loss reduction as an ancillary benefit - major upgrades typically are not justified on loss reduction benefits alone. For example, several projects are line reconductoring; that is, replacing smaller wire with larger wire. However, the amount of wire replaced typically is a relatively small percent of the total miles of conductor on the feeder, which accounts for the relatively small amount of loss savings as a function of total feeder load. However, because distribution feeder losses typically are less than five percent of total feeder demand, the reduction that AEP Ohio cites for each project represents significant savings.

3.2 Transmission Loss Savings

The magnitude of total loss savings (1,900 kW at peak) associated with transmission level is based on the combined savings associated with seven projects or line segments resulting in loss savings. The 2016 transmission peak loss savings is 2,400 kW lower than 2015, a 56 percent decrease. Table A-2 (Appendix) lists specific transmission projects and upgrades placed into service in 2016. Notably, the number of transmission projects is lower than 2015 (7 versus 24); however, the average energy savings per project has increased by about 25 percent compared to 2015 (demand savings per project, on average, has remained constant). AEP Ohio reports the reduction in transmission loss savings was due to a larger amount of funds spent on reliability projects in 2016. Reliability upgrades typically produce few, if any loss savings.

Similar to prior years, the magnitude of transmission demand and energy loss savings is greater than distribution. This finding is not unusual, as major transmission upgrades often result in substantial line loss savings, as the amount of power delivered per line mile is much higher than distribution lines. Navigant views AEP Ohio's transmission peak loss savings as consistent with the level of loss reduction achieved by other utilities that have implemented upgrades comparable with those listed in Table A-2. Similar to distribution, transmission upgrades usually are implemented to improve performance and increase capacity transfer capability, with loss reduction as an added benefit.

Navigant's conclusions are supported by the review of AEP Ohio's project details and the analysis AEP Ohio prepared for each project, each of which confirms the level of rigor applied to transmission level projects also is consistent with methods employed by electric utilities and transmission system operators. Further, the analysis AEP Ohio used to derive transmission energy savings is consistent with methods used by many electric utilities. Most important, AEP Ohio transmission planning reports it performed detailed network load flow studies to estimate transmission loss savings.⁴ Based on the amount of transmission network load and types of upgrades outlined in Table A-2, Navigant concludes AEP Ohio's reported peak and energy loss savings is reasonable and accurate.

⁴ The loss savings for transmission projects were derived on a composite basis for AEP Ohio, as it was necessary to conduct network load flow studies with all upgrades and modifications in service; that is, the transmission projects are not mutually exclusive in terms of their combined impact on the transmission network, as the resultant line loadings will vary as the network is changed. Thus, the loss savings associated with each project, if modeled individually, are not additive.

Appendix A. T&D PROJECT TYPES

Table A-1 lists the T&D project types from the Draft Ohio TRM. Note some project categories used in prior years did not apply in 2016 as no projects were undertaken; for example, no mass plant retrofit or large customer connection projects were completed in 2016.

Table A-1. T&D Project Types

Ohio TRM T&D Project Types
1. Mass Plant Replacement and Expansion Analysis Protocol
2. Conductor Analysis Protocol
3. Large Customer Connection Analysis Protocol
4. Mass Plant Retrofit Analysis Protocol
5. Substation Transformer Analysis Protocol
6. System Reconfiguration Analysis Protocol
7. Voltage Conversion Analysis Protocol
8. Capacitors & Power Factor Protocol

Table A-2 lists the project name, scope, whether the project was either Transmission (T) or Distribution (D), the type of project in terms of the Ohio TRM designations, the peak demand reduction (kW) and the annualized loss reduction (kWh).

Table A-2. AEP Ohio T&D Projects

Project	Scope	TRM Project Type	Peak Reduction (kW)	Annualized Loss Reduction (kWh)	Transmission or Distribution (T or D)
1. North Baltimore Station, East Circuit - Reconductored approximately 7,900 feet of #2 Cu and #2 AS three phase primary with 556 AL conductor.	Reconductoring	2	39.50	145,510	D
2. North Bucyrus Station, North Circuit - Reconductored approximately 3,000 feet of three phase #2 AS primary with #2 AA conductor.	Reconductoring	2	15.60	57,570	D
3. Savannah Station, Lippert Circuit - Converted approximately 300KVA from 4kV to 12kV.	Voltage Conversion	7	9.50	34,820	D
4. Vigo Station, Richmondale Circuit - Reconductored approximately 4,775 feet of three phase primary consisting of #4/0 AS with 556 AL conductor.	Reconductoring	2	56.30	207,240	D

5.	Waverly Station, Zahn's Corner Circuit - Approximately 7,400 feet of three phase #2 AS primary was reducted with #4/0 AL conductor. Three single phase taps were changed to a different phase to balance the load at the station. Upgraded 3-100 amp regulators to 3-150 amps.	Reconductoring and System Reconfiguration	2, 6	71.60	263,700	D
6.	East Haverhill Station, Franklin Furnace-Haverhill Circuit - Reducted approximately 21,000 feet of three phase primary consisting of 2 AS with 556 AL conductor.	Reconductoring	2	104.00	382,970	D
7.	North Zanesville Station, North Circuit - Approximately 3,800 feet of three phase #1/0 AL primary was reducted with #556 AL conductor.	Reconductoring	2	65.7	241,760	D
8.	Kimberly Station, Chauncey Circuit - Reducted approximately 5,300 feet of three phase #4/0 AL with 556 AL conductor.	Reconductoring	2	69.9	257,300	D
9.	Wade Station, Newport Circuit - Approximately 7,700 feet of three phase #2 AA conductor was reducted with #556 AL conductor.	Reconductoring	2	16.8	61,910	D
10.	Stadium Park Station, 17th Street Circuit - Reducted approximately 1,800 feet to three phase overhead primary with 556 AL conductor.	Reconductoring	2	9.6	35,340	D
11.	Stadium Park Station, Broad Avenue Circuit - Approximately 1,800 feet of three phase 4/0 Cu primary was reducted with 556 AL conductor.	Reconductoring	2	31.5	115,950	D
12.	Easton Street Station, West Circuit - Approximately 5,100 feet of three phase primary consisting of 4/0 AL was reducted with 556 AL conductor.	Reconductoring	2	2.9	10,670	D
13.	Amsterdam Station - Reducted approximately 19,800 feet of three phase overhead primary consisting of 3/0 Cu with 556 AL conductor.	Reconductoring	2	7.0	25,620	D
14.	Rebuild 12.6 miles of line from Fremont Center to Tiffin Center 138 kV from single circuit to double circuit with the conductor size 959.6 ACSR/TW Type 16 Suwanee.	System Reconfiguration	6	inc	inc	T
15.	Construct 4.2 miles of 138kV transmission line circuit between Yager and Azalea Road substations	System Reconfiguration	6	inc	inc	T
16.	Delano-Ross 138 kV Line - Rebuild 4.7 miles of 138 kV line with double circuit construction with 1233 ACSR /TW Type 13 Yukon	System Reconfiguration	6	inc	inc	T

17. Biers Run install a new 345/138 kV 675 MVA transformer and a 138/69 kV 130 MVA transformer.	Substation Transformer	5	inc	inc	T
18. Install a new 4.9 mile Nottingham - Freebyrd 138 kV line with the conductor size 1033.5 ACSR Curlew six wired.	System Reconfiguration	6	inc	inc	T
19. East Amsterdam-Miller SW 69kV rebuild with the conductor 1234 ACSR/TW Yukon. Excludes Miller-South Amsterdam which was done in 2015.	System Reconfiguration	6	inc	inc	T
20. Sunnyside-Wagenhals 69kV (3.1 miles) and Sunnyside-Stanley Court 69kV (2.9 miles) rebuilds with 1033 ACSR Curlew.	System Reconfiguration	6	inc	inc	T

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